Vegetables, Fruits & Herbs Book

A Guide to Vegetables, Fruits & Herbs

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Apricots in the Garden

by Michael Caron, Taun Beddes & Brent Black

INTRODUCTION

Apricots (Prunus armeniaca) originated in China, but can be grown in most of the western world including much of Utah. Like peaches, plums, and cherries, apricots have a large, hard pit or 'stone' in the fruit and are considered 'stone fruits'. They are beautiful in flower and are among the most ornamental of the tree fruits. Apricots are a versatile fruit that can be dried, made into fruit leather, frozen, canned/bottled, made into jam/jelly, or eaten fresh.

SPECIES AND CULTIVARS

Some common winter-hardy, later blooming cultivars include 'Chinese' ('Mormon'), 'Moorpark', 'Goldrich', 'Tilton' and 'Harglow'. Of these, 'Goldrich' and 'Harglow' are the latest blooming. Even though these cultivars are later blooming, they are still prone to spring freeze damage. All are good for eating fresh and general processing. The cultivar 'Royal Blenheim' is among the most popular apricots but is NOT recommended for Utah because it is not winter hardy and blooms very early.

GENERAL INFORMATION

Apricots are commonly grown in USDA Hardiness Zones 5 to 8. Many common cultivars can survive Zone 4, but produce fruit sporadically because of frost damage to blossoms. Because apricots bloom early, damage to blossoms by spring freezes may sometimes occur even in warmer zones. Selecting cultivars that have long winter chilling requirements can potentially delay bloom and help reduce the risk of freeze damage. Manchurian (Prunus armeniaca mandshurica) and Siberian (Prunus armeniaca siberica) apricots can be grown in Zone 3. Fruit size is often smaller and of poorer quality than for other named cultivars. Some common Manchurian selections include 'Mandan', 'Sungold' and 'Moongold'. Siberian apricot is available in commerce but no common cultivars exist.

Apricots are generally self-fruitful, but most will produce better when another cultivar with similar bloom time is nearby for pollinizing. Most fruit is borne on short spurs on 1-year-old wood that remain productive for 3 to 5 years. Fruit is typically harvested July through August (cultivar dependent), when they turn yellow or develop a red blush and begin to soften. Trees typically over-bear and will produce many small, less-useable fruits unless fruit is thinned. When fruits are grape-sized, thin to one fruit every 4 to 6 inches along the branch to increase size of remaining fruit and to maintain tree health.

Plum-Apricot Hybrids: Plum and apricot readily cross pollinate and the resulting seeds will produce trees that are interspecific hybrids, with a wide range of these hybrids available in the marketplace. Plum-apricot hybrids range in genetic background and characteristics from predominantly plum to predominantly apricot, and are known in commercial trade as Plumcot, Pluot®, Aprium®, etc. (trademarks of Zaiger Genetics).

HOW TO GROW

Soil Preparation: Apricots grow in most Utah soils as long as the soil has sufficient drainage. However, soil testing can help determine the appropriate amendments to add to a site before planting. Apply any deficient nutrients as indicated from soil tests and till into the soil. Visit the USU Analytical Laboratory for more information on soil testing: www.usual.usu.edu. Apricots, like peaches and plums, have little tolerance of wet and heavy soils and will easily get root-rotting diseases in such conditions, especially when irrigation is not carefully managed. Apricots are very prone to iron chlorosis in the alkaline soils of Utah. Overwatering will significantly increase the risk of chlorosis and general tree decline as a result. Deep, infrequent irrigation and use of EDDHA chelated iron may help considerably. For more information on iron chlorosis management see the USU Iron Chlorosis in Berries fact sheet.

Planting and Spacing: Trees should not be planted in lawns, because irrigation and fertilization needs for each are very different. Grass is usually watered more often than is ideal for trees. Grass also aggressively competes for nutrients such as nitrogen, and can slow the growth of fruit trees. The location should also be free of perennial weeds such as field bindweed and quackgrass.

Space trees 18 to 22 feet apart. For potted trees, prepare a hole for planting twice the width and the same depth as the container. Planting the tree at the same height as the rootball is important. If too shallow, the root ball will dry out. If too deep, lack of soil oxygen will cause root loss and trees will decline. For bare-root trees, prepare a hole slightly wider than the roots, and deep enough so that the root flare is just above the soil line and the graft is 2 to 4 inches above ground. Never allow the roots to dry out. Immediately after planting, water thoroughly to settle the soil and eliminate any air pockets around the roots. In windy areas, bare-root trees should be staked for 1 year. The stake should not remain for more than a year. For more specific information, see the YouTube video "USU Extension - How to Plant Bare Root Trees."

Example of an open vase training system. Photo: Michael Caron.

Irrigation: During the first season, irrigate at an interval that will keep the soil moist but not soggy. Depending on rainfall and temperature, irrigate about two times per week to ensure establishment. For the next few years, maintain a biweekly watering program that will apply around 30 inches of water over the season. This can be reduced if there is significant rainfall accumulation. Irrigation methods that apply water near the base of the tree, such as drip systems, soaker hoses, or hand watering, will keep the canopy dry and help prevent foliar disease.

Fertilization: There are no specific fertilizer recommendations for apricots grown in a home orchard. Newly planted apricots should not be fertilized in the first year they are transplanted. Young apricot trees should produce new shoots that average 10 to 20 inches in length each year. For older trees, growth slows to 8 to 10 inches of new growth per year. Fertilization is not needed if growth rates are adequate. The most common limiting nutrient is nitrogen, and when inadequate, trees will not produce sufficient new growth. If planted near a lawn or garden that is fertilized, trees will usually get plenty of nutrition from those areas. Many factors including irrigation, diseases, soil type, and pests affect plant performance. If any of these factors reduce vigor, fertilizer is not helpful. When trees are not growing satisfactorily, soil testing may be helpful in determining fertilization needs. It is important to understand that fertilizer is not a panacea that solves all plant problems. When nitrogen is needed, apply ½ to 1 cup 20-0-0 around the dripline of trees younger than 5 years old. If phosphorus and potassium are also deficient, apply a similar quantity of 16-16-16, or an equivalent balanced fertilizer. For older trees apply 1 to 2 cups.

Pruning: Prune/train apricot trees to an open vase system, similar to peaches. An open vase training system is done by selecting 3 to 4 branches that originate 18 to 24 inches above the ground that are evenly spaced around the tree to become the main "scaffold" branches. Remaining branches and the central stem are removed. Annual pruning on new and established trees is needed and should be done in late winter. Start by removing any dead, diseased, or damaged branches. For established trees, remove about 25% of the branches to allow light penetration, increase fruit quality, and encourage new branch development. Remember apricots produce fruit on spurs (short side shoots) up to 5 years old, so do not remove too much fruit-bearing wood. Remove suckers (shoots coming from the roots or stem below the graft) on a regular basis. A modified central leader system also works well, particularly in Utah's hotter environments. A modified central leader results in more foliage in the middle of the tree, which in Utah's hotter climates reduces sunburn on the fruit and scaffold branches. For more information on training and pruning see the USU Extension Bulletin Pruning the Home Orchard.

Example of a modified central leader training system. Photo by Michael Pace.

HARVEST, STORAGE AND USE

When ripe, fruit should be slightly soft and skin will change from green to yellow, red, orange, or combinations of these depending on cultivar. Yields of 3 to 4 bushels per tree may be expected, depending on cultivar. When harvesting, twist fruit slightly when pulling to avoid spur injury. Store slightly unripe apricots at room temperature until ripe. Ripe fruit can be refrigerated for 3-5 days. Apricots can be prepared and eaten using many methods including broiled, grilled, and poached. They can also be preserved by freezing, canning, or drying. For more information visit the USU Preserve the Harvest –Apricots factsheet.

PROBLEMS

For current and specific pest and disease information please visit the UtahPests IPM Website (www.utahpests.usu.edu) and subscribe to the tree fruit updates.

Disease	Identification	Control
Coryneum Blight (Shot Hole)	Round, purple-tinted lesions on leaves turn black and centers fall out leaving many small holes in leaves. Similar lesions on fruit eventually turn black. Black cankers form on branches which will eventually die.	Prune out heavily infected branches. Clean up debris including leaves in fall. Timed fungicide sprays just after petal fall in spring and at 50% leaf drop in autumn. See also the USU Coryneum Blight Factsheet.
Cytospora/Pseudomonas Canker	Wounds/cankers that ooze or produce amber-colored gummy sap. Leaves may suddenly wilt due to the plugging of conductive tissue. Bark may have areas of dark discoloration.	Avoid tree injuries. Protect trunk and lower limbs from winter sun injury. Fruit thinning also prevents branch cracking, eliminating wounds open to infection. Prune out infected wood 1 foot below where last symptoms are seen as soon as symptoms appear. Fall pruning is not recommend for northern Utah conditions. Fungicides are not generally recommended for these diseases.
General Root Diseases	Yellowing leaves, general decline and lack of vigor. Branch dieback. Extremely common with newly planted trees due to unintentional overwatering.	Manage irrigation carefully based on soil type- most critical on heavy soils. Ensure good drainage, Avoid planting in turf. See also the USU Peach Irrigation fact sheet.

Insect		
Greater Peach Tree Borer	Clear wing moth species lays eggs on bark near the base of the tree. Borers are often present in the roots to lower limbs. Multiple generations per year.	Subscribe to USU Pest Lab updates for spray timing and registered products at www.utahpests.usu.edu/ipm. Prevention is the best approach- keep trees healthy and do not damage bark and roots.
Aphids	Multiple species infest trees. Early season leaf curl and deformation and stick leaves are signs of aphids or other sap feeding insects. Can occur throughout the growing season.	For minor to moderate infestations treat with an insecticidal soap, or summer weight horticultural oil or neem. Infestations rarely require stronger insecticides.
Spider Mites	Leaves develop a mottled or stippled, dusty appearance. Over time branch dieback is common. Webs may be observed as populations build. Especially common on trees excessively sprayed with a pyrethroid or carbaryl due to natural predators being killed.	For minor to moderate infestations treat with an insecticidal soap, or summer weight horticultural oil or neem. Infestations rarely require stronger insecticides.
San Jose Scale	Small insect with hard protective covering that infests branches and fruit. Colonies may look somewhat like bark ridges but develop a gray or black color late in the season. Usually two to three generations per year.	Apply a horticultural oil/carbaryl mix at the delayed dormant stage. Monitor infested branches for larval crawlers late spring to early summer using double sided tape. Most registered insecticides easily control crawlers. When spraying older protected insects use a surfactant or a spreader/sticker in combination with a registered insecticide.

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Artichokes

by Dan Drost

SUMMARY

Artichoke prefers a sunny location and fertile, well drained soils. Incorporate plenty of organic matter into the area before planting. Start plants in late winter for early spring planting. Plant artichoke 18 inches apart in rows 2-3 feet wide. Fertilize the plants regularly with nitrogen and keep the soil moist throughout the summer. Control all pests that reduce vigor during the year. Harvest artichoke buds when they reach full size but before the bracts open. Plants are frost and freeze sensitive so they need to be protected. Imperial Star and Green Globe varieties perform well in Utah.

RECOMMENDED VARIETIES

Variety	Yield	Comments
Imperial Star	Excellent	Medium sized plants, many dark green buds with small hearts, good disease resistance, excellent as an annual crop.
Green Globe	Excellent	Large sized plants, many dark green buds with large hearts, do best if plants are maintained for several years.

HOW TO GROW

Soils: Artichoke prefers organic, rich, fertile soils for best growth. Most soils are acceptable provided they are well drained.

Soil Preparation: Before planting, incorporate 2-4 inches of well composted organic matter and 1/2 pound of a complete fertilizer (16-16-8) per 100 square feet of planted area. Incorporate compost and fertilizer to a depth of 6 inches.

Plants: Purchase quality plants from local garden centers or seed catalogs if available. You may also grow artichoke transplants from seed. Germinate seeds at 70-75°F, then plant in 2-3 inch pots. Start seeds in early January. Plants require 2-3 months to reach transplantable size.

Planting and Spacing: Artichoke should be planted 3-4 weeks before the frost-free date for your area. Artichoke requires cool temperatures to initiate the flower stalk. If planted too late, plants will not flower. Space plants 18 inches apart in the row, with rows 2-3 feet apart. Planting through plastic mulches accelerates early growth and leads to higher yields. Water frequently after transplanting to ensure good root and shoot growth. Maintain healthy vigorous growth during the spring and summer to ensure that artichoke produces for a long time.

Water: Water frequently during the year by supplying 1 to 2 inches per week in several applications. Use drip irrigation if possible. Mulch heavily around the plants to conserve soil moisture and reduce weed growth. Artichoke has a shallow root system, does not tolerate hot, dry conditions and likes moist soils if high productivity is expected.

Fertilization: Artichoke requires high amounts of nitrogen fertilizer for best growth and development. Apply 2 teaspoons per plant of a nitrogen-based fertilizer (21-0-0) every 4 weeks beginning 4 weeks after transplanting to encourage sustained and rapid plant growth. Place the fertilizer to the side of the plant and irrigate it into the soil.

PROBLEMS

Weeds: Control weeds in artichoke. Mulch artichoke heavily (2-3 inches) with compost to keep weeds down and hold moisture in the soil. Till carefully around artichoke as damage to the roots may occur.

Pest	Description and Symptoms	Control
Aphids	Green plant sucking insects that stunt leaves and reduce yield and plant vigor. Aphids damage young plants the most.	Use insecticidal soaps or labeled insecticides.

Disease	Symptoms	Control
Root Rot Diseases	Fungal diseases reduce plant vigor and stands. Tips of leaves turn yellow, growing points die, whole stem and plant eventually dies. Buds are small and tough.	Reduce plant stress. Common stresses include insects, over watering, over cutting, drought, and weed pressure.
Viruses	Virus cause plants to decline and die and yields to go down.	Control aphids that transmit the disease.

HARVEST AND STORAGE

Harvesting: Artichoke harvest begins in late July or early August and continues until frost. Once the flower buds form, do not stress the plant. Harvest buds when they reach full size but before the bracts (bud leaves) begin to open. Cut off the bud with 2-3 inches of stem. Continue to water and feed the plants. Buds not harvested produce attractive purple blooms that can be used as centerpieces or dried and used in flower arrangements.

Fall Plant Care: After harvest is completed and the plant has received several frosts, cut back the leaves and mulch the root heavily. Throw 4-6 inches of soil over the plants, then cover with 8 inches of leaves or straw. Heavy mulching may allow the plant to over-winter in the garden in warmer areas of Utah. In the colder areas of the state, dig up the plants and store them in a cold cellar in moist sand or peat to keep the plant from drying out. Divide and replant the root the following spring.

Productivity: Each flower stalk will produce 3-5 buds and each plant can produce several flower stalks.
Buds can be stored for 3-5 days under refrigeration.

FREQUENTLY ASKED QUESTIONS

Why didn't the plant flower this year? If the plants do not receive enough chilling temperatures, some of them will not flower. Plant early, based on your local conditions. Often the plant fails to flower when it is hot during flower stalk formation.

How many plants should I have? That depends on how well you like artichokes. They are large plants and require quite a bit of area in the garden.

Author: Dan Drost, USU Extension Vegetable Specialist

Asparagus

by Dan Drost

SUMMARY

Asparagus prefers a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and phosphorus fertilizer into the area before planting. Plant asparagus crowns 12 inches apart in 8 inch deep furrows in early spring. Cover the crowns with 2 inches of soil and slowly fill the furrows over the rest of the summer. Fertilize the plants with nitrogen after the fern is established and water regularly throughout the summer. Control all pests during the establishment years. Harvest all emerging asparagus spears for 4 weeks beginning 2 years after planting. Harvest can be 6-8 weeks in following years. After harvest, fertilize and water the plants to encourage good fern growth and control pests. When ferns die in the fall, mow and mulch them on the beds. Newer all male varieties like Jersey Giant and Jersey Knight perform well in Utah.

RECOMMENDED VARIETIES

Try these newer asparagus varieties which are very productive. Mary Washington is no longer recommended.

Variety	Yield	Comments
Jersey Giant	Excellent	Large, dark green spears, good disease resistance, all-male variety
Jersey Knight	Excellent	Large, dark green spears, good disease resistance, all-male variety
UC 157 F1	Excellent	Large, pale green spears, good disease resistance, male/female plants
Purple Passion	Good	Large, dark purple spears, male/female plants

HOW TO GROW

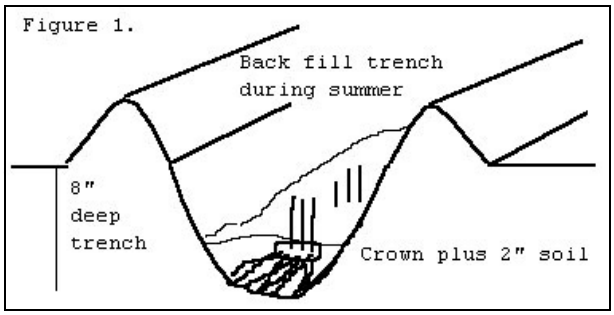
Soils: Asparagus prefers organic, rich, well-drained, sandy soils for best growth. Most soils will do provided they are well drained.

Soil Preparation: Before planting, control all perennial weeds. Incorporate 2-4 inches of w ell composted organic matter. Apply 1/2 pounds of high phosphate (11-52-0) fertilizer per 100 square feet of planted area. Work compost and fertilizer into soil to a depth of 6 inches.

Plants: Purchase quality 1 year-old crowns from local garden centers or seed catalogs. Crowns should have 8-10 large roots and a healthy bud cluster. You may also establish asparagus from transplants grown from seed. Plant seed in January in good potting soil and grow for transplanting in April.

Planting and Spacing: Asparagus crowns should be planted in 8 inch deep furrows in April (Figure 1). Space plants 12 inches apart in the row, with rows 3-4 feet apart. Cover crowns with 2 inches of soil. Add 2 more inches of soil to the furrow by cultivation in June, August, and October trying not to bury those ferns already established.

Figure 1.



Water: During the first 2 years after planting, water ever other week by supplying 1 to 2 inches in one application. Use drip irrigation if possible. Mulch around the plant with compost or grass clippings to conserve soil moisture and reduce weed growth. Irrigation can be reduced to every 2-3 weeks after year 4. Irrigate so that moisture goes down 3-4 feet in the soil.

Fertilization: After harvest, fertilize with a complete fertilizer (16-16-8) using about 1 pound per 100 square feet.

PROBLEMS

Weeds: Control all perennial weeds and grasses in asparagus. Mulch asparagus heavily (2-3 inches) with compost each year. "Round-up" herbicide may be applied to weeds before or after the harvest period. Avoid spraying "Round-up" on asparagus plants. Avoid tilling asparagus as damage to the roots may occur.

Insects	Description and Symptoms	Control
Asparagus aphid	Green plant sucking insects that stunt fern and reduce yield and plant vigor.	Use insecticidal soaps or labeled insecticides.
Asparagus beetle	Beetles are black or orange and have 6 or 12 spots on their wings. Larvae feed on fern which reduces leaf area and plant vigor. Adults feed on emerging spears in spring.	Used insecticides labeled for this pest.
Diseases	**Symptoms**	**Control**
Root Rot diseases	Fungal diseases reduce plant vigor and stands. Tips of fern turn yellow, growing points die, whole stems and plants eventually die. Spears are small and skinny.	Reduce plant stress. Stresses include insects, over-watering, over cutting, drought, and weed pressure.
Viruses	Viruses cause plants to decline and die and yields to go down.	Control aphids which transmit the disease.

HARVEST AND STORAGE

Harvesting: Asparagus harvest begins 2 years after planting. Plants may be harvested for up to 3 weeks the first year. Cut 9 inch tall spears at ground level. Remove all emerging spears during harvest since tall growing spears suppress further spear growth. Harvest for 4 weeks in year 3 and 5 weeks in year 4. After year 5, harvest for 6-8 weeks Stop harvesting when the majority of spears are smaller than a pencil in diameter.

After Harvest Plant Care: After harvest is completed, control weeds and then allow spears to develop into fern. Fertilize the beds, water regularly, and control pests. After ferns die in the fall, mow them down and use as a soil mulch. Avoid tilling asparagus beds since this damages the crown.

Productivity: A mature asparagus plant can produce ½ to ¾ pound of spears during the complete harvest period. Plant approximately 20 plants per family member in order to have sufficient spears for fresh consumption and storage purposes. Spears will store for 3-5 days under refrigeration.

FREQUENTLY ASKED QUESTIONS

How long will asparagus last? Expect the plant to produce spears for 10-15 years.

Why are the spears always skinny? Plants may have been water stressed last summer when the spears formed or the plant did not store enough food for good spear growth. As the harvest season progresses spear size naturally decreases. If the crown is planted shallow, spears tend to be small. Cover with more soil.

Can you harvest asparagus at other times of the year beside spring? You can, but generally these plants do not yield well and the life span of the bed is greatly reduced.

Can you grow white asparagus in Utah? Yes, but you need to mound soil over the planted bed and then cut the spears just as they poke through the soil. If light gets to the spear it will turn green. Use black plastic in the spring to cover the beds. This will keep the light out.

Author: Dan Drost, Extension Vegetable Specialist

Basil

by Lindsay Pearson & Dan Drost

SUMMARY

Basil loves warm weather, lots of sun and plenty of moisture. It prefers nutrient-rich and well-drained soils. Before planting, amend the soil with compost and fertilizer and plant after the last frost. Plant the seeds 1/8 inch deep and thin to 3 to 4 inches apart after emergence. The plants germinate in 5-14 days. Irrigate basil with about 1½ inches of water per week. To maintain rapid leaf growth, side dress with liquid fertilizer every 14 days. When the plants have 6 to 8 leaves, harvesting can begin; remove enough of the stem so that only 2 to 4 leaves remain.

BASIL VARIETIES

Most varieties perform well in Utah so experiment with some of the following:

Culinary Varieties: Piccolo verde fino, Red Rubin, Purple Ruffles, Lemon, Genoa Green, Napoletano, Greek, Lesbos, Ansi', and Thai.

Other Varieties: Cinnamon, Green Ruffles, Italian Dwarf, Lemon Mrs. Burn', Lettuce Leaf, Miniature, Mexican Spice, Sweet, and many others.

HOW TO GROW

Soils: Basil prefers fertile, well-drained loamy soils rich in organic matter. Most soils in Utah are well suited for basil production. Choose sites that have good air circulation around the plants.

Soil Preparation: Before planting, add 4-6 inches of compost or 1-2 inches of manure and a complete, all-purpose fertilizer (16-16-8). Work compost and fertilizer into the top 6-8 inches of soil.

Plants: Basil can be grown from seed or transplants. Plant seeds or transplants after the last frost of the season. Basil seeds germinate best when soil temperatures are 65-85 degrees F and take about 5 14 days to sprout. Transplants take 4-6 weeks to grow to size and should be planted after frosts in mid to late May.

Planting and Spacing: Sow seeds 1/8 inch deep, cover lightly with soil, and water regularly so that the soil doesn't dry out. Basil grown in full sun has more of the essential oils associated with flavor than shade grown basil. After the seedlings emerge, thin the plants to 3-4 inches apart leaving larger ones. Continue to thin the seedlings until the final plant stand is 12 inches apart. Thinned plants can be eaten or transplanted to adjacent areas. High summer temperature and other stresses are responsible for basil going to seed, developing off flavors, or stopping leaf production.

Water: Water basil regularly supplying 1½ inches of water per week to maintain vigorous growth. Water requirements depend on soil type and temperatures. Irrigation will prevent wilting that slows growth, damages roots, and stunts plants. Drip irrigation systems can work well for watering basil plants.

Fertilization: Basil requires some additional nitrogen to sustain rapid leaf growth, especially when pinching it back to constantly produce more leaves. Once the plants reach the harvestable stage, side dress with organic or all-purpose liquid nitrogen sources by applying 1/3 cup of fertilizer per 25 square foot of growing area every 2 to 3 weeks.

PROBLEMS

Weeds: Basil does not compete well with weeds so control during seedling establishment is critical. Cultivate shallowly and avoid root pruning to ensure growth is uninterrupted. Organic mulches such as grass clippings, straw and newspapers can help control weeds.

Insects	Identification	Control
Japanese Beetles and Grasshoppers	Holes eaten in the leaves.	Apply a ground treatment that kills immature insects developing underground. For adults, cover plants with garden fabric.
Slugs	Soft-bodied or shelled mollusks that chew holes in leaves.	Control with appropriate pesticides or traps. Avoid moist conditions that favor these pests.
Disease	**Symptom**	**Control**
Root Rot Diseases	Fungal diseases that cause decay and rotting of the roots and premature plant death.	Do not over water, practice crop rotations, and solarize the growing area.
Basil Shoot Blight	Fungal diseases that cause leaf spotting and premature loss of leaves. Dark streaks appear on the stems of older plants.	Keep the plants spaced far enough apart for adequate air circulation to keep plants dry.

HARVEST AND STORAGE

Regular leaf removal before flower heads form will force the plant to grow more leaves and branches. When the plants have 6-8 leaves, harvest the leaves from the plant using a sharp knife or scissors to remove enough of the stem to leave only 2-4 leaves. If you alternate the plants that you harvest, you can have a steady supply of basil. For fresh use cut just before use. To store fresh basil, re-cut the stems and place in a jar of water away from direct sunlight. For longer storage (7-10 days), cover the jar and stems with a plastic bag and put in the refrigerator.

Drying: Drying basil leaves for long term preservation is relatively easy. Tie the harvested leaves into bunches, and then hang them indoors or in a shady place to dry. Do not dry basil in direct sun. Hang stems in bunches of 3-5 leaves in a well-ventilated area out of direct sunlight. Leaves should dry in 5-10 days. Any non-dried leaves can be dried in an oven for 3-5 minutes at 150-200°F. Pack dried leaves in a jar with an air tight lid and store in a cool dark place. Dried basil has a shelf life of about 1 year.

Freezing: Basil leaves can be frozen, but they are mushy when thawed and don't retain their flavor well. To retain more of the flavor, freeze whole leaves in ice cubes or chop with olive oil and freeze in ice cube trays. Frozen basil should be used within 3-6 months.

Pests and Disease: Basil is not susceptible to many production problems provided you rotate planting locations and maintain hygienic conditions near the plants.

Productivity: Leaf production depends on the variety planted and the amount of pinching back done to the plant. 'Genoa Green' variety is a top foliage producer and 'Purple Ruffles' is a low foliage producer. Plant 5-10 plants per person for fresh use and an additional 5-10 plants for storage purposes.

Nutrition: Basil is high in vitamin E, folate, and antioxidants. Basil is low in calories, sodium and carbohydrates, and can supply dietary fiber and protein. Dried, it is much higher in all categories.

FREQUENTLY ASKED QUESTIONS

Does pinching off the flowers make more leaves grow? Pinching off the flowers as they form does not stimulate new foliage; in fact it encourages flowers to form in the axils of the leaves thus reducing the yield of the plant. Planting basil every other week and avoid stressing the plants will help keep them from flowering too quickly.

Authors: Lindsay Pearson, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Beans
by Dan Drost

SUMMARY

All beans require full sun and fertile, well drained soil for maximum yield. Incorporate plenty of organic matter and a complete fertilizer into the soil before planting. When soils are above 60ºF, space rows 18-24 inches apart and plant seeds 1 inch deep and 2-3 inches apart in the row. Plant beans every 14-21 days until mid-July for a continuous crop throughout the growing season. Beans require regular watering particularly at flowering, so maintain soils near field capacity. Water stress will reduce yields and pod quality. Organic mulches help conserve water, supply extra nutrients and reduce the need for weeding. Control insect and diseases if they occur. Harvest when pods are plump and full but before seeds develop. For dry beans delay harvest until pods are yellow and dry. Use fresh beans immediately for best quality.

RECOMMENDED VARIETIES

There are many good bean varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Pod shape, size, and color vary among varieties. Here is a list of some potential varieties and plant types that have performed well in Utah.

Bean Types	Suggested Varieties
Bush Beans	Blue Lake, Greencrop, Gold Crop, Kinghorn Wax, Royal Burgundy, Slenderette, Strike, Tendercrop
Pole Beans	Blue Lake types, Kentucky Wonder, Romano
Dry Beans	Kidney, Great Northern, Pinto, Blackbean, Blackeye Pea

HOW TO GROW

Soils: Beans will grow in all soil types provided they are rich in organic matter, well drained, and fertile.

Soil Preparation: Before planting, incorporate 2-3 inches of well composted organic matter and 1 lb of all-purpose fertilizer (16-16-8) per 100 square feet of garden area. Work compost and fertilizer into the soil to a depth of 6 inches.

Plants: Beans are warm weather vegetables that require soil and air temperatures above 60ºF for best germination and plant growth. Start planting beans one week before the last frost-free date for your area. Seedlings will emerge in 7-10 days when planted in soil that has warmed to 65-85ºF.

Planting and Spacing: To plant 100 feet of row, you will need about 3-4 ounces of seed. Extra seed can be stored and used the next year. Plant seeds 1 inch deep, spaced 2-3 inches apart, in rows 18-24 inches wide. No thinning is necessary if plant stands are too thick. Plant bush beans every 14-21 days until mid-July for continuous production throughout the growing season. Bush beans require 50-60 days to mature depending on variety. Pole beans generally produce pods over a very long time period so one or two plantings are necessary each year. Dry beans planted after July 1 generally will not mature in cooler areas of Utah but will produce mature seeds in the warmer regions of Southern Utah. Mulching the crop during the summer will reduce soil water loss and increase nutrient availability.

Support: Most bean varieties are bush plants that do not need support during growth. Pole beans are climbing types that flower over long time periods thus yielding more when trellised. Trellises also make harvest easier. Wooden poles or other fencing materials make ideal supports for beans. Plants climb naturally so little additional work is required other than construction of the supports.

Water: Beans require regular watering throughout growth for best production. Soil moisture levels should be maintained near field capacity. Do not overwater as wet soils promote root rot diseases and slow plant growth. Water needs are most critical during flowering and pod sizing. Drought stress during and after flowering will decrease yield due to flower abortion and reduce pod size and increase stringiness. For dry beans, reduce water applications as the seeds begin to mature. Watering amounts depend on soil type and organic matter content.

Fertilization: Beans do not require additional fertilizer if an all-purpose fertilizer and compost was applied at planting. Additional applications of nitrogen will over-stimulate leaf growth, delay flowering and reduce pod set. Most beans fix some nitrogen from the air via soil bacteria attached to the plant roots.

Mulches and Row Covers: Plastic mulches can help conserve water, provide some frost protection, and allow earlier planting and maturity. Fabric row covers also protect young plants from frosts. When using plastics and row covers, plant 2-3 weeks before the last frost date for your area. Apply organic mulches such as grass clippings, straw, and shredded newspaper in the heat of summer to help control weeds, improve soil water holding capacity, and increase nutrient availability.

PEST CONTROL

Weeds: Control weeds with regular cultivation, especially when plants are small. Avoid root damage that slows plant growth. Closer row spacing and dense growth help reduce weed pressure.

Insects and Diseases: Most mustard is fast growing and is not susceptible to many production problems. Rotating locations from year to year helps control most diseases.

Insect	Identification	Control
Mexican Bean Beetle and Leaf Beetle	These beetles are round, copper or tan colored with black spots on their wings. Beetles look like lady beetles. Larvae feed on roots, leaves, and pods doing the most damage when plants are small. Look for yellow eggs under leaves.	Dust small plants with appropriate insecticides. Large, flowering plants can withstand feeding pressure with minimal loss in production.
Leafhoppers	Small green wedge-shaped sucking insects that feed on leaf juices. Leaves curl and dry out.	Difficult to control as insects are very mobile.
Cutworms and Army Worms	These green, reddish, or black caterpillars grow up to 2 inches long. Army worms will climb the plants and feed on leaves and stems. Cutworms do most of their feeding near the soil surface.	Control weeds and debris in the garden that provide cover for the worms. Use appropriate insecticides if populations are high.

Disease	Symptoms	Control
Bean Blight	Small water soaked spots that enlarge and form large lesion on stems, leaves, and pods.	Damp conditions favor this disease. Water carefully and allow soil to dry between irrigations.
Root Rot and Damping Off	Seedlings darken, wilt and die. Associated with cool, wet conditions in the spring.	Use treated seed. Allow soils to dry before re-watering.

HARVEST AND STORAGE

Bush and pole beans are harvested before the pods are fully mature. Pods should be full size, with small seeds, and firm, crisp flesh when picked. Pods are ready for harvest about 7-14 days after flowering. Pick regularly as the plant will flower and mature the pods for 2-3 weeks on bush varieties and for 5-6 weeks on pole types. Harvest and use immediately for best quality and flavor. Refrigerate if not used immediately. Dry beans are harvested when the pods are fully mature and they are beginning to dry. Pull up the plants and lay in a row in the garden for 5-7 days. Once plants are dry, remove the pods, shell out the seeds and allow some additional time for the seeds to dry further. For long term storage, keep in sealed containers in a cool dry place.

Productivity: Expect 75 lbs per 100 feet of row from bush types and 125 lbs from pole types. Plant 5-15 feet of row per person for fresh use and an additional 10-20 feet of row per person for canning or freezing. With dry beans expect about 20-25 lbs of seed per 100 feet of row.

Nutrition: Fresh bean pods are high in fiber, low in calories, and a good source of vitamin C. Dry bean seeds are excellent sources of protein, phosphorus, iron, vitamin B1, fiber, and have very low levels of cholesterol.

FREQUENTLY ASKED QUESTIONS

I sometimes have problems getting my beans to emerge in the garden. Beans generally germinate and emerge well regardless of garden conditions. If you plant when soils are below 60ºF, germination is greatly reduced. In heavy clay soils, crusting may be a problem which affects emergence, and pay attention to the seed planting depth. Finally, older seed or poorly stored seed may not germinate and emerge as expected.

Why are the flowers falling off my plants? Plants may have been water or heat stressed just prior to or after the flowers open. Hot weather (above 95ºF) and dry conditions cause the plants to shed (abort) flowers. Keep the soil moist and use organic mulches during the flowering stage to minimize stress.

Why do bean pods get stringy? Stringy beans are further evidence of heat or water stress. Fibers in the pods form during stress making them stringy.

Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Beets

by Dan Drost & Wade Bitner

SUMMARY

Beets are cool season vegetables that prefer sunny locations and fertile, deep, well-drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-½ inch deep. Thin seedling beets to 3 inches apart in the row with rows 12-18 inches apart. Plant 2-3 weeks before the last frost. Beets taste best when plants have been exposed to several weeks of cool frosty weather. Avoid water or fertilizer stress during growth. Irrigation should be frequent and uniform to ensure good growth. Control insects and diseases throughout the year. Harvest beets when the roots reach full size.

BEET VARIETIES

There are many good beet varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Beet varieties include Detroit Dark Red, Red Ace, Early Wonder, Green Leaf, and Golden.

HOW TO GROW

Soils: Beets prefer fertile, well-drained, deep, sandy soils rich in organic matter for best growth. Most light soils in Utah are well suited for beet production. Heavy soils need to be amended with plenty of compost to allow good root development.

Soil Preparation: Before planting, incorporate up to 2-4 inches of well composted organic matter and apply 2-4 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Beets are always grown from seed. Beets can be sown after soils reach 40°F. Seeds germinate best at 55-75°F and require 7-14 days to emerge. Temperatures above 80°F reduce seed germination. Beets grow best when temperatures do not exceed 85°F. Many gardeners plant beets at 2-3 week intervals to maintain a steady supply throughout the year.

Planting and Spacing: Seeds should be planted ½-1 inch deep. Crusting soils will limit seedling emergence and affect plant stands. Maintain a uniform and moist soil surface to ensure good plant stands. Seeded beets should be spaced 3-4 inches between plants in the row with rows 12-18 inches apart.

Water: Water beets regularly. Water requirements depend on soil type. Mulching around the plants helps to conserve soil moisture. Use drip irrigation if possible. Moisture fluctuations cause root cracking, slow leaf development, and contribute to low yields. Water stress during the first 6 weeks of growth often leads to premature flowering and low yields.

Fertilization: Apply ¼ cup per 10 foot of row of a nitrogen-based fertilizer (21-0-0) 6 weeks after emergence to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil. Beets require adequate amounts of boron to develop properly. Black, sunken spots on or in the root generally indicate low boron levels in the soil.

PROBLEMS

Weeds: Beets do not compete well with weeds. Weed control is particularly important during germination and early establishment when plant growth is slow. Thin closely spaced plants to encourage good root size. Avoid cultivation as root pruning and damage will affect growth and yield.

Insects and Diseases: Most beets grow rapidly and are not susceptible to many production problems. Rotate planting locations in the garden from year to year to help control many diseases. Boron deficient plants are more susceptible to many of the more common root diseases.

Insect	Identification	Control
Leaf Miners	Small white maggots that burrow and feed in the leaves. Leave a lacy trail.	Do not significantly affect yield, but make the leaves less usable.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control with chemicals at seeding or after seedlings have emerged from the soil.
Disease	**Symptom**	**Control**
Leaf Spots	Fungal diseases that cause circular spotting on infected leaves.	Occur when foliage remains wet for long periods. More common late in the year.
Root Rots	Fungal diseases that cause decay and rotting of the root. May affect plant stands	Crop rotation, improved soil drainage, and seed treatments are effective control options.
Yellows	Yellow discoloration of plants.	Carried by leafhoppers. Cover plants with fabric mulch. No known control.

HARVEST AND STORAGE

Beets can be harvested as soon as the roots begin to size. Generally roots are mature 60-80 days from seeding, depending on variety. As the roots get larger they tend to get more fibrous. Use a digging fork to loosen soil and pull up needed plants by the tops and trim off leaves. Wash and store at 32ºF and 95% relative humidity for 2-4 months. Young leaves may be cooked and eaten as well. Harvest beet leaves when they are 4-6 inches tall. Beets should be harvested before heavy frosts or freezes.

Productivity: Plant 5-10 feet of row per person for fresh use and an additional 10-20 feet for storage or canning. Expect about 75 lbs of beet roots per 50 linear feet of planted row.

Nutrition: Beets are low in calories and are a good source of vitamin C. A medium sized root has only 50 calories, no fat, and supplies 4% of the daily vitamin C requirement. Beet tops (greens) are an excellent source of vitamin A and provide more minerals and vitamins than the root.

FREQUENTLY ASKED QUESTIONS

Why do my beets flower rather than form a bulb? Beets require some chilling to form flower stalks. If planted too early, this can occur.

Why do some of my beets fail to form a bulb? Beets need some room to grow. Over-crowding can contribute to poor bulb development.

What can I do to reduce woody beet roots? Hot weather and water stress can cause woody bulbs. Keep plants well watered when temperatures go above 85ºF.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Wade Bitner, Horticulture Student

Black Salsify

by Jodie M.H. Moser & Dan Drost

SUMMARY

Black Salsify (*Scorzonera hispanica*), is also known as Spanish salsify. Black salsify is a cool season crop grown primarily for its long, brown-black roots, but its leaves can also be used as fresh greens for salads. The roots of black salsify tend to be longer, smoother, less fibrous, and of a finer texture than regular salsify. It is also more cold hardy, but requires about the same length growing period as regular salsify, which is 120 days.

The cultural practices for both are also generally the same. Both have an oyster-like taste which gives them the name "oyster plant" and both are highly suitable for diabetic diets.

RECOMMENDED VARIETIES

Purchase high quality seeds from a local nursery or seed catalogs. The seeds should be sown directly into the soil in early spring so there is no need to grow transplants.

HOW TO GROW

Soils: Salsify prefers deep, fine textured, well drained soils with good water holding capacity. Work the soil 18-24 inches deep to reduce compaction so the plants can develop long, straight roots with few deformities. Plants prefer to be within a pH level of 6-8.

Soil Preparation: Before planting, incorporate 2-4 inches of well composted organic matter or 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet of planting area. Rocks and other large objects should be removed to reduce root deformities.

Planting and Spacing: Because salsify is a cool season crop, it needs to be sown as soon as the soil can be worked in northern areas of Utah and can be fall seeded in more mild areas of the state. Seeds should be planted about ½ inch deep in rows 10-15 inches apart with plants spaced 2 inches apart within the row after thinning.

Water: Salsify originated in Southern Europe so it prefers a regular supply of water, keeping the soil at a constant moisture level. Irrigate with 1-2 inches per week to maintain a moist, but not wet soil.

Fertilization: Apply ½ cup of a nitrogen based fertilizer (21-0-0 or 34-0-0) per 25 foot of row in midsummer. Place the fertilizer to the side of the plants and irrigate it into the soil.

PROBLEMS

Weeds: To reduce weeds without chemicals, cultivate often when weeds are small, practice crop rotation, and mulch around plants with grass clippings, straw, or newspapers. Cultivate shallowly and avoid root pruning to ensure uninterrupted growth.

Pests and Diseases: Salsify is not susceptible to many common production problems. Rotating planting locations from year to year helps control most diseases.

Insects	Identification	Control
Aphids	Green or black soft-bodied insects that feed on the underside of leaves. Insects that reduce plant yield and vigor and are especially harmful to young plants.	Use appropriate insecticides, insecticidal soaps, or strong water stream to dislodge insects.
Diseases	**Symptoms**	**Control**
White rust	Yellow spots on upper side of leaves	Use appropriate fungicides; reduce moisture levels.

HARVEST AND STORAGE

Salsify roots are very hardy and are not damaged by freezing so roots can be dug, topped, and stored or left in the garden until needed. However, the roots get brittle when frozen so they should be handled with care.

Store salsify like topped carrots. Store roots at 32°F and 95-98% relative humidity. High humidity is important for keeping roots from shriveling. When stored correctly black salsify roots should last about 6 months.

Productivity: Each plant produces one root and several leaves that are available from late fall to early spring. Plant 5-10 feet of row per person for fresh and storage purposes.

FREQUENTLY ASKED QUESTIONS

Why are some of my roots splitting? This is a disorder salsify commonly contracts, but the reasons for contracting it and control are actually unknown. The best thing to do is try to reduce plant stress as much as possible. There are also some varieties of salsify being developed that have a higher resistance to this problem. Splitting has no effect on root taste.

Authors: Jodie M.H. Moser, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Blueberries

by Brent Black, Grant Cardon & Mark Ehlenfeldt

SUMMARY

U.S. consumers have become increasingly interested in blueberries. Part of this is due to the exceptional flavor and versatility of the berries, while some of the interest can be attributed to recent discoveries regarding the health benefits of this "super food." In response to this increased demand, more chain stores are now selling blueberry plants to intrepid and/or gullible Utah gardeners. Here we describe the difficulties you will encounter in home blueberry production.

BACKGROUND

Commercially harvested blueberry fruit comes from one of several different blueberry species, including lowbush, highbush, and rabbiteye. The lowbush or wild blueberry is native to the northeastern U.S. and eastern Canadian provinces. The highbush blueberry originated in the coastal forests of eastern North America and was first domesticated in the Pine Barrens of New Jersey. The rabbiteye blueberry is native to coastal regions of the southeastern U.S. including Florida, Georgia and the Carolinas. All of these forested coastal regions have sandy soils with high organic matter content, a low pH, and high annual rainfall. As one might expect, blueberries are uniquely adapted to this environment. Specifically, the root system is broad, shallow and fibrous, and requires soil that has an acidic pH, that is coarse textured, well drained, and has high organic matter content.

SOIL pH

Soil acidity/alkalinity is measured in units of pH, where the lower the pH the more acidic the soil, with a pH of 7 being neutral. Blueberries prefer a soil pH of 4.5 and will tolerate pH levels as high as 5.5. The pH of typical garden soils in Utah is above 7.5. The pH scale is an exponential measurement of the amount of acidic cations (positively charged ions) in solution, so a pH difference of 1 unit equates to a 10-fold difference in acidic cation concentration. In other words, blueberries require an acidic cation concentration 1000 times higher than typically found in Utah soils. Soil pH determines the relative availability of essential elements. When the pH becomes either too high or too low, the plant usually shows nutrient deficiencies. In Utah's high pH soils, this is commonly seen as iron chlorosis or zinc deficiency.

SOIL ACIDIFICATION

In some cases, soil pH can be lowered by the addition of acids or materials such as sulfur that form acids in the soil. However, many Utah soils are "buffered" at higher pH by the presence of carbonates, bicarbonates, and cations such as calcium and magnesium. These soil buffers would need to be saturated by the addition of acid before the soil pH will begin to decrease. The observed consequence of this buffering capacity is that large amounts of acid must be added before the soil pH changes appreciably (Figure 1).

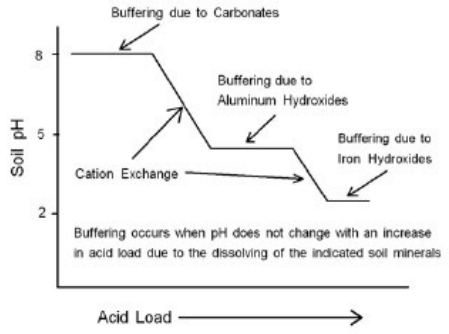


Figure 1. pH buffering effects in Utah soils.

Typical Utah soils contain lime (calcium carbonate)ranging from 1 percent to greater than 20 percent of the soil weight. One percent lime is equivalent to one pound of lime per square foot, and would require nearly a pound of sulfuric acid, or 4.7 ounces of elemental sulfur per square foot, just to neutralize the lime. In the case of soils with 20 percent lime content, 20 times that amount (5.9 pounds of elemental sulfur per square foot) would be required to neutralize the soil's buffering capacity. Once this buffering capacity has been satisfied, additional acid is required to lower the pH. The amount of acid required is dependant upon soil type and texture. A routine soil test, along with a test for percent lime, will provide the information needed to determine the potential for pH adjustment in your soil (see Additional Resources section below).

Acidifying soils may create additional problems. When soil pH is adjusted, some minerals in the soil become more soluble, and thus more available to the plant. In the case of aluminum and manganese, this increased solubility may result in plant toxicity.

SOIL TEXTURE

The fine fibrous root system of blueberry plants requires a coarse-textured soil. Blueberry root growth in acidified soils is often restricted by fine-textured soils (clay). The pH, nutrient availability, and physical properties (texture) of the soil environment can be improved using organic amendments. Interestingly, in some commercial plantings, repeated side-dress applications of organic amendments, such as wood chips, results in a mound of decomposing organic matter that essentially replaces the existing soil as a substrate for root growth (Figure 2).

SOIL REPLACEMENT

With the difficulty of soil acidification, it might be easier and more cost effective to substitute the existing soil with a media that has the texture, organic matter content, and soil pH suitable for blueberry root growth. This can be accomplished by establishing windrows of organic matter, as shown in Figure 2, or by planting in pots containing a suitable potting medium. However, growing blueberries in a soil substitute is not without difficulties. First, the broad shallow root system is not well-suited to restricted root volumes such as in pots. Further, root zone temperatures in containers and raised beds will often exceed that which is optimal for blueberry roots. For growing in pots, use a 5 to 7 gallon pot that is wider than it is tall, and that is either light colored, or protected from direct sunlight. Finally, like the soils, Utah water is also alkaline and is buffered by the presence of dissolved carbonates. In order for the soil substitute to remain a favorable environment for root growth, irrigation water may also need to be acidified.

Figure 2. Highbush blueberries growing in a raised bed made up of decomposing wood chips, placed on the surface of a clay loam soil.

WATER ACIDIFICATION

Alkaline irrigation water can be neutralized or acidified for the maintenance of pH when growing blueberries in acidic soil materials or growing media (peat, potting mixes, etc.). This is done by mixing acid (usually sulfuric acid) directly with water in appropriate amounts, or by oxidizing (burning) elemental sulfur in the presence of water to form sulfuric acid which is then mixed with the irrigation water (known as the sulfur burner process). Homeowner-scale sulfur burners are not available, so the process is generally restricted to commercial production.

Handling concentrated acid solutions is a difficult and potentially hazardous procedure and should only be undertaken with the utmost care and according to the safety precautions outlined by the manufacturer of the acid product. Always use rubber gloves and eye protection when handling acid. When mixing acid and water, ALWAYS add acid to water, NEVER add water to acid as this can be a violent, volatile reaction!

Typical water sources in Utah contain from 60 to 1200 mg/L (or ppm) dissolved carbonate and bicarbonate which buffers pH between 7 and 8. Neutralizing the alkalinity of the water and reducing the pH to about 5 (optimal for blueberries) requires from 160 to 3,175 pounds of sulfuric acid per acre foot of water. This is about 16 to 355 gallons of fertilzer-grade (62%) sulfuric acid (or 10 to 220 gallons of concentrated (98%) sulfuric acid) per acre foot of water treated. For the home garden, this would be equivalent to 0.5 to 8 teaspoons of fertilizer grade sulfuric acid per 100 gallons of water. The water will need to be treated each time the blueberry plants are irrigated. The amount added is critical, as too much acid will lower the pH below 4.0 and can damage the blueberry plants. It should also be noted that for secondary irrigation water sources, the carbonate and bicarbonate content varies over the course of the season. Therefore, the amount of acid required to treat your irrigation water will vary somewhat from spring to fall. For best results, you may need to invest in a test kit or pH meter to measure water pH, then monitor your treated irrigation water and periodically adjust the amount of acid added.

VARIETIES AND PLANT SOURCES

In addition to the lowbush, northern highbush and rabbiteye types mentioned previously, additional blueberry types have been created through plant breeding. The southern highbush results from crosses between northern highbush and rabbiteye. The half-high varieties are the result of crosses between northern highbush and lowbush types. These general types differ in plant size, fruit

ripening time, and most importantly in cold hardiness. For colder parts of the state, the half-high and northern highbush types would be best adapted. For the Dixie area, southern highbush and rabbiteye would be best adapted. The following varieties are a good starting point.

They have been included based upon vigor, toughness, and reliability. Many other varieties are available if these prove successful under your specific conditions. The different types are listed from most cold hardy (half-high) to least cold hardy and most heat tolerant (rabbiteye).

Half-high varieties:

Friendship – a native selection from Wisconsin that is a taller (chest high), more vigorous bush than typical half high types. Early ripening, with a medium to medium small fruit size.

Northblue – a knee-high selection from Minnesota with a spreading bush habit. Blooms later than some other half-highs so it may offer better frost avoidance, but is still relatively early ripening. Medium-sized fruit with good fruit quality.

Northland – a mid-height (waist high) Michigan variety often grown by smaller growers in the northeastern U.S. Cold tolerant and productive, but it has relatively soft fruit that is not well-suited to shipping. Early ripening, with medium-sized fruit.

Northsky – a low, brushy, Minnesota variety with a growth habit somewhat like lowbush blueberry. Early ripening, with a medium to medium-small fruit size.

Highbush varieties:

Bluecrop – one of the most widely grown varieties. It ripens in midseason, is a broadly-adapted, reliable producer year after year, with classic blueberry flavor.

Blueray – is a sibling of 'Bluecrop' with similar recommendations regarding ease of growing. 'Blueray' ripens slightly earlier, but is also slightly less productive.

Herbert – a late ripening variety that has a vigorous bush and very good flavor. Productive, but fruit are less firm than many other varieties.

Lateblue – one of the latest ripening varieties. Plants are vigorous, upright, and productive year after year.

Southern highbush:

Echota – an extremely vigorous North Carolina variety with a somewhat sprawling bush habit, but nice quality fruit. Ripens in late midseason.

Georgiagem – an upright bush with reliable production under many different conditions. Ripens in midseason and has medium-sized fruit.

Legacy – a New Jersey variety adapted to a wide range of conditions. Plants may be a bit brushy when young, but develop into an upright, vigorous plant. Very good flavor and fruit quality with a very productive mid- to late harvest season.

Star – a Florida variety that also has good cold adaptation. Large, attractive, early season fruit. Rabbiteye (rabbiteye types ripen later than almost all highbush types under typical conditions, notes on ripening below refer to their relative order within the rabbiteye ripening season):

Baldwin – a very productive, late-ripening variety with a long harvest season and a sprawling bush habit.

Ira – a newer North Carolina midseason variety, 'Ira' is productive with very good quality fruit.

Montgomery – another new North Carolina midseason variety. 'Montgomery' has very good fruit quality and more volatile flavors than most typical rabbiteye.

Powderblue – a widely-grown, midseason, Georgia variety with upright habit and good fruit quality.

Tifblue – a classic Georgia variety that combines vigor, cold tolerance, and productivity. An upright type with considerable suckering, but reliable mid-late yields. Fruit is medium sized and light blue.

GENERAL CULTURE

Healthy blueberry plants will form a medium-sized multi-stem shrub within 3 to 4 years, with a flush of new healthy shoots coming from the crown each year. Plants should be spaced 2.5 to 4 feet apart within the row, with rows 8 to 10 feet apart. More vigorous varieties such as the rabbiteye types may need more space. Blueberries are sensitive to both drought and waterlogging. The porous soils that blueberries prefer will drain quickly, but also will dry out quickly, so the plants will need to be irrigated frequently. If amending an existing garden soil with organic matter, use raised beds to improve drainage and soil aeration. A raised bed 3 feet wide and 8 to 12 inches high will be sufficient.

Blueberries are also sensitive to over fertilization. Apply 2 tablespoons of 10-20-10 fertilizer per plant at planting. In subsequent years, apply one to four ounces of fertilizer per plant (depending on plant size) in both the spring and the fall. Fertilizer nitrogen can be in either the ammonium or nitrate form. Blueberries best utilize the ammonium form. Where possible, use balanced fertilizers that contain ammonium nitrogen. Acid fertilizers, such as those formulated for azaleas, generally contain ammonium nitrogen. Alternatively, use ammonium sulfate to supply fertilizer nitrogen needs.

During the first growing season, do not allow the blueberry plants to produce fruit as this will slow establishment. To prevent fruiting, pick off the flower clusters as they emerge in the spring.

Once established and fruiting, blueberry plants will need to be pruned to maintain productivity. Each spring as the buds begin to swell, prune out low growing shoots around the base, and any dead wood, or small nonvigorous shoots. Select for vigorous (larger) shoots with lateral branches and bright colored bark. After removing the small twigs and basal growth, additional renewal pruning may be required to thin out remaining canes and make room for the establishment of new more productive canes. The degree of renewal pruning required will depend on the health and vigor of the plant. Where plants are extremely vigorous, approximately 1/3 of the wood should be removed annually. Typically this would entail removing two or three of the largest oldest canes. With less vigorous varieties or on less vigorous sites approximately 1/5 to 1/6 of the wood (one or two of the oldest canes) will need to be removed annually.

ADDITIONAL RESOURCES

Highbush Blueberry Production: Oregon State University Extension, Publication PNW215.
http://extension.oregonstate.edu.

Additional online information available at:

www.fallcreeknursery.com/Gardener/index.htm, Fall Creek Nursery. ***www.extension.umn.edu***, The University of Minnesota.

The USU Analytical Laboratory (USUAL) maintains an information website at: www.usual.usu.edu. Prices and sample submission forms for soil and water testing services can be found at the website, or by visiting your local county Extension office.

Nursery sources: Following is an alphabetical list of blueberry nurseries, including location, phone number, and featured blueberry cultivars. Except where noted, these nurseries sell small quantities of plants directly to home gardeners.

Bottoms Nursery, Concord, Georgia. Phone 770-884-5661. Georgiagem, Star, Baldwin, Powderblue, Tifblue.

DeGrandchamps Farms, South Haven, Michigan. 888-483-7431. Friendship, Northblue, Star.

Finch Blueberry Nursery, Bailey, North Carolina. 252-235-4664. Bluecrop, Blueray, Echota, Georgiagem, Legacy, Baldwin, Ira, Montgomery, Powderblue, Tifblue. Hartmann's Plant Company, Lacota, Michigan 269-253-4281. Bluecrop, Blueray, Northblue, Northsky, Legacy.

Heartland Blueberries, Hodgenville, Kentucky. 270-358-5837. Bluecrop, Blueray, Star, Georgiagem, Legacy.

Ison's Nursery, Brooks, Georgia. 800-733-0324. Powderblue, Tifblue.

Miller Nurseries, Canandaigua, New York 800-836-9630. Bluecrop, Blueray, Northblue, Herbert.

Morrisons's Home and Garden, Plymouth Massachusetts. 508-746-0970. Bluecrop, Blueray, Lateblue.

Octoraro Farm and Gardens, Nottingham, Pennsylvania. 610-932-0225. Friendship, Herbert, Lateblue.

Oregon Blueberry Farms, Silverton, Oregon. 503-873-1200. Bluecrop, Legacy, Powderblue.

Stark Brothers. Louisiana, Missouri. 800-325-4180. Bluecrop, Blueray, Legacy, Northblue, Tifblue.

Commercial sales only:

Fall Creek Nursery, Lowell, Oregon. 800-538-3001. Bluecrop, Blueray, Legacy, Northblue.

Authors: Brent Black, USU Extension Fruit Specialist, Grant Cardon, USU Extension Soils Specialist & Mark Ehlenfeldt, USDA-ARS Research Specialist

Notes

Broccoli

by Dan Drost & Michael Johnson

SUMMARY

Broccoli is a cool season vegetable that prefers sunny locations and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep, 2-3 weeks before the last frost in the spring. Thin seedlings or transplant broccoli 12-18 inches apart in the row with rows 2-3 feet apart.

Avoid growing during the heat of summer as yield and quality are reduced. After harvest, side-dress with additional nitrogen fertilizer for continued sideshoot development. Irrigation should be deep and infrequent. The use of plastic or organic mulches helps conserve water and reduce weed growth. Control insects and diseases throughout the year. Harvest broccoli when the heads are large and compact, but before the flower buds open.

RECOMMENDED VARIETIES

There are many good broccoli varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Packman (50 days), Green Comet (55 days), and Premium Crop (65 days) have excellent production and eating quality.

HOW TO GROW

Soils: Broccoli prefers fertile, well-drained soils rich in organic matter for best growth. Most soils in Utah are suitable for broccoli production.

Soil Preparation: Before planting, incorporate 15-20 lbs of well composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Broccoli can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned to the final stand when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants are used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Larger, more mature transplants are prone to form small, early heads (buttoning) which flower prematurely.

Planting and Spacing: To produce nice sized heads, seeded or transplanted broccoli should be spaced 12-18 inches between plants in the row with rows 2-3 feet apart. Closer spacing (1 by 1 foot) can be used, but head size is reduced and side shoot development inhibited by these arrangements. Broccoli grows best and produces highest yields when temperatures do not exceed 75°F and is not seriously damaged by temperatures down to 28°F. Broccoli grown for transplants should be sown 5-6 weeks before the expected planting date. Transplants may be planted 2-3 weeks before the last frost free date for the growing area. Seeded broccoli may be planted at the same time. For fall maturing broccoli, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date can be several weeks after the first fall frost. High summer temperatures reduce growth, decrease quality, and cause loose heads to form, which taste bitter.

Water: Water broccoli deeply and infrequently while trying to maintain even soil moisture. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Applying mulch around the plant also helps conserve soil moisture and reduce weed growth.

Fertilization: Apply 1/2 cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or thinning to encourage vigorous plant growth. Apply an additional ¼ cup of nitrogen fertilizer when the broccoli head is the size of a quarter. After harvesting the main head, apply additional nitrogen fertilizer to encourage side shoot development. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weed growth and allow earlier planting and maturity, especially with transplants. Hot caps and fabric covers are used to protect seedlings and transplants from frosts. Fabric covers also protect young plants from insect pests. Apply organic mulches when temperatures rise. These will cool the soil, reduce water stress, and control weeds. Organic mulches such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small and be careful not to damage roots when cultivating.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become yellow, crinkled, and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms are light to dark green. Adult loopers are a gray or brown moth while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in broccoli heads.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

Disease	Symptom	Control
Alternaria Leaf Spot	Damping off of seedlings. Leaf spots on leaves or heads is a more common symptom. Spots form concentric circles and have a black sooty color.	Avoid overhead irrigation. Practice good sanitation. Rotate crops. Apply appropriate fungicide as a last resort.

Deficiency	Symptom	Control
Boron	Nutrient deficiency which causes brown spotting on the head and hollow, discolored stem below the head.	Avoid excess fertilizer. May occur in high pH soils or where plants have been water stressed.

HARVEST AND STORAGE

Broccoli heads should be harvested when the heads are compact but before the flower buds open. Mature heads are 6-12 inches in diameter and should be cut with stems 8-10 inches long. With additional water and fertilizer, broccoli will produce many 4-6 inch long side-shoots. Broccoli can be stored for 1-2 weeks at 32°F and 95% relative humidity.

Productivity: Plant 3-5 broccoli plants per person for fresh use and additional 5-10 plants for storage, canning or freezing. Expect 100 lbs per 100 feet of row.

Nutrition: Broccoli has low sodium, no fat, no cholesterol, high vitamin C, is low in calories, and is a source of folate, calcium, and vitamin A.

FREQUENTLY ASKED QUESTIONS

Some years many of my broccoli plants only produce very small heads and they do this soon after planting. What's wrong? Buttoning is the development of pre-mature flower heads in broccoli and cauliflower. Plants that button have been exposed to cold weather or were stressed for water or nutrients shortly after transplanting. Larger transplants are more prone to button so try to select plants with 4-6 leaves.

Why do the broccoli heads open up and flower during the summer? Broccoli plants are cool season vegetables grown for their immature flower stalks. During hot weather, plants may not get enough water which leads to poorer quality heads that are more open. Keep plants well watered during the heading period. Plants that are stressed often flower prematurely as well.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

Notes

Brussels Sprouts

by Dan Drost & Michael Johnson

SUMMARY

Brussels sprouts are cool season vegetables that prefer a sunny location and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep. Thin seedlings or transplant Brussels sprouts 12-18 inches apart in the row with rows 2-3 feet apart. Plant Brussels sprouts in early summer for maturity in the fall after several frosts. Avoid fertilization during sprout formation as this may cause loose, soft sprouts, and splitting. Irrigation should be deep and infrequent. Plastic or organic mulches help conserve water and reduce weedgrowth. Control insects and diseases throughout the year. Harvest Brussels sprouts when the sprouts are 1 inch in diameter, but before they burst open.

RECOMMENDED VARIETIES

There are many good Brussels sprouts varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Long Island Improved (90 days), Prince Marvel (100 days), and Jade Cross (100 days) have excellent production, eating quality and storage potential.

HOW TO GROW

Soils: Brussels sprouts prefer fertile, well drained soil rich in organic matter for best growth. Most soils in Utah are suitable for Brussels sprouts production.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Brussels sprouts can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned to the final stand when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted Brussels sprouts should be spaced 12-18 inches between plants in the row with rows 2 feet apart. Brussels sprouts grow best when temperatures do not exceed 70°F and are not seriously damaged by temperatures below freezing. Brussels sprouts require a long time to mature. Plants should be planted in early summer (early June to late July) for maturity in the fall. Seeded Brussels sprouts may be planted at the same time. They should be planted so that the sprouts develop when fall temperatures cool. High summer temperatures reduce plant growth, decrease sprout quality, and cause internal tipburn.

Water: Water Brussels sprouts deeply and infrequently while trying to maintain even soil moisture. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Applying mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations during heading will cause maturing sprouts to split open or develop bitter flavors.

Fertilization: Apply ½ cup per 10 feet of row of nitrogen-based fertilizer (21-0-0) at 4 and 8 weeks after transplanting or thinning to encourage vigorous plant growth. Avoid applying additional nitrogen after sprouts begin to form. High nitrogen levels cause loose sprouts and splitting to occur. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water and reduce weed growth when using transplants. Fabric covers also protect young plants from insect pests. Apply organic mulches when temperatures increase above 80°F. Mulches help control weeds, cool the soil, and reduce water stress. Organic mulches, such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small, and be careful not to damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become yellow, crinkled, and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in Brussels sprouts heads.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

Disease	Symptom	Control
Alternaria Leaf Spot	Damping off of seedlings. Leaf spots on leaves or heads is a more common symptom. Spots form concentric circles which have a black sooty color.	Avoid overhead irrigation. Remove diseased leaves and plants. Rotate crops. Apply appropriate fungicide as a last resort.

Deficiency	Symptom	Control
Tipburn	Nutrient deficiency which causes breakdown of the leaf tissue near the center of the head. Affected tissue becomes dry and brown or black.	Avoid excess fertilizer and water stress during head development. Keep plants evenly moist during growth.

HARVEST AND STORAGE

Brussels sprouts should be harvested when the sprouts reach 1 inch in diameter and are firm and compact. Sprouts near the bottom of the plant develop first. As they are harvested, sprouts further up the stem continue to enlarge. For more uniform sprout development along the whole stem, remove the growing point at the top of the plant when the lower sprouts begin to form. Sprouts can be harvested by breaking or cutting them off the stem. Brussels sprouts can be stored for 2-6 months at 32°F and 95% relative humidity. Avoid storing Brussels sprouts with apples, pears, or other ethylene producing fruits as bitter flavors will develop.

Productivity: Plant 3-5 Brussels sprouts per person for fresh use and additional 5-7 plants for storage, canning or freezing. Expect 50-75 lbs per 100 feet of row.

Nutrition: Brussels sprouts are high in vitamin C, a source of thiamine, iron, calcium, and fiber, and are low in calories.

FREQUENTLY ASKED QUESTIONS

My Brussels sprouts taste bitter. What's wrong? Brussels sprouts taste better after they have been exposed to a few frosts. The frosts cause the sugars to become more concentrated in the Brussels sprouts.

When I cut open my Brussels sprouts, they have brown coloration inside. Why is this? Tipburn is caused by calcium deficiencies in the plant. Most soils in Utah are very high in calcium so plants have access to plenty of this nutrient. However, when plants go through irregular growth periods, calcium is not adequately transported to the inner leaves and this causes the leaf edges to "burn" or turn brown. Uniform irrigation, moderate fertilizer additions, and mulches can help prevent this problem.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

Notes

Cabbage

by Dan Drost & Michael Johnson

SUMMARY

Cabbage is a cool season vegetable that prefers sunny locations and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep, 2-3 weeks before the last frost in the spring. Thin seedlings or transplant cabbage 12-18 inches apart in the row with rows 2-3 feet apart. Avoid fertilization during head formation as this causes excessive leaf growth and head splitting. Irrigation should be deep and infrequent. The use of plastic or organic mulches helps conserve water and reduces weed growth. Control insects and diseases throughout the year. Harvest cabbage when the heads reach full size, but before they split open.

RECOMMENDED VARIETIES

There are many good cabbage varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Golden Acre (65 days), Ruby Ball (55 days), Savory Ace (80 days), and Danish Ball Head (100 days) have excellent production, eating quality, and storage potential.

HOW TO GROW

Soils: Cabbage prefers fertile, well-drained soil rich in organic matter for best growth. Most soils in Utah are suitable for cabbage production.

Soil Preparation: Before planting, incorporate 15-20 lbs of well composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Cabbage can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned to the final stand when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants are used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted cabbage should be spaced 12-18 inches between plants in the row and rows 2-3 feet apart. Cabbage grows best when temperatures do not exceed 80°F and is not seriously damaged by temperatures down to 25°F. Transplants should be planted 2-3 weeks before the last frost free date for the growing area. Seeded cabbage may be planted at the same time. For fall maturing cabbage, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The
maturity date should be about 1-2 weeks after the first fall frost. High temperatures reduce growth, decrease quality, and may cause internal tipburn to form.

Water: Water cabbage deeply and infrequently while trying to maintain even soil moisture. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Applying mulch around the plant also helps conserve soil moisture and reduces weed growth. Moisture fluctuations during heading will cause maturing heads to split open.

Fertilization: Apply 1/2 cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or thinning to encourage plant growth. Avoid applying additional nitrogen after heads begin to form. High nitrogen levels at this time cause loose heads and splitting to occur. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weed growth and allow earlier planting and maturity, especially with transplants. Hot caps and fabric covers are used to protect seedlings and transplants from frosts. Fabric covers also protect young plants from insect pests. Apply organic mulches when temperatures increase. These will cool the soil and reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small and be careful not to damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms and loopers are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in cabbage heads.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

Disease	Symptom	Control
Alternaria Leaf Spot	Damping off of seedlings. Leaf spots on leaves or heads is a more common symptom. Spots form concentric circles which have a black sooty color.	Avoid overhead irrigation. Practice good sanitation. Rotate crops. Apply appropriate fungicide as a last resort.

Deficiency	Symptom	Control
Tipburn	Nutrient deficiency which causes breakdown of the leaf tissue near the center of the head. Affected tissue becomes dry and brown or black.	Avoid excess fertilizer and water stress during head development. Keep plants evenly moist during growth.

HARVEST AND STORAGE

Cabbage heads should be harvested when the heads reach full size and are firm and compact. Cut the stem below the head leaving 2-3 wrapper leaves for protection. Cabbage can be stored for 2-6 months at 32°F and 95% relative humidity. Avoid storing cabbage with apples, pears, or other ethylene producing fruits as bitter flavors will develop.

Productivity: Plant 3-4 cabbages per person for fresh use and additional 5-10 plants for storage, canning or freezing. Expect 150 lbs per 100 feet of row.

Nutrition: Cabbage has no fat, is low in calories, high in vitamin C, and is a source of fiber, calcium, iron, and folic acid.

FREQUENTLY ASKED QUESTIONS

When I harvest my cabbage, I notice that the outside leaves are green and healthy, but when I cut into the cabbage the leaf edges are tan or dark brown. Why is this? Tipburn is caused by a calcium deficiency in the younger, internal leaves in the cabbage plant. Most soils in Utah are very high in calcium so plants have access to plenty of this nutrient. However, when plants go through irregular growth periods, calcium is not adequately transported to these younger, inner leaves and this causes the leaf edges to "burn" or turn brown. Uniform irrigation moderate fertilizer additions, and mulches can help prevent this problem.

How do I prevent head-splitting in mature cabbage? Pull the cabbage head up out of the soil in order to break some of the side roots. This will stop excess water from being transported into the head, which causes splitting.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

Notes

Calendula

by Liz Braithwaite & Dan Drost

SUMMARY

Calendula, also called pot marigold, is an annual herb grown for its medicinal blooms, edible leaves and stems. It grows best in fertile, well drained soils from full sun to part shade. Calendula blooms throughout the season with yellow to orange blossoms that open and close with the sun. Calendula is easily grown from seed. Sow seeds in the spring planting ¼ inch deep and thin seedlings to 8 to12 inches apart after emergence. Plants grow 8 to 24 inches tall and require regular irrigation for best performance. Harvest flower heads when the plant reaches full bloom and use fresh or dried.

RECOMMENDED VARIETIES

There are 15 species in the Calendula genus with *C. officinalis* being the most popular. Cultivars are mostly ornamental selections with single or double blooms that vary in color from pale yellow to deep orange and have uniquely colored centers.

'Coronet' and 'Pacific Beauty' exhibit increased heat tolerance. The 'Touch of Red' mixed series features double flowers with red petal edges and the 'Kabouana' series has dark centers. Both 'Resina' and 'Erfurter Orangefarbige' have high resin content in the blooms for medicinal use.

HOW TO GROW

Soils: Calendula prefers well drained, moderately rich soils with a pH of 6-7 but can survive in a wide range of soil types. Most soils in Utah are suited for calendula.

Soil Preparation: Before planting, incorporate 2 to 4 inches of compost and apply 1 to 2 teaspoons per square foot of an all purpose fertilizer (16-16-8). Work compost and fertilizer into the top 6 to 8 inches of soil.

Plants: Calendula can be grown by transplants or by seed. Seeds germinate readily. Plant seeds ¼ inch deep when soil temperatures reach about 60°F. Seeds germinate in 8 to 14 days. Transplants are available at many garden centers, often grown as ornamental annuals. Plant transplants after danger of frost has past.

Planting and Spacing: After emergence, thin seedlings to 8 to 12 inches apart in the row. Calendula prefers cooler temperatures (< 85°F) and often stops blooming in extreme heat. Plants will survive temperatures down to 25°F. Removal of the old flowers (deadheading) will encourage re-bloom.

Water: Routine watering is advisable, but calendula will also survive in low water conditions. Avoid overwatering, but supply 1 to 1½ inches of water per week in mid-summer for optimal growth.

Fertilization: Calendula needs little additional fertilization. Periodically side dress the plants with a complete soluble fertilizer to insure optimal growth and constant bloom development.

PROBLEMS

Weeds: Manage weeds by cultivation or hand pulling. Avoid damaging the plants during cultivation. Mulches also effectively control weeds. Calendula self-seeds readily if not deadheaded and may become weedy in the garden.

Pests and Diseases: Calendula is often planted as a companion plant to tomatoes and potatoes to help deter insect pests.

Insect	Identification	Control
Whiteflies	Small white flies that hide and feed on the underside of leaves.	These insect are easily controlled by a hard stream of water or by regular applications of insecticidal soap.
Aphids	Green or black soft bodies insects that feed on the underside of the leaves. Aphids produce honeydew and cause crinkled or curled leaves.	
Disease	**Symptom**	**Control**
Powdery mildew	White fungal patches on leaves that can spread to all the plants. Associated with cool, wet weather conditions.	Insure good air circulation, control irrigation and remove infested plant parts.

HARVEST AND STORAGE

To harvest flowers, pick the complete flower at full bloom. Petals can be removed for culinary use. Blooms can be harvested multiple times in a season. Plants will re-bloom in about 2 weeks. Collect seeds when fully mature and dry.

Drying: Dry the blooms in a well ventilated area, away from sunlight. A food dryer can also work effectively. Flowers should dry in 1 to 5 days.

Storage: Store blooms in a moisture tight container in a cool, dark place.

Productivity: Calendula has a high productivity rate. A 60 foot row of calendula will produce 1 pound of dried flower heads.

USES

Ornamental uses of calendula include cut flowers and as border annuals. Culinary uses include the use of petals, stems, and leaves. Petals can add color to dessert and salads, and have a slightly salty taste. Calendula is often used as a saffron substitute, but contributes the color more than the flavor. The flower head is bitter and resinous and used more for medicinal purposes. It is reported to be antiseptic, antifungal, antiinflammatory, and can help aid digestion and skin aliments. This plant is non-toxic and is safe for any use.

ADDITIONAL RESOURCES

Mindy Grace. *Calendula*. Keats Publishing, 1998.

Lesly Bremness. *Smithosonian Handbooks: Herbs*.
Dorling Kindersly Inc., 2002.

Authors: Liz Braithwaite, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Cantaloupes

by Dan Drost & Rick Hefelbower

SUMMARY

Cantaloupes prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant 4-6 seeds, 1-2 inches deep, in mounds 4 feet apart when soils are 65°F. Thin the mounds after emergence to 2 plants. Transplant cantaloupe 2 feet apart through black plastic for early maturity. Use row covers to protect the plants when planting before the frost-free period. After the vines develop runners, side dress with additional nitrogen fertilizer. Irrigation should be deep and infrequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75°F. Control insect and diseases throughout the year. Harvest cantaloupes when the fruits separate from the vine easily and the background color is creamy yellow.

RECOMMENDED VARIETIES

Ambrosia, Classic Hybrid, Hales Best, Mission, Rocky Sweet, and Summit Hybrid are excellent cantaloupe varieties.

HOW TO GROW

Soils: Cantaloupes prefer organic, rich, well-drained, sandy soils for best growth. Most soils will grow cantaloupe provided they are well drained.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter. Apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting.

Plants: Cantaloupe can be grown from seed or transplants. Seed should be planted 1-2 inches deep. Transplants should have 2-3 mature leaves and a well developed root system. Transplants mature about 2 weeks before seeded melons and should be used in short growing areas of Utah.

Planting and Spacing: Cantaloupe should be planted when soils are 65°F or after all frost danger has past. Plant 4-6 seeds in mounds 4 feet apart. After they have two leaves, thin to two plants per mound. Transplants should be planted 2 feet apart in row, with rows 4-6 feet apart. Avoid damaging the roots when planting, which slows establishment and growth.

Mulches: Black plastic mulch warms the soil, conserves water and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. Lay the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out about 2 week before the last frost date. Do not apply organic mulches until soils are warmer than 75°F. Grass clippings, straw, newspapers, etc., also conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels and fabric covers protect seedlings and transplants from cool air temperatures. Row covers enhance growth and early maturity. Covers need to be removed when plants start to flower or when temperatures exceed 90°F.

Water: Water deeply and infrequently, 1-2 inches per week. Use drip irrigation if possible. Mulch around the plant will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. Reduce watering amount as the fruits ripen to improve flavor.

Fertilization: After the vines develop runners, side dress with a nitrogen fertilizer (21-0-0) using 1-2 tablespoons per plant or mound. Incorporate the fertilizer at least 6 inches away from the plants.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Vigorous vine growth will also smother weeds.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet, or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Cucumber Beetles	Adults have stripes or spots and feed on leaves and vines which reduces vigor. They transmit bacterial disease. Larvae bore into roots and stems causing plants to wilt and die.	Application of chemicals at first appearance is needed to control the pest.
Disease	**Symptom**	**Control**
Powdery Mildew	White fungal patches start on older leaves. The disease eventually spreads to all plant parts. The foliage dies, exposing fruits to the sun, which causes premature ripening.	Plant resistant varieties.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on stems. Diseases are caused by different pathogens.	Identify causal disease. Treat disease as recommended once identified.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. An aphid transmitted disease.	Control aphids. Destroy severely infected plants.

HARVEST AND STORAGE

Cantaloupe requires 35-45 days to mature from flowering, depending on the temperature. Use the following guide to determine fruit maturity. The netting gets coarse and rough, the stem breaks (slips) away from the vine easily, and the background color of the fruit turns from green to yellow (see photo). Pick melons as they ripen. Cantaloupe will store for 1-2 weeks if held at 45-50°F.

Productivity: Plant 3-4 cantaloupe per person for fresh use and an additional 3-4 plants for juicing or freezing. Expect 100 fruits per 100 feet of row.

Nutrition: Cantaloupes are mostly water. A quarter of a melon has about 50 calories, is low in fat and is an excellent source of vitamin A and vitamin C.

FREQUENTLY ASKED QUESTIONS

Why do the first blossoms drop off my muskmelon plants? The first flowers to appear on the vines are male. The female flowers, which open later, have a swelling at the base that forms the fruit. After bees pollinate these female flowers, the fruit develops.

What causes poor fruit set and low yields? The failure for female flowers to set and develop melons is due to a lack of proper pollination by bees, very hot weather or water stress.

How can I grow muskmelons in a small garden? Cantaloupe plants can be trained to a fence or trellis or grown in a large pot. After the fruits begin to enlarge they will need support or the fruit weight may damage the vines.

Do muskmelons cross-pollinate with other vine crops? No. Cantaloupes do not cross-pollinate with cucumbers, watermelons, squash or pumpkins. Different varieties of cantaloupe do cross-pollinate, but the effect of this cross-pollination is not evident unless the seeds are saved and planted the following year.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Rick Hefelbower, USU Extenion Washington County Horticulture Agent

Carrots

by Dan Drost & Wade Bitner

SUMMARY

Carrots are cool season vegetables that prefer sunny locations and fertile, deep, well-drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-½ inch deep. Thin seedling carrots to 3 inches apart in the row with rows 12-18 inches apart. Plant 2-3 weeks before the last frost. Carrots taste best when plants grow rapidly and mature before the heat of summer. Avoid water or fertilizer stress during growth. Irrigation should be frequent and uniform to ensure good growth. Control insect and diseases throughout the year. Harvest carrots when the leaves reach full size.

CARROT VARIETIES

There are many good carrot varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Carrots come in a variety of root types and colors. Suitable varieties include Danvers, Chantenay, Scarlet Nantes, Imperator, Thumbelina, Yellowstone, and Nutrired.

HOW TO GROW

Soils: Carrots prefer fertile, well-drained, deep, sandy soils rich in organic matter for best growth. Most light soils in Utah are well suited for carrot production. Heavy soils need to be amended with plenty of compost and should be double dug to allow good root development.

Soil Preparation: Before planting, incorporate up to 2-4 inches of well composted organic matter and apply 2-4 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6-8 inches of soil.

Plants: Carrots are always grown from seed. Carrots can be sown after soils reach 40°F. Seeds germinate best at 55-65°F and require 14-21 days to emerge. Temperatures above 80°F reduce seed germination. Carrots grow best when temperatures do not exceed 75°F. Temperatures down to 32°F do not seriously damage plants. High summer temperatures reduce growth, decrease quality, and cause bitter or off-flavors to develop.

Planting and Spacing: Seeds should be planted ¼-½ inch deep and thinned when plants have 3-4 true leaves. Crusting soils will limit seedling emergence and affect plant stands. Plant seeds on soil surface, then cover seed with compost or fine sand to help with stand establishment. Maintain a uniform and moist soil surface to ensure good plant stands. Seeded carrots should be spaced 2-3 inches between plants in the row with rows 12-18 inches apart. Dense plantings will reduce weed pressure. Planting radishes with carrots helps minimize the crusting problem and identifies where the planted rows are. Some gardeners sow seeds in wide beds rather than rows. For season long production, plant carrots every 4 weeks through mid-summer.

Water: Water carrots regularly. Water requirements depend on soil type. Use drip irrigation if possible. Avoid over-watering as hairy roots will form and forking will occur. Mulching around the plants helps to conserve soil moisture. Moisture fluctuations can also cause root disorders, slow leaf development, and contribute to bitterness. Wet and dry periods favor root cracking.

Fertilization: Apply ¼ cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 6 weeks after emergence to encourage rapid plant growth and root enlargement. Place the fertilizer to the side of the plants and irrigate it into the soil.

PROBLEMS

Weeds: Carrots do not compete well with weeds. Weed control is particularly important during germination and establishment. Avoid deep cultivation near the plants as root pruning and damage will affect growth and yield.

Insects and Disease: Most carrots are fast growing and have few production problems. Rotating planting locations in the garden each year helps control many diseases.

Insect	Identification	Control
Carrot Fly	Small white maggots that feed on and burrow into the developing root.	Use soil applied chemicals at planting or cover young emerging seedlings with fabric row covers to exclude egg-laying adults.
Disease	**Symptom**	**Control**
Leaf Blights	Fungal diseases that cause spotting on infected leaves.	Occur when foliage remains wet for long periods.
Root Rots and Spots	Fungal diseases that cause decay and rotting of the root. Leads to forking and off-shaped roots.	Crop rotation. Soil solarization.
Yellows	Multiple tops per plant, yellow discoloration of leaves, and numerous hairy roots.	Carried by leafhoppers. Cover plants with fabric mulch. No known control.

HARVEST AND STORAGE

Carrots can be harvested when the roots begin to size. Generally roots are mature in 70-100 days from seeding. Use a digging fork to loosen soil and pull up needed plants by the tops and trim off leaves. Wash and store the roots at 32°F and 95% relative humidity for 2-4 weeks. Plants can be left in the garden after light frosts. Many gardeners overwinter carrots in the garden under heavy mulches and harvest them as needed. Carrots can be stored in moist sand in a cool cellar for several months. Do not store carrots with apples or pears as the fruit gasses cause the roots to go bitter.

Productivity: Plant 5-10 feet of row per person for fresh use and an additional 10-15 feet for storage, freezing, or canning. Expect about 50 lbs of roots per 50 linear feet of planted row.

Nutrition: Carrots are low in calories and are an excellent source of vitamin A. One 7 inch long root has only 35 calories, no fat, and supplies 270% of the daily vitamin A and 10% of the vitamin C requirement.

FREQUENTLY ASKED QUESTIONS

Why do carrots flower rather than form a usable root? Carrots require cold weather (chilling) to form flowers. If planted too early, this can occur.

Why do some of my carrots form many roots rather than one long root? Carrots form multiple roots (fork) when damage to the primary root occurs. Forking is associated with rocky, stony, or heavy soils. Carrot fly damage can also cause this problem. Deep digging, the addition of compost, and pest control will help reduce this disorder.

I regularly have very pale yellow colored roots. Why does this happen? Hot weather and hot soil temperatures are responsible for poor color formation in the roots. When temperatures go above 85°F, keep the plants well watered and mulch around the roots to cool the soil.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Wade Bitner, Horticulture Student

Cauliflower

by Dan Drost & Michael Johnson

SUMMARY

Cauliflower is a cool season vegetable that prefers a sunny location and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep, 2-3 weeks before the last frost. Thin seedlings or transplant cauliflower 12-18 inches apart in the row with rows 2-3 feet apart. Avoid growing during the heat of summer, as yield and quality are reduced. Irrigation should be deep and infrequent. Use plastic or organic mulches to conserve water and reduce weeding. Control insects and diseases throughout the year. Tie the leaves over the head to avoid developing off colors. Harvest cauliflower when the heads are white, large and compact.

RECOMMENDED VARIETIES

There are many good cauliflower varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Early Snowball (65 days), Snow Crown (65 days), White Contessa (heat tolerant, 65 days), Self Blanche (60 days), and Ravelle (70 days) have excellent production and eating quality.

HOW TO GROW

Soils: Cauliflower prefers fertile, well drained soil rich in organic matter for best growth. Most soils in Utah are suitable for cauliflower production.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Cauliflower can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants are used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Avoid shocking the plant when transplanting or premature heading (buttoning) may occur. Buttoning often occurs in plants exposed to dry soils, low temperatures, low nitrogen, or other shocks at planting. Larger, more mature transplants are also more prone to form small heads (buttons) prematurely.

Planting and Spacing: Seeded or transplanted cauliflower should be spaced 12-18 inches between plants in the row with rows 2-3 feet apart. Cauliflower grows best when temperatures do not exceed 75°F. Low (32°F) or high (greater than 80°F) temperatures decrease plant growth, lower yields and decrease head quality. Cauliflower grown for transplants should be sown 5-6 weeks before the expected planting date in the garden. Transplants may be planted 1-2 weeks before the last frost free date for the growing area. Seeded cauliflower may be planted at the same time. For fall maturing cauliflower, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 1-2 weeks after the first fall frost.

Water: Water cauliflower deeply and infrequently while trying to maintain even soil moisture. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Mulch around the plant also helps conserve soil moisture and reduce weed growth.

Fertilization: Apply 1/2 cup per 10 feet of row of a nitrogen based fertilizer (21-0-0) 4 weeks after transplanting or thinning. This encourages vigorous leaf growth which is necessary for high yields. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weed growth and allow earlier planting and maturity, especially with transplants. Hot caps and fabric covers are used to protect seedlings and transplants from frosts and insect pests. Apply organic mulches when temperatures increase. These will cool the soil and reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small, and be careful not to damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become yellow, crinkled, and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms and loopers are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in cauliflower heads.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

Disease	Symptom	Control
Alternaria Leaf Spot	Damping off of seedlings. Leaf spots on leaves or heads are more common symptom. Spots form concentric circles and have a black sooty color.	Avoid overhead irrigation. Practice good sanitation. Rotate crops. Apply appropriate fungicide as a last resort.

Deficiency	Symptom	Control
Boron	Nutrient deficiency which causes brown spotting on the head and hollow discolored stem below the head.	Avoid excess fertilizer. May occur in high pH soils or where plants have been water stressed.
Molybdenum	Nutrient deficiency which causes stunting of the plant and narrow, incompletely developed leaves to form.	Use a complete fertilizer when growing transplants. Apply trace element mix to plants.

HARVEST AND STORAGE

As the head enlarges, it will discolor and develop bitter flavors if exposed to the sun. Blanch the head by tying the leaves together with strong twine or rubber bands when the heads are the size of silver dollars. This keeps the sun off the head and helps whiten them. Harvest the heads when they are fully developed (6-12 inches in diameter), compact and blanched white. Cauliflower can be stored for 3 weeks at 32°F.

Productivity: Plant 3-5 cauliflower plants per person for fresh use and an additional 5-8 plants for storage, canning, or freezing. Expect 100 lbs per 100 feet of row.

Nutrition: Cauliflower is low in fat and calories, high in vitamin C, and is a good source of fiber, calcium, and iron.

FREQUENTLY ASKED QUESTIONS

Some years many of my cauliflower plants only produce very small heads and they do this soon after planting. What's wrong? Buttoning is the development of pre-mature flower heads in broccoli and cauliflower. Plants that button have been exposed to cold weather, or were stressed for water or nutrients shortly after planting.

Why do the cauliflower heads open up during the summer? Cauliflower is a cool season vegetable. During hot weather, plants may not get enough water which leads to poorer quality heads that are more open. Keep plants well watered during the heading period. Plants that are stressed often flower prematurely as well.

I often get yellow heads forming and they taste funny. What's wrong? Cauliflower heads need to be protected from the sun to maintain their white color and sweet flavor. Tying the leaves over the head helps. Hot weather conditions also affect head flavor. Keep the soil moist during heading.

Why do leaves grow up through the cauliflower head? Water stress and high temperatures can cause leaf growth in the heads. Keep plants well watered and fed to avoid this disorder.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

Notes

Celery

by Brandon West & Dan Drost

SUMMARY

Celery grows to a height of 18 to 24 inches and is composed of leaf topped stalks arranged in a cone that are joined at a common base. The stalks have a crunchy texture and a delicate, but mildly salty taste. It is a biennial vegetable that belongs to the Umbelliferae
family whose other members include carrots, fennel, parsley and dill. While many people associate celery with its prized stalks, the leaves and roots can also be used as a food or seasoning as well as a natural medicine.

RECOMMENDED VARIETIES

Utah and Pascal are two varieties that remain green when ready for eating and are considered to be the finest quality.

HOW TO GROW

Soils: Celery prefers fertile, well drained, organic sandy soils with lots of organic matter for best growth. Most Utah soils will grow celery with proper site preparation.

Soil Preparation: Celery has a small root system and is a poor nutrient forager, so there needs to be a good supply of nutrients in the soil. Before planting, incorporate 2-4 inches of well-rotted manure, organic matter or compost, and a complete fertilizer (16-16-8) at a rate of 2 lbs per 100 square feet. Work the compost and fertilizer into the soil to a depth of 6-8 inches, then smooth the surface for planting.

Plants: Celery is generally transplanted. Transplants should have 3-4 mature leaves and a well established root system, before they are planted in the garden. In areas with very long growing seasons, seed may be planted directly in the garden and later transplanted at the appropriate spacing.

Planting and Spacing: Celery is started from seed planted around February 1st and then transplant to the garden in late April or early May depending on your area. Space the rows 2 feet apart and the plants 12 inches apart in the row. A tight planting helps force tall growth and long petioles.

Mulches: Black plastic mulch warms the soil, conserves soil water and helps control weeds. Plastic mulches allow earlier planting which is necessary for a crop such as celery. You can also mulch with compost to control weeds and help retain moisture.

Row Covers: Hotcaps, plastic tunnels and fabric covers will protect young transplants from frost and cooler temperatures. Row covers also stimulate early growth and bigger plants. Celery is very susceptible to early and late season frosts so some protection is advisable.

Water: Good watering is essential to successful celery production. Celery needs at least 1 to 2 inches of water from rainfall or irrigation each week during the growing season. Always soak the soil thoroughly when watering because celery has a small, shallow root system. Any water stress during the year causes the stalks to become stringy and gives them a strong flavor. Celery is crisper and more tender if watered regularly especially prior to harvesting. One of the most efficient ways to water celery is to use drip irrigation.

Fertilization: In addition to the fertilizer used at planting, celery responds to additional fertilizer to produce optimum yields. Apply a side dressing of a complete fertilizer at a rate of 2 pounds per 100 square feet 6 weeks after transplanting and with nitrogen at ½ lb (46-0-0) per 100 square feet 4 weeks later.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small, and be careful not to damage roots when cultivating.

Insects and Disease:

Insects	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Diseases		
Powdery Mildew	White fungal patches start on older leaves which will eventually die. The disease eventually spreads to all plant parts.	Plant resistant varieties. Use appropriate fungicides for control and water so the leaves have time to dry during the day.
Black Heart	Discoloration of the young leaves in the center of the plant. Affected tissue turns black and dies. Injury occurs gradually and is not visible until later in the season. This nutrient imbalance is due to a localize deficiency of calcium which is essential for cell development.	Control black heart applying calcium rich fertilizers to the soil. Use bone meal, blood meal, or calcium sprays. Avoiding water stress is a good way to minimize this problem.

HARVEST AND STORAGE

Harvest celery stalks by removal of the outer petioles when they are a foot or more in length. Whole plants are ready to use when they are 3 inches or more in diameter. The inner stalks are the most tender and taste the best uncooked. Celery harvested in hot, dry weather may be tough, stringy, and bitter. Store harvested celery in the refrigerator for up to 2 weeks.

Productivity: Plant 5-10 celery plants per person for fresh and storage purposes.

Nutrition: Celery has no calories and is a source of important vitamins and minerals. Celery has been reported to reduce blood pressure, support the immune system, lower cholesterol, and help prevent cancer.

FREQUENTLY ASKED QUESTIONS

My celery has a black spot in the center of the plant, what is it? This is called blackheart. Refer to the disease section above for treatment.

What temperatures are best for celery? The minimum temperature for celery is 36°F, but if exposed to cool temperatures for several weeks the plants will flower. The ideal temperature is 55-65°F. When temperatures go above 85°F, water the plants more frequently to minimize stress and fiber development.

Why doesn't my celery seed germinate uniformly? Celery germinates better if you soak the seeds in water and change the water every day. The seed contains natural germination inhibitors that soaking helps leach away.

Authors: Brandon West, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Chicory

by Rachael Gibson & Dan Drost

SUMMARY

Chicory is a cool-season vegetable that prefers a sunny location and fertile, well-drained soils. Two garden types of chicory include witloof (grown for its root), and radicchio (grown for its head of leaves). Plant chicory seeds ¼ inch deep in early spring. Thin seedlings or transplant witloof 9 inches apart in the row with rows 20 inches apart. Plant radicchio 8 inches apart in the row with rows spaced 12 inches apart. Avoid excessive nitrogen fertilization to retain tight heads and healthy root formation. Irrigation should be uniform and frequent to ensure healthy growth. Control insects and diseases throughout the year. Harvest witloof 3-5 weeks after forcing, and radicchio after heads reach full size.

RECOMMENDED VARIETIES

Chicory comes in many types; two of the garden types are witloof and radicchio. Witloof is grown for its root, which is forced in the winter to produce a tight, white set of leaves. Radicchio is grown for its head of leaves, with some producing loose leaves and others producing a tight head. Planting a range of different types makes salads and meals more interesting. There are many good varieties for sale through seed catalogs. Suitable varieties of witloof include Daliva, Flash, and Zoom. Suitable varieties of radicchio include Rossa di Treviso, Rossa di Verona, Giulio, and Firebird. Check with local garden centers or seed catalogs for specific varieties.

HOW TO GROW

Soils: Chicory prefers fertile, well-drained soils rich in organic matter for best growth. Most soils in Utah are suitable for chicory production provided they are well drained and fertile.

Soil Preparation: Before planting, incorporate 2-4 inches of well-composted organic matter or apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Chicory can be grown from seeds or transplants. Seeds germinate best at 65-70ºF, while temperatures above 80ºF reduce germination. Seeds of chicory types should be planted ¼ inch deep and thinned when plants have 3-4 true leaves. Plants removed at thinning can be used to transplant adjacent areas. Transplanting is used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing:

Witloof: Seeded or transplanted witloof should be spaced 9 inches between plants in the row with rows 20 inches apart. Dense planting will reduce weed pressure. Seeded witloof may be planted 3-4 weeks before the last frost-free date for the growing area. Transplants should be planted shortly after the last frost-free date for the growing area. Witloof grows best when temperatures do not exceed 75°F. High summer temperatures reduce growth, decrease quality, and may cause bitter or off-flavors to develop.

Radicchio: Seeded or transplanted radicchio should be spaced 8 inches between plants in the row with rows 12 inches apart. Sow several seeds for each plant desired, as not every seed will germinate. Dense planting will reduce weed pressure. Seeded radicchio may be planted 3-4 weeks before the last frost-free date for the growing area. Transplants should be planted near the last frost-free date for the growing area. Radicchio grows best when temperatures do not exceed 75ºF. Temperatures down to 20ºF do not seriously damage young plants. High summer temperatures reduce growth, decrease quality and cause the plant to go to seed. For

fall planted radicchio, select early maturing cultivars and plant 75-85 days before the anticipated maturity date. The maturity date should be about 3-4 weeks after the first fall frost.

Mulches and Row Covers: Fabric covers are used to protect seedlings and transplants from frost. Apply organic mulches such as grass clippings, straw and newspapers to help cool the soil during high temperatures, reduce water stress, and control weeds.

Water: Water chicory regularly to maintain a uniformly moist soil, applying 1-2 inches per week. Water requirements depend on soil type and temperatures. Using organic mulch around the plant also helps conserve soil moisture and reduce weed growth. Drought stress during growth will cause slow leaf development and bitter flavors to develop.

Fertilization: Apply 1/4 cup of a nitrogen-based fertilizer (21-0-0) per 10 feet of row 4 weeks after transplanting or thinning. Place the fertilizer to the side of the plants and irrigate it into the soil. Avoid adding additional nitrogen after heads begin to form.

PROBLEMS

Weeds: Chicory does not compete well with weeds, so weed control is particularly important during establishment. Closely spaced plants will help control weeds. Cultivate shallowly to avoid root damage and ensure uninterrupted plant growth.

Insects and Disease: Rotating locations from year to year helps control most diseases in radicchio.

Pests	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Worms and Loopers	Light to dark green insects that chew holes and hide in leaves. Adult loopers are gray or brown moths while cabbage worms are white butterflies.	Control worms and loopers with appropriate insecticides or biological measures.
Diseases	**Symptoms**	**Control**
Fungal Root Rots	Wilting and reduced plant vigor which occurs during forcing.	Cultural practices that facilitate air movement will reduce disease severity.
Viruses	Stunting of growth. Interveinal yellowing and brittleness in older and lower leaves.	Control aphids which transmit the disease.

HARVEST AND STORAGE

Witloof: Witloof used for greens should be harvested when leaves are young and tender. Witloof roots used for forcing chicons should be harvested just before the first frost date. Cut leaves 1 inch from the crown, lift the root from the soil, and trim roots to uniform size. Trimmed roots should be stored for 3 to 7 weeks at temperatures of 32-34°F before forcing. Forced witloof heads should be harvested 3-5 weeks after roots have been transferred to pots. Heads are snapped from the root and the loose outer leaves removed. Chicons can be stored for 2-4 weeks at 32°F and 95% relative humidity.

Radicchio: Radicchio should be harvested when the leaves or heads reach full size. Delaying harvest causes radicchio to develop bitter flavors and toughness. Cut the stem just below the leaves to keep the head together. Radicchio can be stored for 2-3 weeks at 32°F and 95% relative humidity. Avoid storing radicchio with fruits such as apples and pears as bitter flavors will develop.

FORCING

Witloof: Witloof used for greens should be harvested when leaves are young and tender. Witloof roots used for forcing chicons should be harvested just before the first frost date. Cut leaves 1 inch from the crown, lift the root from the soil, and trim roots to uniform size. Trimmed roots should be stored for 3 to 7 weeks at temperatures of 32-34°F before forcing. Forced witloof heads should be harvested 3-5 weeks after roots have been transferred to pots. Heads are snapped from the root and the loose outer leaves removed. Chicons can be stored for 2-4 weeks at 32°F and 95% relative humidity.

Radicchio: Some varieties of radicchio require cool temperatures to induce head formation. To force radicchio, leave plants in the ground past the first frost date to expose the plant to temperatures that favor heading. Remove dead outer leaves and harvest the head.

PRODUCTIVITY

Witloof: For every 10 pounds of root, expect 1½ - 2 pounds of chicons. One Witloof root produces one chicon.

Radicchio: Expect 100 pounds per 100 foot row.

NUTRITION

Witloof: Witloof has no fat, no cholesterol and is an excellent source of potassium, vitamin C, vitamin A and folate.

Radicchio: Radicchio is low in calories, has no fat and no cholesterol. It is a good source of vitamin C, vitamin E, folate and anthocyanins.

FREQUENTLY ASKED QUESTIONS

Why don't my radicchio plants form heads? There are many types of radicchio that require cool temperatures to force a head to grow. If the temperatures are not cold enough where you are growing your radicchio, you may cut out the top leaves, lift the plants out of the soil, place them in a sack and store them in a cool place until the heads form.

Can I force Witloof roots more than once? Yes, witloof roots can be forced more than once, but the second chicon produced will be smaller than the first. The roots will also require a resting period of at least one to two months between the first and second forcing.

Authors: Rachael Gibson, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Notes

Chives

by Dan Drost

SUMMARY

Chives are cool-season, cold-tolerant perennials that prefer full sun and fertile, well-drained soils. Seeds should be planted ¼ inch deep and final plant spacing should be 4-6 inches apart in all directions. Mulches may be used to conserve water and control weeds. Control weeds, insects and diseases throughout the year. Harvest chives by cutting the leaves back to within 1-2 inches of the soil. Use chives fresh or dry them for storage.

RECOMMENDED VARIETIES

Check with your local garden center for seed varieties available. Talk with a friend or local gardener to see if you can get divisions from their established plants.

HOW TO GROW

Soils: Chives will grow in all soil types provided they are rich, well drained, moist, and fertile. Soil Preparation: Before planting, incorporate 4-6 inches of well-composted organic matter. Apply 2-3 tablespoons of all-purpose fertilizer (16-16-8) per square foot of planting area. Work compost and fertilizer into the soil to a depth of 6-8 inches.

Plants: Chives can be grown from seeds, transplants, or divisions. Seed chives as early as possible in the spring. Seeds should be planted ¼ inch deep and thinned to 4-6 inches in all directions after emergence. Transplants need 6-8 weeks of growth before planting in the garden. Transplants or divisions can be planted in late April or early May. In addition to regular chives, there are garlic chives that have a mild garlicky flavor. Regular or garlic chive seeds or transplants are available at most garden centers.

Planting and Spacing: Chives, regardless of planting method (seeds or transplants), should be spaced 4-6 inches apart. Dividing existing plants into smaller units easily propagates chives. Chive beds should be renovated (divided) every 2-3 years. Chives may be grown as an indoor plant. Plant in pots filled with potting soil. Water and feed regularly to maintain growth. Make sure the plants receive plenty of light especially during the winter months.

Water: Chives require regular watering throughout growth for best production. Soils need to be maintained near field capacity. Moisten the soil thoroughly when watering. Chives will survive periods of drought stress but growth and productivity will decrease.

Fertilization: Chives need little additional fertilizer for optimum yields. Side dress in May and July with 1 teaspoon of 21-0-0 per square foot to ensure good growth and high yields.

Mulches and Row Covers: Organic mulches help conserve water, supply extra nutrients, and reduce weeding.

PROBLEMS

Weeds: Control weeds through regular cultivation but avoid root damage that slows plant growth by damaging shallow roots. Mulches may also be used to control weeds. Weed control is particularly important during the first 2 months of growth when plants are growing slowly and compete poorly.

Insects and Disease:

Insect	Identification	Control
Thrips	Tiny, slender insects that feed on leaves. Leaves turn silver or gray, may twist and die. Thrips hide near where the leaf and bulb meet.	Spray with registered chemicals
Root Maggot	White worm that feeds on seedlings, roots or bulbs.	Apply diazinon granules at planting.
Disease	**Identification**	**Control**
Pink Root	Fungal disease that changes roots to a pink color. Roots eventually die and yields severely reduced.	Use 5-year crop rotation. Solarize the soil where chives to be planted.
Downey Mildew	Fungal disease that turns leaves a light tan to brown color. Furry growth, grayish violet in color, may be visible on the surface of infected leaves during moist periods.	Cultural practices that facilitate air movement and drying of leaves will reduce disease severity. Registered fungicides may be used.

HARVEST AND STORAGE

Chives may be harvested as early as 60 days after seeding or 30 days after transplanting. Harvest the leaves with scissors or a knife, cutting the plants back to within 1-2 inches of the soil. Harvest 3-4 times during the first year. In subsequent years, cut plants back monthly. Harvest potted chives in a similar manner to garden chives. Chives generally flower in May and June. The small purple flowers and stalks are unpalatable and should be discarded. Chives may be used fresh or dried for later use. Store dried chives in a resealable container in a cool, dry place.

Productivity: One chive seed will produce a clump of chives in a matter of a couple months. The clump can then be harvested as outlined above. 20-25 plants will provide enough chives for fresh and dried use.

Nutrition: A 1 tablespoon serving of raw chives is low in saturated fat, and very low in cholesterol and sodium. It is also a good source of thiamin, phosphorus and zinc, and a very good source of dietary fiber, vitamin A, vitamin C, riboflavin, vitamin B6, folate, calcium, iron, magnesium, potassium and copper.

FREQUENTLY ASKED QUESTIONS

How big do chives get? Over time, chives will form a clump that is 8-10 inches tall and may spread nearly 1 foot across. You will find that the plants are most productive if they are divided regularly.

When is the best time to divide my chives? When dividing plants, do it in the spring. Let the plants reestablish themselves for several weeks before beginning to harvest them again. If you want to grow some indoors, dig and divide in the autumn and replant them outdoors the following spring.

Author: Dan Drost, USU Extension Vegetable Specialist

Chokecherry

by Sky Wiser, Tiffany Maughan and Brent Black

SUMMARY

Chokecherry (Prunus virginiana), also known as bitter-berry or wild cherry, is usually grown as a large shrub but can also be trained to be a small tree. It is native to North America and can be found growing wild in most counties of Utah. Fragrant cream-colored flowers bloom in the spring, and develop into small dark red to black fruit with relatively large pits. Chokecherries are not usually consumed raw; rather they are processed to make preserves, juices, wines, syrups, and jellies. Recently, chokecherry has gained popularity as a health food due to its high antioxidant levels. This tough plant can grow in most soil types and with minimal water. It is also very cold tolerant, making it an excellent choice for home fruit production in harsh climates.

RECOMMENDED VARIETIES

Although wild chokecherries are quite astringent, there are some cultivars that produce more palatable fruit and will do well in a home garden. 'Boughen's Chokeless' (sometimes sold as 'Boughen's Sweet') produces large, non-astringent fruit that have even been described as sweet. 'Maskinonge' is another non-astringent cultivar and produces high quality fruit. In addition, this bush does not heavily sucker. Both 'Boughen's Chokeless' and 'Maskinonge' are typically grown as large shrubs and will grow to be about 6 to 8 feet wide and 8 to 12 feet tall. 'Canada Red' and 'Shubert' are widely popular purple-leafed ornamental cultivars, primarily grown as a small tree instead of a shrub. Both produce large black fruit.

HOW TO GROW

Soils: Chokecherries occur naturally in a wide variety of soil types and pH levels. They grow well in soil ranging in pH from 5 to 8. This wide adaptability makes chokecherry an excellent choice for sites with poor soil where a fruit crop is still desired. However, well-drained soils with lots of organic matter, and sufficient irrigation water will help ensure larger, more abundant fruit.

Soil Preparation: Soil testing can help determine the appropriate amendments to add to the site before planting. Apply any deficient nutrients as indicated from soil tests, to the planting area and till into the soil.

Plants: Chokecherries are a woody, deciduous perennial. They grow in zones 2 to 10 and are found in all but 6 of the 50 states. They are grown either as a large erect shrub or a small tree. Size varies by cultivar, but most plants will not reach over 30 feet high and 10 to 20 feet wide when mature.

Chokecherry leaves are oval to somewhat oblong. They are glossy dark green on the top and lighter green on the bottom in early spring. Leaves of 'Canada Red' and 'Schubert' start out green in the spring and turn reddish purple as they mature. In general they do not have noteworthy fall color. The leaves have an alternate arrangement along slender reddish-brown stems and the stems have horizontal rows of raised air pores called lenticels. They have a deep rhizomatous root system that extends beyond the drip line of the tree. Due to this, chokecherry plants are prone to suckers, particularly if the roots are damaged. It is best to plant them in an area where suckering can be tolerated.

Depending on location, flowers open anytime from late April to July. The inflorescences are very fragrant and form in long, dense clusters or racemes of creamy-white flowers. These long clusters grow on the last year's leafy twig growth and appear before the leaves are fully developed. Chokecherry fruits are drupes, having a fleshy outside with a stone center that contains the seed. It takes 10 weeks for fruit to fully mature, which depending on location and elevation, is usually from July to September. Most plants will not begin fruiting heavily until their 3rd or 4th year.

Planting and Spacing: Plant in the spring or fall to allow time for root establishment before summer heat. Spacing will depend on cultivar, but as a general guideline, chokecherry plants should be spaced 5 to 8 feet apart. A gentle east or northeast slope helps reduce frost risk as slopes allow for cold air drainage. If planting multiple plants, run aisles north and south to help equalize light distribution and reduce wind. Before planting, prepare a hole twice the width and the same depth as the container or roughly the same depth and somewhat wider than the roots of the bare-root plant. Immediately after planting, water heavily to settle the soil around the roots and to remove air pockets. Applying mulch around the plant will help keep the soil moist between watering and keep weeds down.

Irrigation: During the first season, irrigate at an interval that will keep the soil moist, but not wet. Depending on rainfall and temperature, irrigate about two times per week to ensure establishment. For the next few years, maintain a bi-weekly watering program that will apply about 30 inches of water over the season. This can be reduced if there is significant rainfall accumulation. Although chokecherry plants are extremely drought tolerant, irrigation will improve yield and fruit quality. To keep the canopy dry and prevent disease occurrence, water at the base of the shrub. This may be accomplished with a drip system or deep watering with a hose.

Fertilization: Currently there are no specific recommendations of fertilizer application for chokecherry production. However, having the soil tested to determine current nutrient levels is helpful for making fertilization decisions. Applying a general, balanced fertilizer each spring (such as 4 ounces of 16-16-16 per plant) should meet most chokecherry nutrient needs. Adjustments in fertilizer application should be determined by plant growth, harvest and leaf color.

Pruning: Chokecherry can be trained as either a tree or a shrub. Regular pruning prevents chokecherry plants from becoming brushy and unproductive. Pruning should be carried out in late winter or early spring, prior to bud break. When training as a tree, the center of the plant should be thinned to keep it open for air circulation and light penetration, similar to other stone fruits such as peach or cherry. When trained as a shrub, renewal pruning, removing about one third of the old growth, will ensure adequate 1-year old wood for continuous production. In either case, low spreading branches should also be removed. Plants should be maintained at about 6 to 10 feet in height to facilitate easy harvest. Since fruit forms on young wood, remove older, weaker wood annually.

PROBLEMS

Pests and Diseases:

Pest /Disease	Identification	Control
Prairie Tent Caterpillar, Eastern Tent Caterpillar	Mass of webbing on branches. ½ inch light green caterpillars. Defoliation / deformation.	Destroy tents on cool days with larva inside. Foliar insecticides or BT application.
Aphids	Black or green soft bodied insects feeding on underside of leaf.	Insecticidal soap, horticultural oil, malathion.
Chokecherry Gall Midge	Bright orange larvae feed in infested fruit. Fruit will enlarge and seed aborts.	No registered insecticide for this pest. Remove and destroy damaged fruit in early summer.
Black Knot Fungus (Dibotryon morbosum)	Long, black swellings on tips of branches.	Prune out and burn infected branches. Fungicide.
Bacterial Spot (Xanthomonas prunii)	Leaves with red to purple spots that eventually become small holes. Fruit also develop brown spots.	Sanitation, avoid over-fertilizing with nitrogen.
Canker Fungus (Valsa cincta)	Sunken cankers on branches and trunk that lead to girdling.	Remove and burn infected branches. Fungicide, remove plant.

Toxicity: Wildlife also consume the fruit and help spread the seeds. However, the leaves, stems and pits of chokecherry are toxic. Poisoning generally occurs if an animal consumes over 0.25 percent of its bodyweight in less than an hour. Non-lethal exposure usually results in a stomach ache. Wilted or stressed leaves are more dangerous due to higher cyanide levels. The fleshy part of the fruit is not toxic. Separate out the pits during processing to avoid contaminating the fruit flesh with the toxin.

HARVEST AND STORAGE

For best results, harvest chokecherries once fruit are fully ripe. Typically, this is when they have turned dark purple, black or dark red. Fruit can be dried, used in jams, jellies and syrups or to make wine.

FORCING

The chokecherry has a relatively long lifespan of 20 to 40 years. After a plant has established, some varieties can produce up to 30 to 40 pounds of fruit per plant per year.

ADDITIONAL RESOURCES

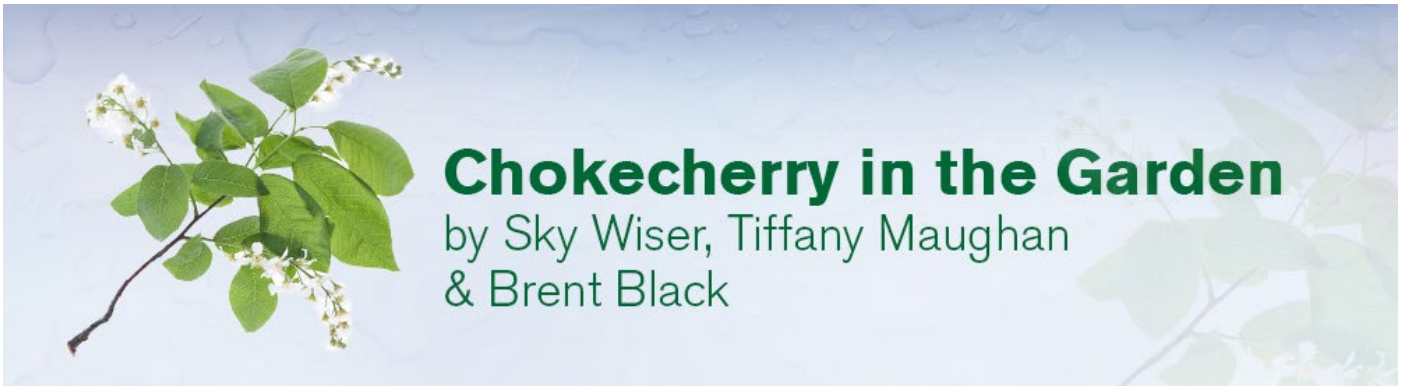
USDA NRCS Plant Fact Sheet. 2009. Black chokecherry Prunus virginiana L. var. melanocarpa (A. Nelson) Sarg. plants.usda. *gov/factsheet/pdf/fs_prvi.pdf*

Bjerke, M.R. 1999.The chokecherry tree. *ndsu.edu/pubweb/chiwonlee/plsc368/student/papers99/mbjerke/index.htm*

Oregon State University. Common chokecherry. *http://oregonstate.edu/dept/ldplants/prvir.htm*

Authors: Sky Wiser, Student, Tiffany Maughan, Research Associate, & Brent Black, USU Extenion Fruit Specialist

Notes



Chokecherry in the Garden

by Sky Wiser, Tiffany Maughan & Brent Black

SUMMARY

Chokecherry (Prunus virginiana), also known as bitter-berry or wild cherry, is usually grown as a large shrub but can also be trained to be a small tree. It is native to North America and can be found growing wild in most counties of Utah. Fragrant cream-colored flowers bloom in the spring, and develop into small dark red to black fruit with relatively large pits. Chokecherries are not usually consumed raw; rather they are processed to make preserves, juices, wines, syrups, and jellies. Recently, chokecherry has gained popularity as a health food due to its high antioxidant levels. This tough plant can grow in most soil types and with minimal water. It is also very cold tolerant, making it an excellent choice for home fruit production in harsh climates.

RECOMMENDED VARIETIES

Although wild chokecherries are quite astringent, there are some cultivars that produce more palatable fruit and will do well in a home garden. 'Boughen's Chokeless' (sometimes sold as 'Boughen's Sweet') produces large, non-astringent fruit that have even been described as sweet. 'Maskinonge' is another non-astringent cultivar and produces high quality fruit. In addition, this bush does not heavily sucker. Both 'Boughen's Chokeless' and 'Maskinonge' are typically grown as large shrubs and will grow to be about 6 to 8 feet wide and 8 to 12 feet tall. 'Canada Red' and 'Shubert' are widely popular purple-leafed ornamental cultivars, primarily grown as a small tree instead of a shrub. Both produce large black fruit.

HOW TO GROW

Soil: Chokecherries occur naturally in a wide variety of soil types and pH levels. They grow well in soil ranging in pH from 5 to 8. This wide adaptability makes chokecherry an excellent choice for sites with poor soil where a fruit crop is still desired. However, well-drained soils with lots of organic matter, and sufficient irrigation water will help ensure larger, more abundant fruit.

Soil Preparation: Soil testing can help determine the appropriate amendments to add to the site before planting. Apply any deficient nutrients as indicated from soil tests, to the planting area and till into the soil.

Plants: Chokecherries are a woody, deciduous perennial. They grow in zones 2 to 10 and are found in all but 6 of the 50 states. They are grown either as a large erect shrub or a small tree. Size varies by cultivar, but most plants will not reach over 30 feet high and 10 to 20 feet wide when mature.

Chokecherry leaves are oval to somewhat oblong. They are glossy dark green on the top and lighter green on the bottom in early spring. Leaves of 'Canada Red' and 'Schubert' start out green in the spring and turn reddish purple as they mature. In general they do not have noteworthy fall color. The leaves have an alternate arrangement along slender reddish-brown stems and the stems have horizontal rows of raised air pores called lenticels. They have a deep rhizomatous root system that extends beyond the drip line of the tree. Due to this, chokecherry plants are prone to suckers, particularly if the roots are damaged. It is best to plant them in an area where suckering can be tolerated.

Depending on location, flowers open anytime from late April to July. The inflorescences are very fragrant and form in long, dense clusters or racemes of creamy-white flowers. These long clusters grow on the last year's leafy twig growth and appear before the leaves are fully developed. Chokecherry fruits are drupes, having a fleshy outside with a stone center that contains the seed. It takes 10 weeks for fruit to fully mature, which depending on location and elevation, is usually from July to September. Most plants will not begin fruiting heavily until their 3rd or 4th year.

Planting and Spacing: Plant in the spring or fall to allow time for root establishment before summer heat. Spacing will depend on cultivar, but as a general guideline, chokecherry plants should be spaced 5 to 8 feet apart. A gentle east or northeast slope helps reduce frost risk as slopes allow for cold air drainage. If planting multiple plants, run aisles north and south to help equalize light distribution and reduce wind. Before planting, prepare a hole twice the width and the same depth as the container or roughly the same depth and somewhat wider than the roots of the bare-root plant. Immediately after planting, water heavily to settle the soil around the roots and to remove air pockets. Applying mulch around the plant will help keep the soil moist between watering and keep weeds down.

Irrigation: During the first season, irrigate at an interval that will keep the soil moist, but not wet. Depending on rainfall and temperature, irrigate about two times per week to ensure establishment. For the next few years, maintain a bi-weekly watering program that will apply about 30 inches of water over the season. This can be reduced if there is significant rainfall accumulation. Although chokecherry plants are extremely drought tolerant, irrigation will improve yield and fruit quality. To keep the canopy dry and prevent disease occurrence, water at the base of the shrub. This may be accomplished with a drip system or deep watering with a hose.

Fertilization: Currently there are no specific recommendations of fertilizer application for chokecherry production. However, having the soil tested to determine current nutrient levels is helpful for making fertilization decisions. Applying a general, balanced fertilizer each spring (such as 4 ounces of 16-16-16 per plant) should meet most chokecherry nutrient needs. Adjustments in fertilizer application should be determined by plant growth, harvest and leaf color.

Pruning: Chokecherry can be trained as either a tree or a shrub. Regular pruning prevents chokecherry plants from becoming brushy and unproductive. Pruning should be carried out in late winter or early spring, prior to bud break. When training as a tree, the center of the plant should be thinned to keep it open for air circulation and light penetration, similar to other stone fruits such as peach or cherry. When trained as a shrub, renewal pruning, removing about one third of the old growth, will ensure adequate 1-year old wood for continuous production. In either case, low spreading branches should also be removed. Plants should be maintained at about 6 to 10 feet in height to facilitate easy harvest. Since fruit forms on young wood, remove older, weaker wood annually.

'Canada Red' chokecherry, trained as a tree (left). Chokecherry trained as a shrub (right).

PROBLEMS

Pests and Diseases:

Pest /Disease	Identification	Control
Prairie Tent Caterpillar, Eastern Tent Caterpillar	Mass of webbing on branches. ½ inch light green caterpillars. Defoliation / deformation.	Destroy tents on cool days with larva inside. Foliar insecticides or BT application.
Aphids	Black or green soft bodied insects feeding on underside of leaf.	Insecticidal soap, horticultural oil, malathion.
Chokecherry Gall Midge	Bright orange larvae feed in infested fruit. Fruit will enlarge and seed aborts.	No registered insecticide for this pest. Remove and destroy damaged fruit in early summer.
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Bacterial Spot (*Xanthomonas prunii)*	Leaves with red to purple spots that eventually become small holes. Fruit also develop brown spots.	Sanitation, avoid over-fertilizing with nitrogen.
Canker Fungus (*Valsa cincta*)	Sunken cankers on branches and trunk that lead to girdling.	Remove and burn infected branches. Fungicide, remove plant.

Toxicity: Wildlife also consume the fruit and help spread the seeds. However, the leaves, stems and pits of chokecherry are toxic. Poisoning generally occurs if an animal consumes over 0.25 percent of its bodyweight in less than an hour. Non-lethal exposure usually results in a stomach ache. Wilted or stressed leaves are more dangerous due to higher cyanide levels. The fleshy part of the fruit is not toxic. Separate out the pits during processing to avoid contaminating the fruit flesh with the toxin.

HARVESTING, STORAGE AND USE

For best results, harvest chokecherries once fruit are fully ripe. Typically, this is when they have turned dark purple, black or dark red. Fruit can be dried, used in jams, jellies and syrups or to make wine.

YIELD POTENTIAL

The chokecherry has a relatively long lifespan of 20 to 40 years. After a plant has established, some varieties can produce up to 30 to 40 pounds of fruit per plant per year.

REFERENCES

USDA NRCS Plant Fact Sheet. 2009. Black chokecherry Prunus virginiana L. var. melanocarpa (A. Nelson) Sarg. <plants.usda.gov/factsheet/pdf/fs_prvi.pdf>

Bjerke, M.R. 1999.The chokecherry tree. <ndsu.edu/pubweb/chiwonlee/plsc368/student/papers99/mbjerke/index.htm>

Oregon State University. Common chokecherry. <http://oregonstate.edu/dept/ldplants/prvir.htm>

Authors: Sky Wiser, Student, Tiffany Maughan, Research Associate & Brent Black, Extension Fruit Specialist

Notes

Cilantro/Coriander

by Cold Miller & Dan Drost

SUMMARY

Cilantro/coriander prefers a sunny well-drained location and cooler weather for optimal leaf growth. Plant seeds directly into soil after danger of frost has passed and mulch around the seedlings as soon as they emerge. Water and fertilize sparingly as cilantro/coriander does not do well in damp or humid conditions. Be careful not to add too much nitrogen when fertilizing. Harvest cilantro leaves when they are about 6 inches long. For coriander seeds, wait until the plant has flowered and the seed heads turn brown. Place the plant in a bag and let them dry until the seeds fall off.

RECOMMENDED VARIETIES

Costa Rica, California Long Standing, Leisure, Lemon, Delfino, Moroccan, and Slow Bolting are excellent varieties. When selecting a variety, keep in mind the end use of the plant. If harvesting for the leaves, choose a cultivar that is slow bolting (Slow Bolting variety and the Leisure). When selecting a cultivar for seed all varieties perform well.

HOW TO GROW

Soils: Cilantro/coriander prefers a light well-drained, moderately fertile loam or sandy soil. Most soils in Utah are well suited for cilantro production.

Soil Preparation: Before planting, incorporate 2-4 inches of well composted organic matter per 25 square feet of garden area. Work this into the top 4-6 inches of soil leaving a loose seedbed to allow the seeds to emerge easily.

Plants: Cilantro/coriander prefers a sunny and dry location. In cooler locations in Utah, plant in the early spring for summer to fall harvest. In warmer areas, plant in the fall and harvest in the spring. Seeds germinate in about 21 days and grow 1-3 feet tall. Cilantro/coriander can also be started indoors. Plant in a peat pots, and minimize root disturbance when transplanting seedlings.

Planting and Spacing: Plant cilantro seeds ½ inch deep and space 2 inches apart if you are planning to use the plant for its leaves. For coriander seed, space the seeds 8-10 inches apart. Rows should be at least 15 inches apart. Successive plantings may be done until late summer if a continued harvest is desired.

Water: Make sure that the young plants don't dry out. Once the plants are established they need little water. Avoid over watering as this plant does not do well in damp or humid conditions.

Fertilization: Fertilize once or twice during the growing season by applying ¼ cup of a nitrogen based fertilizer (21-0-0) per 25 square foot of growing area. Be careful of over fertilization, too much nitrogen can make the plant less flavorful.

PROBLEMS

Weeds: Mulch around the plants as soon as they emerge to prevent weeds. Till shallowly to minimize root damage.

Insects and Disease:

Disease	Symptoms	Control
Aster's Yellow Disease	The disease is caused by leafhoppers; flowers turn yellow, plant grows tall and spindly, plant eventually becomes sterile.	Use appropriate insecticide to control leafhoppers (the carriers of the disease).
Damping Off or Seedling Rot	Death of new seedlings and yellowing of plants.	Crop Rotation
Insects		**Control**
Leafhoppers	Damage done includes piercing plant tissues to feed on sap. May transmit Aster's Yellows.	Appropriate insecticide

HARVEST AND STORAGE

Cilantro: Harvest when leaves are about 4-6 inches tall. Cilantro can be used fresh, or stored either by freezing or drying. When freezing, simply place in a resealable bag and put in the freezer. Dry the cilantro by hanging it upside down in a warm place.

Coriander: For seeds, let the plants grow until the seeds form in late summer or early fall. When plants begin to turn brown, cut off the seed heads, put them in a paper bag and hang this until the plant dries and seeds fall to the bottom of the bag. Store seeds in sealed containers.

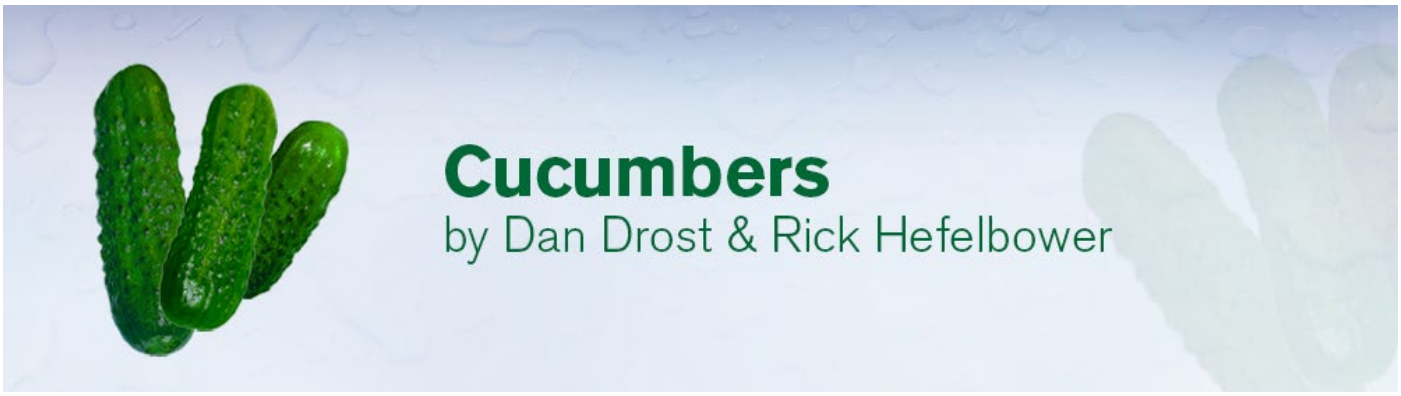
Nutrition: A ¼ cup serving of cilantro leaves provides some fiber, protein, carbohydrates, sodium, vitamin C, and very little fat.

FREQUENTLY ASKED QUESTIONS

What can I do to keep my cilantro/coriander from bolting? Plant early when it is cool. Start seedlings indoors and transplant into the garden when frost has passed. Mulch the soil to keep it cool and make sure the plant is well watered. Grow plants close together.

Is it advisable to plant my cilantro/coriander indoors? Yes, but make sure that the container is deep enough. Be sure to grow it in a place where it will get enough sun. Try to keep the soil temperature below 75°F, especially if grown near a heat source or a particular window that becomes quite warm.

Authors: Colt Miller, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist



Cucumbers

by Dan Drost & Rick Hefelbower

SUMMARY

Cucumbers prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant multiple seeds 1 inch deep, 12-18 inches apart in rows 4 feet apart when soils are 65ºF. Thin after emergence to two plants per location. Transplant cucumber 2 feet apart through black plastic for early maturity. Use row covers to protect the plants when planting before the frost-free period. After the vines develop runners, side dress with additional nitrogen fertilizer. Irrigation should be deep and frequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75ºF. Control insect and diseases throughout the year. Harvest cucumbers when fruits are young and tender.

RECOMMENDED VARIETIES

Marketmore, Spacemaster, Sweet Success, SMR58, Armenian, and Boston Pickling are excellent cucumber varieties. Most varieties will grow in Utah so check for availability with your local garden center or seed catalog.

HOW TO GROW

Soils: Cucumbers prefer organic rich, well-drained, sandy soils for best growth. Most Utah soils will grow cucumbers provided they are well drained.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter. Apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting. Work these into the top 6 inches of soil.

Plants: Cucumbers can be grown from seed or transplants. Seed should be planted 1 inch deep. Transplants should have two or three mature leaves and a well-developed root system before moving into the garden. Seeds germinate in 5-10 days at temperatures between 65-85ºF.

Planting and Spacing: Cucumbers should be planted when soils are 65ºF or after all frost danger has past. Plant 4-6 seeds every 12-18 inches in rows 4 feet apart. After they have two leaves, thin to two plants per location. Transplants should be planted 2 feet apart in row, with rows 4 feet apart. Avoid damaging the roots when planting, which slows establishment and growth.

Mulches: Black plastic mulch warms the soil, conserves water and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. Lay down the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulch and row covers, seeds or plants can be set out about 2 weeks before the last frost date. Do not apply organic mulches until soils are warmer than 75ºF. Grass clippings, straw, newspapers, etc., also conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels and fabric covers protect seedlings and transplants from cool air temperatures. Row covers stimulate growth and earliness. Covers need to be removed when plants start to flower or when temperatures under the covers exceed 90ºF. Hot temperatures will reduce fruit set and affect fruit quality.

Water: Water deeply applying 1-2 inches per week depending on plant size. Use drip irrigation if possible. Organic or plastic mulch around the plant will conserve soil moisture and reduce weed growth. Irrigate so the plants do not experience stress as this causes the fruits to be bitter, have pointed ends, and be misshapen.

Fertilization: After the vines develop runners, side dress with a nitrogen fertilizer (21-0-0) using 1/4 cup per 10 feet of row. Side dress before the plant starts to flower.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Heavy vine growth by cucumber will also smother weeds. Be sure to control weeds when plants are small and do not damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet, or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Cucumber Beetles	Adults have stripes or spots and feed on leaves and vines which reduces vigor. May transmit bacterial disease. Larvae bore into roots and stems causing plants to wilt and die.	Application of chemicals at first appearance is needed to control this pest.
Disease	**Symptom**	**Control**
Powdery Mildew	White fungal patches start on older leaves. The disease eventually spreads to all plant parts. The foliage dies, exposing fruits to the sun, which causes premature ripening.	Plant resistant varieties.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on stems. Diseases are caused by different pathogens.	Identify causal disease. Treat disease as recommended once identified.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. An aphid transmitted disease.	Control aphids. Destroy severely infected plants.

HARVEST AND STORAGE

Cucumbers are ready to harvest 5-7 days after flowering. Do not let fruits get too large as flavor decreases with age, seeds begin to mature and the skin gets tough. Handle carefully as fruits bruise easily. Pick regularly to encourage continual production. Cucumbers can be stored for 10-14 days at 55ºF. If held in the refrigerator, fruits will break down rapidly and will yellow if stored near apples.

Productivity: Plant two to three cucumbers per person for fresh use and an additional three to five plants for canning or pickling. Expect 100 lbs of fruit per 100 feet of row.

Nutrition: Cucumbers are mostly water. They do contain a small amount of beta carotene, and are low in fat, protein and carbohydrates.

FREQUENTLY ASKED QUESTIONS

Some of my small cucumbers are badly misshapen. Will they develop into normal cucumbers? No. They should be removed from the vines. Misshapen cucumbers may result from poor pollination, low soil moisture or soil fertility. Side-dress with a complete fertilizer and keep the soil uniformly moist.

Is there really a "burpless" cucumber? Yes. Burpless cucumbers are no longer considered novelties and are offered in most garden catalogs. They are mild, sweet and crisp when fresh. The skin is tender and free of bitterness, although many people peel it off. Most varieties are 10 to 12 inches long and curved, unless grown on a trellis. Armenian is considered a burpless type.

How far away from melons should I plant my cucumbers to avoid cross pollination? Contrary to popular belief, cucumbers do not cross-pollinate with cantaloupe, squash or watermelons and cause them to become bitter, tasteless or off-flavored. Cucumbers and melons do require considerable space to grow so plant the rows far enough apart for good vine growth without overlapping.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Rick Hefelbower, USU Extenion Washington County Horticulture Agent

Dill

by Adam Oakley & Dan Drost

SUMMARY

Dill, Anethum graveolens, is a common, aromatic garden herb, known for its culinary and medicinal properties. Dill prefers full sun, well drained, low fertility soils and grows best from seed. Cover seeds lightly with soil. After emergence, thin to stand and be careful not to overwater. Prune plants to promote a lush, bushy growth. Plant continuously, since it takes approximately 6 weeks to harvest. Dill flavor is best when it starts to flower. The stems, leaves, flowers, and seeds are edible so enjoy this easy to grow staple of the herb garden.

DILL VARIETIES

Costa Rica, California Long Standing, Leisure, Lemon, Delfino, Moroccan, and Slow Bolting are excellent varieties. When selecting a variety, keep in mind the end use of the plant. If harvesting for the leaves, choose a cultivar that is slow bolting (Slow Bolting variety and the Leisure). When selecting a cultivar for seed all varieties perform well.

HOW TO GROW

Soils/Soil Preparation: Most soils in Utah are suited to dill provided they are well-drained and moderately fertile. Before planting, incorporate 1 to 2 inches of compost or ½ tablespoon per square foot of all-purpose fertilizer (16-16-8) into the soil. Dill does not require an overly rich soil.

Plants: Dill is grown for two reasons: as a plant 'dill' usually references the flower head and seeds, however 'dill weed' is used to describe the dark blue-green leaves. Dill stems are hollow, upright, and green and the roots are long and spindle-shaped. Dill flowers are bright yellow umbels.

Planting and Spacing: Dill should be planted from seed. Seedlings emerge 7-21 days after planting depending on soil temperature. Cover seeds lightly with soil. For a continuous supply of dill weed, sow seeds every 4 to 6 weeks. Flavor peaks once flowering starts, so make sure there is a succession of plantings. After emergence, thin plants to 9 inches apart and space rows 12 inch apart. Dill grows best in full sun and oil content in the leaves increases with longer day lengths and higher temperatures; however, hot temperatures (+95° F) decrease seed production. Dill is quite hardy and is able to tolerate cold winters.

Water/Fertilization: Dill is not a big water user requiring one or two irrigations per week once established. Dill can tolerate drier soil conditions particularly after seed set. No additional nutrients are needed if soil is amended at planting.

PROBLEMS

Weeds: Control weeds when plants are small. Dill can become weedy, as it self-seeds regularly.

Insects and Diseases: If over watered, dill is susceptible to powdery mildew. Aphids can be a problem at the time dill starts to flower and the seeds ripen. Dill often attracts more beneficial insects than it has problems with insects. Dill attracts bees, butterflies, wasps, lady beetles, lacewings, hoverflies, tachinid flies, and parsley worms. Parsley worms, a tiny, bright green caterpillar with black stripes, is the larva of swallowtail butterflies, so make sure to leave them on the plants.

HARVEST AND STORAGE

Dill leaves can be harvested at any time after seedlings emerge. Cut the leaves at the stem or cut the stem within a few inches of the ground, discarding the thick, tough stems. Dill is commonly used as a fresh herb to garnish fish dishes, dips, and potatoes. When used fresh, add it to something that has already been cooked since it loses its flavor when heated to high temperatures. For the best flavor, harvest dill when the flowers begin to open. Freezing is the appropriate way to preserve dill's distinct flavor. Put the fresh sprigs of dill in plastic sandwich bags and place them in the freezer. The cultivar 'Bouquet' is typically used as fresh cut flowers because of the bright yellow color and long stems. Harvest when the flowers completely turn yellow. Harvest dill seeds after the flower heads turn brown. The ripe seeds fall off the flower easily when touched, so collected them by hanging the mature flower heads upside down in a paper bag. Crush the flowers, sift out the seeds, and then allow them to dry before storing in a dark, cool place. When growing dill for pickling, use the entire plant (stems, leaves, flowers and seeds) to flavor the pickles.

Productivity: Short rows, 2 to 3 feet long planted regularly will supply sufficient quantities of dill for daily use, storage and seed production.

Nutrition: Dill is high in vitamins A & C, has some calcium and iron present, and is low in calories and balanced in carbohydrates, fats, and proteins.

FREQUENTLY ASKED QUESTIONS

What benefit do you get from eating dill? In ancient Rome, dill was considered a fortifying herb. It was believed that dill bolstered strength, allowing the gladiators to fight well. It can be used to freshen the breath and may have additional medicinal benefits.

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Authors: Adam Oakley, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Edamame

by Dennis Worwood

SUMMARY

Edamame (eh-dah-MAH-may), or vegetable soybeans, have long been a staple food in Asia and are gaining popularity in America. Edamame beans (seeds) are eaten green, rather than dry, and have a sweet, nutty flavor. Usually consumed as a snack, Edamame can also be used in recipes where immature lima, garbanzo or fava beans are called for, as in making hummus.

PLANTING

Edamame need full sun, warm temperatures, and rich, moist soil for proper growth. Prepare the seedbed by tilling 2 inches of compost or organic matter into the soil. If desired, 1 pound of 16-16-8 or equivalent fertilizer can be applied per 100 square feet. The goal is to have a smooth, fine, weed-free seedbed.

Like all legumes, Edamame team with a specific species of rhizobium bacteria to "fix" nitrogen from the air into a form that plants can use. If soybeans have not been grown in the garden before, seeds can be dusted with inoculant to insure that the proper rhizobium is present. Many seed suppliers sell soybean inoculant (Rhizobium japonicum). If seeds are not inoculated, fertilizer can supply needed nitrogen.

After all danger of frost is past, and when soil temperature is at least 60°F, sow seeds 2 to 4 inches apart in furrows that are 1 to 1 ½ inches deep. Rows can be spaced 8 to 24 inches apart. Closer row spacing produces higher yields and greater competition against weeds; wider spacing results in bigger plants with larger pods. Once seedlings have emerged, thin plants to stand 4 inches apart in the row.

Edamame seedlings can be killed or damaged by seed-eating insects or damping-off diseases. The best defense against these pests is to plant into warm, moist soil that favors rapid seedling growth.

Trellises are not needed. Edamame plants are self-supporting 14 to 24-inch tall bushes.

VARIETIES

Choose varieties that will mature in your growing season. Table 1 lists some commonlyavailable varieties that the author has grown. Edamame varieties not named may be equally suitable.

Table 1. Commonly available varieties of Edamame:

Variety	Days to Harvest	Comments
Midori Giant	70	Largest pods and beans of early varieties
Envy	70	Widely available; early maturing
Early Hakucho	75	Compact plant, early maturing
Kouri	80	Vigorous, high yielding
Tohya	80	Productive main season variety
Shirofumi	90	High yield, over 100 pods per plant
Sayamusume	90	Large pods and beans
Be Sweet	92	Large plant, late maturing, high yield

Like all soybeans, Edamame plants flower after midsummer when days are getting shorter (and nights are getting longer). Each variety is prompted to flower when a certain day length is reached. Latitude affects day length, with longer summer days in the north and shorter days closer to the equator.

Edamame varieties are classified in "maturity groups" 0 through 8 according to their day length requirement. Varieties in maturity group 2 are adapted to northern Utah, group 3 to central Utah, and group 4 to far southern Utah. Unfortunately, maturity group rating is seldom provided in descriptions of Edamame varieties, so gardeners must rely on estimates of days from planting to maturity.

If Edamame flowers when the plants are very small, doesn't begin flowering until very late in the growing season, or doesn't flower at all, the variety was in the wrong maturity group for the area's latitude.

Edamame harvest cannot be extended by repeatedly planting the same variety over a period of weeks. Since flowering is triggered by day length, all plants will recognize the signal and begin flowering at about the same time, regardless of plant size. To extend the harvest season, plant two or more varieties with different days to maturity.

FERTILIZATION

Edamame plants begin "fixing" nitrogen by the time seedlings are 6 to 8 inches tall if the seed was inoculated with the correct rhizobium. No fertilizer is required beyond the initial seedbed preparation. If seeds were not inoculated, plants can be side-dressed once with a light application of nitrogen fertilizer when seedlings are 8 to 10 inches tall.

IRRIGATION

Water requirements for Edamame are similar to those of green or wax beans. Water stress at any point in the life cycle will limit plant growth and yield. The most critical period is from bloom through pod fill, when drought stress can cause aborted blossoms, small pods and shriveled beans.

Weekly irrigation is usually sufficient, but irrigation timing and amount vary depending upon climate, soil type, and the stage of plant growth. From bloom through pod fill, plants typically use from 1 to 1 ½ half inches of water per week. Edamame may need to be irrigated twice a week during this critical period. The goal is to keep the root zone moist, but not soggy. Overwatering favors root rot and increases the risk of iron chlorosis.

IRON CHLOROSIS

Chlorosis (yellow leaves with green veins) is a symptom of iron deficiency. Iron chlorosis is a common problem in Edamame grown in Utah. Affected leaves get progressively lighter and may turn nearly white before dying. Chlorotic plants are less vigorous and yield less than healthy plants.

Most Utah soils are alkaline (have a pH above 7). In alkaline soils iron may be present in a form that plants cannot readily use. Excessive irrigation increases the risk of iron chlorosis.

To minimize iron chlorosis, practice good irrigation management. It is usually impractical to attempt to lower the pH of alkaline soils to make iron more available.

The most effective treatment for iron chlorosis is a chelated (KEY-lated) fertilizer containing ferric ethylenediamine di-ohydroxyphenylacetic acid (FeEDDHA). A variety of products containing FeEDDHA are available, including Sprint Fe138, Miller's Ferriplus, Grow More EDDHA and many others. They quickly correct iron chlorosis if applied according to label directions.

FeEDDHA is a fine brownish-red powder that is difficult to spread evenly. Dissolve a tablespoon of powder in a gallon of water and use a watering can to apply the solution around plants.

WEED CONTROL

Regular weeding is important, especially when plants are small. Mulch applied between rows after Edamame plants have emerged will smother weed seedlings and conserve soil moisture. In multiple-row plantings, Edamame plants eventually cover the area, suppressing weed growth.

PESTS AND DISEASES

A variety of insects, mites and diseases can affect Edamame. Since soybeans are not a common crop in Utah, soybean pests and diseases are not abundant, and control is usually not needed. This is fortunate, since few home garden pesticides are labeled for use on Edamame. Before applying any pesticide to Edamame, check the label to make sure it can be used on green or vegetable soybeans.

Spider mites are perhaps the most common Edamame pest in Utah. Infested plants show characteristic "bronzing" of leaves caused by mite feeding. To check for mites, shake affected leaves above a sheet of paper and look for small specks crawling on the paper. Mites can be controlled by applying insecticidal soap to the underside of leaves. Thorough coverage is important since the soap solution must contact the mites directly to kill them.

Beetles, grasshoppers and other chewing insect pests can usually be controlled by hand picking.

Foliar diseases are not common on Edamame in Utah's dry climate. Root and stem rots can be minimized by planting in warm soil and by avoiding over-irrigation.

Rabbits and deer love soybeans and can quickly defoliate plants. Repellants and scare devices provide temporary protection. The most effective scare device is an active guard dog. Rabbits may be caught in live traps, but it is difficult to coax them into traps when food is readily available outside. Fencing (including portable electric fencing) that excludes four-legged pests is a good control option.

HARVEST

Edamame is ready to harvest when the pods are well-filled, but still bright green. The seeds should be nearly touching in pods that have two or more seeds. Harvest pods before they begin to turn yellow. Pods that are yellow or brown are overmature and yield beans that are edible, but taste starchy rather than sweet. All pods on a given plant mature over a period of a few days and can be harvested in two or three pickings.

Edamame can also be harvested "on the branch," meaning that the entire plant is pulled up when most of the pods reach maturity. Roots and leaves are removed. This harvest method is sometimes used when the Edamame will be sold locally.

COOKING AND STORAGE

Edamame is usually consumed as a snack, similar to peanuts. Persons unfamiliar with Edamame may be put off by the appearance of the fuzzy, lumpy pods. These reservations disappear when people taste the beans.

To prepare Edamame as a snack, wash pods and boil them for 5 to 8 minutes in salted water. Squeeze the cooked pod between thumb and forefinger to "shoot" the beans into the mouth. If the beans will be used in a recipe, boil the pods for 5 to 8 minutes in unsalted water and squeeze the beans into bowl.

Uncooked pods keep for about 1 week under refrigeration. For longer storage, wash pods and blanch them for 3 minutes in boiling water. Drain and dry the pods, seal them in a bag, and freeze. Frozen pods are prepared the same as fresh pods.

NUTRITION

Edamame beans are about 40% protein and provide several essential amino acids. They are a good source of Vitamin C, Vitamin K, iron, and fiber.

ADDITIONAL RESOURCES

Edamame. University of Kentucky Cooperative Extension Service. http://www.uky.edu/Ag/CCD/introsheets/edamame.pdf

Edamame and "Gardensoy." National Soybean Research Laboratory. http://www.nsrl.illinois.edu/general/edamame.html

Authors: Dennis Worwood, USU Extension Educator

Notes

Eggplants

by Dan Drost

SUMMARY

Eggplant prefers a sunny location, a long growing season, and fertile, well-drained soil for best yields. Do not plant too early as plants are killed by light frost and grow poorly in cool conditions. Most gardeners transplant eggplant through a black plastic mulch for earlier maturity and high productivity. Use row covers or hot caps to protect the plants when transplanting before the frost-free period. Side dress with additional nitrogen fertilizer to help grow large plants. Irrigation should be deep and infrequent. Do not apply organic mulches until soils have warmed to 75°F. Control insect and diseases throughout the year. Harvest eggplant when the fruits are full sized, smooth skinned, and glossy.

RECOMMENDED VARIETIES

In selecting eggplant varieties, consider your growing environment, primary use, and how much space you have available to grow the plants. Most varieties will grow in Utah, but all are not available. Most garden centers and nurseries carry varieties that have been proven to grow well and produce high quality fruits in local conditions.

Fruit Type	Selected Varieties
Black Skin	Black Beauty, Black Bell, Black Magic, Classic, Dusky, Little Fingers, Orient Express
Specialty	Calliope, Easter Egg, Fairy Tale, Ichiban, Snowy, Zebra

HOW TO GROW

Soils: Eggplant prefers organic, rich, well-drained, sandy soil for best growth. Most soils in Utah will grow eggplant provided they are well drained and fertile.

Soil Preparation: Before planting, incorporate 15-20 lbs of well-composted organic matter or 2-3 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting. Work this into the top 6 inches of soil.

Plants: Eggplant grows best if transplanted when plants have 6-9 leaves and a well developed root system. Transplants mature earlier, yield more, and are generally recommended for the cooler growing areas of Utah. When growing transplants, allow 8-10 weeks to grow the plant. Germinate the seeds at 80°F until the seed root emerges, then plant the seeds in sterile seeding mix and grow out at 65-75°F. Adequate light is essential to produce a quality plant. Cool white fluorescent tubes placed 2 to 3 inches above the plants and lit for 14–16 hours per day will ensure plants grow large and healthy. Water regularly and feed weekly with ½ strength soluble complete fertilizer.

Planting and Spacing: Eggplant should be transplanted when soils are 60°F or after all frost danger has past since the plants are very sensitive to cool temperatures. Transplants should be planted 24 inches apart in the row, with rows 24 inches apart. Transplants that are stocky, dark green, have 6-9 leaves and are 5-8 inches tall, grow most rapidly. Plants with blossoms or fruits establish slowly and yield poorly.

Mulches: Black plastic mulch warms the soil, conserves water, and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. After preparing the soil, lay the plastic, secure the edges with soil, and cut holes for the transplants. When using plastic mulches and row covers, plants can be set out several weeks before the last frost date. Do not

apply organic mulches such as grass clippings, straw, or newspapers around the plants until soils are warmer than 75°F. Organic mulches also help conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels, fabric covers, and other devices protect transplants from cool air temperatures and enhance plant growth and earliness. Eggplant grown under row covers requires ventilation when air temperatures exceed 80°F.

Water: Water eggplant deeply and infrequently, applying 1-2 inches per week. Use drip irrigation if possible. Mulching around the plant will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. Irregular watering (under or over) can cause tough leathery fruit or root rot.

Fertilization: Avoid heavy fertilization of eggplant which encourages excessive leaf growth and delays flowering and fruit maturity. Side dress with nitrogen (21-0-0) using ½ tablespoon per plant at 4 and 8 weeks after planting. Place the fertilizer to the side of the plant and irrigate it into the soil.

PROBLEMS

Weeds: Plastic and organic mulches help control weeds. Cultivate shallowly around the plants to avoid root damage, especially when plants are small.

Insects and Diseases:

Insects	Identification	Control
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at planting or after seedlings have emerged from the soil.
Diseases	**Symptoms**	**Control**
Leaf Blights or Spots	Dark spots on stem, leaves, or fruits. The diseases eventually spreads to all plant parts. The foliage eventually dies, exposing fruits to the sun, which causes sunscald.	Diseases promoted by cool, wet conditions. Don't apply overhead irrigation late in the day. Let the soil dry between waterings. Apply appropriate fungicide once disease identified.
Verticilium Wilt	Leaves wilt starting at the bottom of plants and turn yellow before they wither and fall off. Disease causes a brown discoloration in the stem and root.	No varietal resistance. Crop rotations and soil solarization can help reduce wilt diseases.
Disorders	**Symptoms**	**Control**
Sunscald	Scald is caused when fruits are exposured to direct sunlight during hot, dry weather. Exposed areas over-heat, dry out, and do not color uniformly.	Maintain uniform soil moisture during hot weather. Big plants with good leaf cover have less sunscald problems.

HARVEST AND STORAGE

Eggplant is generally harvested when fruits are full size, have a glossy sheen, and are 6 to 8 inches long. Fruits that are firm, plump and fully colored, with smooth skin have the best flavor and quality. Use a knife or pruning shears to cut the stem when harvesting rather than twisting off the fruits. Wear gloves, as eggplant has small prickly thorns on the stems and under the leaves. Pick fruits as they mature. Mature eggplant will store for 7 days if held at 50-55°F. Fruits are subject to chilling injury if refrigerated. Overmature fruits are dull colored, soft, seedy, and taste bitter. Eggplant is not suitable for canning or drying, but can be frozen.

Productivity: Plant one or two plants per person for fresh use depending on fruit shape, size and variety.

Nutrition: Eggplant has limited nutrients and is low in calories, high in fiber and a source of folate and potassium.

FREQUENTLY ASKED QUESTIONS

What can I do to keep my eggplant fruits from getting tough? Tough skins generally form during unfavorable weather (night temperatures lower than 55°F, or day temperatures above 95°F), when plants are water stressed, or when fruits get over-mature. Fruits will achieve their fully mature size in 10 to 20 days after flowering. Since we can't do much about high temperatures, keep the plants well watered and harvest the fruits when they are full size.

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Notes

Elderberry in the Garden

by Tiffany Maughan & Brent Black

SUMMARY

Elderberry (Sambucus spp) plants are native to North America with some species native to Utah. It is a very hardy plant that will grow to be a large shrub. The leaves are pinnately compound and serrated. Elderberry plants are fast growing and have large, cream colored flower clusters that are very showy. Light blue to black colored berries form in the late summer and are also ornamental. The fruit is bitter if eaten raw, but is excellent when processed, and the flowers can be dried and used to make tea. Elderberries can easily be incorporated into a landscape or garden for a unique and flavorful new fruit.

Image from USDA Plant database.

RECOMMENDED CULTIVARS

Until recently, the only cultivars available were older selections, mostly from New York and Eastern Canada. With renewed interest in growing elderberries, more breeding programs have begun working to develop new cultivars. 'Wyldewood' was selected in Missouri and has fairly good tolerance to alkaline soils. It produces large clusters with medium to large berries on first year shoots. 'Adams 2' is also tolerant to alkaline soils and yields medium sized berries in large clusters. 'York' is an older cultivar that produces the largest berries among current American cultivars and ripens early in the season. 'Black Lace' is a new purple-leafed cultivar that has beautiful ornamental characteristics, similar to a Japanese Maple, and also produces a good crop of fruit, but has not been widely tested in Utah's alkaline soils. Some eastern cultivars have shown high levels of iron chlorosis on Utah soils. All of these cultivars will grow to be 6 to 8 feet tall and wide. Elderberries are pollinated by wind and insects. Although they are partially self-fruitful, having more than one cultivar will result in better pollination and higher yields.

HOW TO GROW

Site Selection: Although it can tolerate some shade, elderberry requires full sun for optimum production.

Soil: Elderberry grows in a wide range of soil types and conditions, but performs best in somewhat fertile, well-drained soil. Having your soil tested before planting will determine if any soil amendments need to be made. It is easier to amend and improve soils before planting than after, as elderberries have shallow roots that are easily damaged with cultivation. A soil high in organic matter that has a neutral pH and healthy nutrient levels will result in the best growth. Incorporating compost or other organic matter will improve soil nutrient levels and water holding capacity. In heavy clay soils, forming raised beds can help improve drainage.

Plant Material: Elderberries can be purchased commercially, either as bare-root starts or as potted plants. Purchasing from a reputable nursery will ensure healthy disease-free plants. Elderberry plants can also be propagated from cuttings. Soft-wood cuttings and hard-wood cuttings can be successful for elderberry propagation. Hardwood cuttings should be taken in February or March, well before bud break, and soft wood cuttings root best when taken before July. Plants can also be successfully propagated from root cuttings, dug in late winter and covered in soilless media.

Establishment and Spacing: Dormant, bare root plants can be planted very early in the spring. Actively growing nursery container plants should not be planted until danger of hard frosts has past. It is best to establish plants before summer heat. Elderberry plants can be used as a landscape plant or planted in rows in a garden. Be sure to allow enough space around each

plant; depending on the cultivar, approximately 4 feet in all directions is sufficient. If planting in rows, the plants can be set 2 to 4 feet apart, and the plants will fill in and create a solid row. If multiple rows are desired, leave 6 to 8 feet between rows.

Irrigation: Elderberries are quite drought tolerant. However, regular irrigation will maximize fruit production and quality. Plants can use 1 to 2 inches of water per week during the heat of summer. Mulching will help conserve soil moisture and reduce weed competition.

Fertilizer: Do not fertilize at planting, but a light application of nitrogen (1/4 cup ammonium sulfate per plant) about 2 months later can be beneficial. Mature plants that are actively producing should be fertilized with 1 cup ammonium sulfate per plant per year. Apply phosphorus and potassium based on soil test results.

Pruning: To keep the plant vigorous and healthy, pruning should be done every year. Prune in February or March, while the plant is still dormant. Elderberry produces fruit on current year growth, 1-year-old and some 2-year-old canes. Start by removing all dead, damaged or diseased canes. Next, prune out all 3-year-old and older canes. Finish by tipping back weak canes and shaping the shrub.

PROBLEMS

Weeds: Due to their shallow root systems, elderberry plants can be damaged if the soil is cultivated too deeply. Control perennial weeds before planting and maintain control by hand removing weeds before they seed. Annual weeds can be minimized by using mulch and hand weeding. There are several herbicides registered for use on elderberry, but caution should be taken when applying them. Always be sure to carefully follow the label. The pre-emergent dichlobenil can be used for elderberries and an early spring application will significantly reduce annual weeds in the coming months. Glyphosate and oryzalin are systemic herbicides registered for used on elderberries as a directed application. This means that the herbicide must not come in contact with the elderberry leaves or stems, and caution should be taken to avoid unintended drift that will damage the shrub. It is a good idea to use a shield, to keep herbicide spray off the plant.

Insects and Diseases: Elderberries are relatively pest resistant. However, some pests can cause a reduction in yield and plant health. Maintaining a healthy plant should be the primary pest control strategy. Remove and destroy all prunings, avoid irrigation practices that get water on the canopy, and closely monitor for pest occurrence. When pesticides are needed, consult and closely follow the label.

Pest/Disease	Identification	Control
Elder shoot borer (*Achatodes zeae)*	1/2 inch long red-brown moths lay eggs in late summer. Eggs hatch following spring and black-spotted white larvae bore into new shoots, mining upwards. Watch for wilting shoots and piles of brown frass at the base of canes.	Prune out and destroy infested shoots. No chemical control available.
Verticillim wilt	Fungus that causes wilt or dieback in the tips of canes. These symptoms are often uniform across the plant.	Keep area weed-free as weeds can be alternate hosts. Avoid planting into a site that has recently had raspberries, strawberries, tomatoes or potatoes. *Streptomyces lydicus WYEC* can be effective if applied early.

HARVESTING, PRODUCTIVITY AND USE

In Utah, elderberries can be harvested from late August to early October, depending on location and cultivar. Most individual plants will ripen over a 3 week period. Harvest the fruit by removing the entire berry cluster. Individual berries will need to be removed from the stems, which can be somewhat time-consuming. Freezing the entire cluster and then removing the berries while frozen will reduce skin tearing on the berry and can be faster than when the berries have not been frozen. Once removed from the stem, berries can be frozen for future use or processed. Elderberries are excellent for making juice, wine, extracts, syrup and jam. Mature elderberries produce approximately 2 to 3 pounds of fruit per plant.

NUTRITION

Elderberries are rich in nutrients and are often sold as a health food. Many people use elderberry as a supplemental treatment for colds and flu. The fruit is high in flavonoids, vitamins A and C, iron, and vitamin B6.

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Notes

French Tarragon

by Benjamin Hudson & Dan Drost

SUMMARY

Referred as "a chef's best friend," French Tarragon (Artemisia dracunculus) is an essential aromatic herb. Other common names include estragon, dragon sagewort, or German tarragon, but it should not be confused with the closely related Russian tarragon. French tarragon may be grown as an annual or as a perennial, as it is winter hardy to zone 4. Depending on the climate, it may be necessary to cover French tarragon with mulch during the winter, when grown as a perennial. French tarragon prefers full sun, well-drained soils, grows to a height of 24 to 36 inches with a 12 to 15 inch spread. For fresh use, harvest sprigs of French tarragon as needed or for storage harvest the entire plant and dry.

RECOMMENDED VARIETIES

Buyers looking to start growing tarragon will be confronted with two types: French or Russian. Russian tarragon, while not classified asbeing a different species, has flavor vastly inferior to French tarragon. Buyers typically encounter Russian tarragon when they grow this herb from seed, as French tarragon is almost exclusively grown by vegetative means. Consult a reputable nursery or garden center when purchasing tarragon plants to ensure you get the desired type.

HOW TO GROW

Soils: French tarragon grows best in warm, dry, well-aerated soils and does not tolerate wet or saturated soils. French tarragon grows well in neutral pH soils (pH 6.5-7.5), but exhibits some preference for slightly acidic soils. Most soils in Utah are suitable for growing French tarragon provided they are well drained.

Soil Preparation: Before planting, incorporate 1 to 2 inches of well-composted organic matter or ½ tablespoon of all-purpose fertilizer (16-16-8) per square foot of growing area. Work the compost or fertilizer into the top 6 to 8 inches of the soil. Organic matter additions to soils help improve aeration and water drainage.

Propagation: French tarragon is propagated almost exclusively from stem cuttings and root divisions. Seeds are rarely planted because French tarragon seldom flowers, resulting in little seed availability. Be careful when propagating from root divisions. French tarragon roots are brittle; so use a knife, as opposed to a shovel or hoe, when collecting new plants. Root divisions should be done in the spring just as new shoot tips are emerging. You should get three to five new plants from each parent plant. French tarragon is also propagated by taking cuttings from young stems. Collect stem cuttings early in the morning. Cut 4 to 6 inch long stems just below a node and remove the lower 1/3 of the leaves. Dip the cut end in a rooting hormone and plant in warm/moist potting media, misting periodically. After roots form, transplant the cutting into the garden.

Planting and Spacing: Transplant French tarragon in the spring, after the last frost, to ensure the survival of tender young shoots. French tarragon prefers full sun and warm but not hot temperatures. In areas where summer temperatures exceed 90° F, partial shading of French tarragon increases plant survival. Plant French tarragon 24 inches apart and keep it trimmed to maintain its form. Divide plants in spring, as described above, to maintain plant vigor. French tarragon should be renovated every 2 to 3 years to maintain flavor and vigorous growth.

Water: French tarragon performs best when the soil is allowed to dry between irrigations. Mulch around the plants to retain moisture near the soil surface, since tarragon has shallow roots. Overwatering or poor soil drainage encourages root rot. Water new plants frequently until established, and water existing plants once a week.

Fertilization: French tarragon has low fertilizer requirements. As with many herbs, the tarragon flavor is intensified when grown in nutrient poor soils so only fertilize when planting.

PROBLEMS

Weeds: Mulching plants as soon as they are planted or as stems emerge helps prevent weeds from establishing. If weeding is necessary, use shallow cultivation to avoid damaging the shallow roots as doing so will slow plant growth.

Insects and Diseases: French tarragon is generally insect and disease free. French tarragon is susceptible to root rot if over watered and/or subjected to poorly drained soils.

HARVEST AND STORAGE

Fresh: French tarragon is generally used as a fresh herb and sprigs may be harvested as needed throughout the growing season. A sprig is typically one-third the length of the stem.

Drying/Freezing: French tarragon can be dried, but there is a reduction in flavor after drying. For dried tarragon, the first harvest is 6 to 8 weeks after growth has begun and the second harvest is before the first fall frost. To dry French tarragon, bundle and hang harvested sprigs in a dark airy place. Once dried, crumble the leaves into an airtight container and store in the dark or freeze.
French tarragon leaves can be dried in a microwave set on high for 2 minutes. The advantage to this method is that the leaves retain more of their original color and flavor. Freshly chopped leaves or sprigs can be frozen in tightly sealed freezer bags and used as needed.

Over-wintering: When growing tarragon as a perennial, shear plants to the ground after frost has killed top growth and mulch heavily before winter to ensure survival. French tarragon can be grown as a potted plant. After the fall harvest, bring the plant indoors, water and fertilize to stimulate growth and locate where the plant will get 6 hours of direct sunlight each day.

USES/NUTRITION

French tarragon is used to create vinegars and flavor fish, but is also commonly used to flavor vegetables and meats (shellfish, poultry, and lamb). French tarragon is commonly used in the production of perfumes, Dijon mustard, and various other condiments. French tarragon is a source of calcium, niacin, potassium, thiamine, and vitamin A.

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Garden Cress

by Bonnie Allan & Dan Drost

SUMMARY

Garden cress or pepper-grass is an annual herb that was introduced to the United States from China. Garden cress grows best in cultivated areas that receive full sun or partial shade with moist soils. Garden cress is a very easy plant to grow. Garden cress can also be grown in a window sill or container. Garden cress is usually cultivated for its leaves, which are used in salads, on sandwiches, and as baby greens. The leaves and seed pods have a peppery taste.

RECOMMENDED VARIETIES

Common varieties include Wrinkled, Crinkled, Crumpled, Persian, and Curly. Purchase seed from a local nursery or seed catalogs.

HOW TO GROW

Soils: Garden cress does well in all soil types as long as they are moist and nutrient rich.

Soil Preparation: Before planting, incorporate 4-6 inches of well-composted organic matter and 1-2 lb of all-purpose fertilizer (16-16-8) per 100 square feet. Work compost and fertilizer into the soil to a depth of 6-8 inches.

Planting: Garden cress is planted by seed. Broadcast the seeds by randomly scattering them over the planting area or by mass planting them in rows. Rows should be about 3-4 inches apart. Once seedlings have emerged, thin plants to 8-12 inches apart. Re-sow seeds every 2 weeks for a continuous supply of fresh leaves. Plant seeds ¼-½ inch deep. Garden cress does not tolerate frost so plant near the frost free date for your area.

Water: Garden cress performs best if soil remains very moist. If planting in containers, make sure to water them every few days keeping the soil moist. Drought stress during growth will greatly reduce yield.

Fertilization: Cress has very low fertilizer requirements due to the short growing time for the plants. For container grown plants, fertilize periodically with a soluble liquid fertilizer.

HARVEST AND STORAGE

Harvest begins 2-3 weeks after emergence when the leaves are 2 inches long. Remove the older leaves for immediate use and leave the young ones so the plant doesn't stop growing. A 10 to 15 foot row of garden cress usually provides enough for the average family. By planting several 5 foot rows at different times, a steady supply of fresh cress will be available for fresh use.

USES

Garden cress is used in salads, soups, on sandwiches, and as baby greens. Garden cress is also used to treat inflammation, acne, and skin infections and it acts as a blood purifier, diuretic and expectorant.

Authors: Bonnie Allan, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Notes

Garlic
by Dan Drost

SUMMARY

Garlic is a hardy perennial that prefers full sun and fertile, well drained soils with plenty of organic matter. Apply a complete fertilizer to the area before planting. Plant garlic from late September to November. Plant cloves 1-3 inches deep, 6-10 inches between rows, and 3-4 inches apart in the row. Sidedress with nitrogen in May to ensure good growth and high yields. Maintain soils near field capacity. Mulches help conserve water, supply extra nutrients and reduce weeding. Harvest garlic when the tops have fallen over but before they are dry. Check with local garden centers and seed catalogs for variety availability.

RECOMMENDED VARIETIES

Two types of garlic commonly grown in home gardens; the hardneck and soft-neck (*Allium sativum*) types and elephant (*Allium ampeloprasum*) garlic. Hardneck types have short to medium store life, while softneck types store very well and are preferred for braiding. Elephant garlic is very mild, stores poorly and is more closely related to leek than garlic. Check with local garden centers or seed catalogs for specific varieties.

HOW TO GROW

Soils: Garlic will grow in all soil types provided they are rich, well drained, moist, and fertile.

Soil Preparation: Before planting, incorporate 4-6 inches of well-composted organic matter and 1-2 lb of all-purpose fertilizer (16-16-8) per 100 square feet. Work compost and fertilizer into the soil to a depth of 6-8 inches. Garlic has high nutrient requirements for good growth and size.

Plants: Garlic can be planted anytime from mid September through November. During the fall and winter, the root system develops even though little top growth occurs. Tops will grow rapidly the following spring. Large tops are required to produce large bulbs. Bulb growth is poor and yields low if planted in the spring. Garlic is grown from clean, well-developed, dry bulbs. Carefully break bulbs apart into individual cloves. Plant the largest unpeeled cloves with the pointed end up 1-3 inches deep. Some garlic types produce a flowering stem during the year which robs the plant of energy. Cutting off the stalk helps redirect more energy to the bulb.

Planting and Spacing: Plants should be spaced 3-4 inches apart in the row, and 6-10 inches between rows in a location that will receive full sunlight. High-density plantings will reduce bulb size unless adequate water and nutrients are supplied.

Water: Garlic requires regular watering throughout growth for best production. Moisten the soil thoroughly to a depth of 18 inches every 7 days. Water needs are critical since rooting depth in garlic is shallow. Drought stress during growth will decrease yield and reduce bulb size. Stop watering when the plants start to mature (tops fall over). Excess water as the crop matures causes bulb splitting, delays curing and may cause storage problems.

Fertilization: In addition to the fertilizer used at planting, garlic needs additional nitrogen fertilizer to produce optimum yields. Side dress with 1/2 lb nitrogen fertilizer (21-0-0) per 100 square feet in late April or early May for best growth.

Mulches: Organic mulches help conserve water, supply extra nutrients, and reduce weeding.

PROBLEMS

Weeds: Use shallow cultivation to control weeds and avoid root damage, which slows plant growth and reduces yield. Weed control is particularly important during the first 2 months of growth when plants are growing slowly and compete poorly. Mulching with compost, grass clippings or leaves will help smother weeds.

Insects and Diseases:

Insect	Identification	Control
Thrips	Tiny, slender insects that feed on leaves. Leaves turn silver or gray, may twist and die. Thrips hide near where the leaf and bulb meet.	Spray with registered chemicals
Onion Maggot	White worm that feeds on seedlings, roots or bulbs.	Use crop rotation, avoid excessive amounts of organic matter, and apply appropriate insecticide at planting if maggots have been a problem in the past.
Disease	**Identification**	**Control**
Neck Rot	Fungal disease that occurs during storage. Watery Decay inside the bulb.	Avoid excess moisture near harvest. Cure bulbs well before storing.

HARVEST AND STORAGE

Harvest garlic when the tops begin to yellow and fall over, before they are completely dry. Carefully lift the bulbs with a spade or garden fork. Over mature bulbs do not store well. Place the entire plant in a shady warm spot to dry for 1-2 weeks. When fully cured the garlic skins should be papery and the roots dry. Carefully remove any excess soil from the roots and bulbs. Bruising the bulbs leads to rapid deterioration. Mature bulbs may be braided into garlic ropes or stored in open meshed sacks. For those bulbs stored in sacks, cut off the leaves about 1-2 inches above the bulb. Store garlic in cool (40°F), dry conditions. Avoid freezing. The largest, best-formed bulbs may be used for the next fall planting.

Productivity: Each planted clove will produce one bulb. Each bulb will yield 10-15 usable cloves at harvest.

Nutrition: Garlic is very low in saturated fat, cholesterol and sodium. It is also a good source of calcium and phosphorus, and a very good source of vitamin C and vitamin B6.

FREQUENTLY ASKED QUESTIONS

Can you plant garlic in the spring? Yes. While fall planting is preferred in northern portions of the country (garlic is a bulb, like a tulip), you can get good results with spring planting. This is especially true in the more southerly parts of the U.S. where February and March planting is common. In our part of the country spring plantings will produce small garlic bulbs. Plant the cloves as soon as the soil can be worked and the threat of very hard freezes has ended.

How can you remove garlic odor from your breath? Perhaps the best way of handling the "breath scare" is to be sure everyone is eating garlic and then no one will care. But short of that, try chewing on a sprig or two of fresh parsley. It takes a lot of edge off garlic breath, and it is good for you, too. Great source of iron.

Author: Dan Drost, USU Extension Vegetable Specialist

Goji in the Garden

by Tiffany Maughan & Brent Black

SUMMARY

Goji (Lycium barbarum L.) is native to tropical or warm regions of mainland East and Southeast Asia and South Africa. Other common names are wolfberry, matrimony vine, and boxthorn. Plant growth habit varies significantly among cultivars, ranging from viney to erect. Spines are present on most cultivars but vary in size and number. When pruned, plants are typically 3 to 6 feet tall but if left without cultivation they can reach 12 feet. Solitary, purple blossoms form in the late spring (although some species have greenish or cream flowers) and are followed by small orange to red fruit about 4 to 6 weeks later. Plants are self-fruitful and do not require cross-pollination.

In some areas, they are considered a weed due to their tendency to sucker and spread by seed. Goji are recommended for zones 4 to 7.

Goji is in the same family as tomato (Solanaceae) and some cultural and nutritional needs are similar.

RECOMMENDED CULTIVARS

Although plants can readily be propagated from seeds, using a named cultivar will ensure you are planting a high-quality and productive plant. In China, where goji is most widely produced, Lycium barbarum L. var. barbarum is commonly planted. Goji is a new crop in American markets, so cultivar selection is still limited.

'Crimson Star' (also known as Ningxia #1) and 'Phoenix Tears,' are available. Both begin bearing 1 to 2 years after planting, although they will not reach full production for 3 to 5 years. 'Wolfberry Agrodevco' is another cultivar, but it has limited availability. Many nurseries do not list specific cultivars of goji, but rather list them simply as Lycium barbarum.

Goji plant in bloom.

HOW TO GROW

Site Selection: Plant goji in a location with full sun (although some shade can be tolerated). Plants can handle relatively harsh conditions and are a good choice for locations that may not work well for other, more traditional, fruits. Fruit quality is best during hot, dry conditions and diminishes if weather is cool and humid.

Soil: Natively, goji grow in slightly alkaline soil (pH of 7 to 8) so many Utah soils support plant growth well. They do not grow well in acidic soils. Goji plants tolerate a wide range of soil types but prefer a light loam. Although goji can be grown in clay soil, they do not do well if roots are consistently wet, and care should be taken when irrigating on heavy soils to avoid waterlogging.

Plant Material: Due to the newness of goji as a crop in the U.S., it may be difficult to find at local nurseries. Ordering online may be the best option for purchasing plants. Visit Cornell University's Nursery Guide for a list of reputable nurseries selling goji plants. Plant in the spring into a hole two-times wider than the roots to encourage easy root spreading. Applying organic mulch around the base will help moderate root temperatures and minimize weeds.

Spacing: In a home garden, goji can be tucked into many areas of the landscape, provided they are not too shaded. However, make sure there is enough room in all directions for the plant to reach full size and to allow for easy harvest (about 4 to 5 feet in all directions). If establishing multiple rows, leave 2 to 4 feet between plants within a row and 6 to 8 feet between rows.

Irrigation: Although fairly drought-tolerant once established, more frequent irrigation is needed to establish the roots of new transplants. Irrigation needs vary depending on soil type and time of year. Sandy soils need to be watered more frequently than clay soils as they drain quickly. In general, apply approximately 1 inch of water per week.

Plants can be watered by surface flooding, micro-sprinklers or drip irrigation. Drip irrigation is the most efficient method and helps keep weed and disease pressure low. If drip irrigation is not available, a deep soak with the hose at the base of the plant works well. Fruit are prone to blossom end rot, a localized calcium deficiency that results from lack of irrigation or extreme wet/dry cycles.

Ripe goji berries on plant.

Fertilizer: Too much fertility results in excess vegetation, shading, and reduced fruit quality. There are no specific fertilizer recommendations for goji in our region; however, some growers amend the soil based on recommendations for tomato production. Remember that annual crops, such as tomato, typically require more fertilizer than perennial crops and that applying fertilizer based on tomato recommendations may only be appropriate during plant establishment. Goji fertilizer recommendations for other areas in the U.S. are 4 to 5 tablespoons of 16-16-16 per 10 square feet per year. Reduce this rate in fertile soils to avoid over-fertilizing. Split total fertilizer amount into three applications for the year: at budbreak, flowering, and as the fruit begins to ripen. There is some evidence suggesting that goji perform very well without any fertilizer at all.

Pruning: Fruits form on current year's wood and pruning encourages new growth, increasing yields. Pruning is also important to keep the plant open to allow for good light penetration and air circulation. Typically, no pruning is required in the first year. However, increased pruning in subsequent years is needed to maintain vigorous new growth.

During the dormant season, begin pruning by removing any weak, damaged or crossing branches. Next, shorten lateral branches by cutting back from the tip by 6 to 18 inches. Limit plant height to keep harvesting manageable. During the early summer, pinch off the top 2 to 3 inches of terminal growth. This practice, commonly referred to as tipping, encourages canes to produce more lateral branches which produce more fruit than branches that grow straight up.

After about 3 years (sometimes less) the plant usually begins to sucker, sending up additional new shoots from the root system. If left unchecked, the plant can become very unmanageable. Dig up the shoots and either discard or transplant them.

Heavy goji berry yield at a commercial orchard, grown through black plastic mulch to control weeds.

PROBLEMS

Weeds: A heavy mulch around each plant will help reduce weeds. Keeping weeds clear around the plant minimizes competition and improves goji performance. A spring application of pre-emergent herbicide will greatly reduce annual weeds. Using landscape fabric or a heavy plastic can be very effective and will minimize suckering.

Insects and Diseases: Since goji is still a fairly new crop, pest information is limited. The only pest reported on goji in Utah is the goji gall mite (see table below). Potato leafhopper, thrips, aphids and spider mites have been reported as pests of goji in other states and should be watched for during routine scouting.

Always refer to product labels, and follow all directions specified on the label, before applying any pest control product.

Problem	Identification	Control
Goji gall mite *(Aceria kuko)*	Extremely small, difficult to see with naked eye. Pale salmon and wormlike mites with 6 to 7 generations per year. Small bead-like galls form on leaves. They are yellow/green on the bottom and reddish on top. Each gall holds large numbers of mites.	Sulfur, insecticidal soap, or horticultural oil (0.5% solution) can be used to control. None of these should be used when temperatures will be above 90 °F within 4 hours of spraying. A spray application of 2% horticultural oil, either in the fall (just before leaves drop) or in the spring (just as leaves emerge) will be most effective. Keep alternative hosts such as pepper, eggplant, and black nightshade, clear from the area.
Powdery mildew (*Sphaerotheca* spp.)	Fungal disease that forms white patches of powder on leaves and stems.	Prune to improve air circulation and minimize wet foliage. Horticultural oils can help prevent further spreading once present in field.
Blossom end rot	Calcium deficiency related abiotic disorder resulting in a water-soaked spot on the end of fruit.	Control by careful irrigation to minimize extreme fluctuations in soil moisture (particularly during bloom and fruit sizing).

HARVESTING, PRODUCTIVITY AND USE

Galls on a goji leaf caused by goji gall mite. Photo courtesy of Ryan Davis, Utah State University.

Harvest goji berries when they reach full color (approximately 35 days after full bloom). Unlike some berries that can be shaken or beaten from the plants by mechanical harvesters, goji fruit must be picked by hand as the fruit do not easily separate from the stem, and bruised berries will turn black. Also, the plants continuously produce new blossoms, so that fruit are ripening over a long period of time. They will fruit from mid-summer to late fall. When picking, pull the berries slightly to the side instead of straight up to reduce the amount of stem that comes off with the berry.

Goji plants will begin producing fruit when plants are 2 years old. Maximum production will not be reached until 3 to 5 years after planting. Depending on variety, expect to harvest 2 to 6 pounds per plant.

Goji berries are sought after for their health benefits. They can be dried, juiced, frozen or eaten fresh. Possibly the most common way to consume goji berries is as a dried fruit, similar to a raisin, and they can be eaten alone or used in baking. They can be dried by laying the fruit out on drying trays in the sun, or in a food dehydrator (set the temperature to 105 °F) for about 3 days. Steam juicing works well, and another option is to soak dried berries in water overnight and then strain out the berries to obtain the nutrient-rich juice. Berries can be frozen and thaw well, maintaining their color and flavor. Fresh eating is possible, but many people do not like the texture of the berry and prefer to consume the berries once processed. Once harvested, the fruit will store for approximately 2 weeks in the refrigerator.

Leaves can also be harvested throughout the year to consume fresh or dried. They can be used to make tea or powdered and used as a nutritional supplement.

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Gooseberries in the Garden

by Tiffany Maughan & Brent Black

SUMMARY

Gooseberries are relatively easy to grow and yield rewarding, tart berries perfect for pies and jellies. Gooseberry bushes have arching branches and are usually 3 to 5 feet high and wide. They have inconspicuous small green and pink flowers that are self-fertile and open early in the season. Bushes yield small berries that are usually greenish yellow but can also be pink, red, or even white depending on cultivar. There are two species of gooseberries: the European gooseberry (Ribes grossularia), and the American gooseberry (Ribes hirtellum). Gooseberry plants do well in a home garden and are an excellent option for fruit production in very cold climates as they are hardy to zone 3.

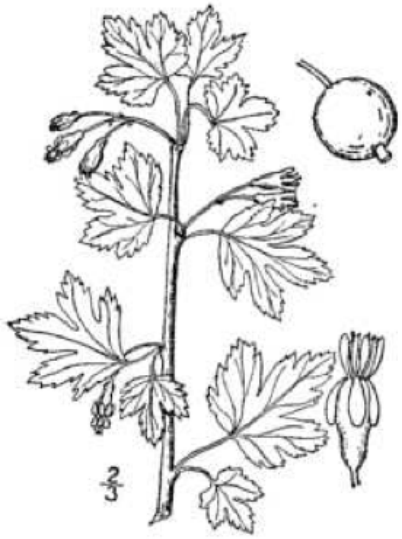

Photo from USDA-NRCS Plant Database.

RECOMMENDED CULTIVARS

European cultivars are usually pure species, but almost all American gooseberries have been crossed with the European species at some point in their lineage. American gooseberry plants are smaller and are more resistant to mildew than the European gooseberry. However, the American cultivars usually have smaller berries and can be less flavorful.

American Cultivars: 'Poorman' is very productive, with medium-sized red fruit and is well suited for the home garden. It has been bred to be particularly cold-hardy, even for a gooseberry. 'Oregon Champion' produces yellow-green berries that work well for processing. 'Downing' is widely grown and is resistant to mildew. It produces small green fruit with very good flavor.

European Cultivars: 'Invicta' is resistant to mildew and produces large green fruit with average flavor. 'Careless' is green-fruited and is one of the most commonly grown European cultivars. 'Achilles' has large green fruit with few hairs and excellent flavor. 'Chautauqua' has a very compact growth habit, possibly suited for container production. It is somewhat resistant to mildew and produces large green fruits with good flavor.

Related Species: Red currant (R. rubrum) and Black Currant (R. nigrum) are closely related to gooseberries and grow in similar conditions.

HOW TO GROW

Site Selection: Gooseberries are an ideal fruit for cold climates, with most cultivars able to survive mid-winter temperatures of -40 °F. Gooseberries require a minimum of 1,000 hours of winter chilling for buds to break and usually perform well in zones 3 to 6. Select a sunny to partly shady location, preferably a spot that gets some shade during the hottest part of the summer such as on the east side of a building or wall. Gooseberries also do well as an understory plant. They tend to bloom early and may be injured by late frost events. Planting on a north-facing slope helps delay blooming in these regions and also helps keep the plant cooler during the summer.

Soil: Since gooseberries can live for many years, it is well worth taking time to prepare the soil before planting. Gooseberries prefer a well-drained soil and organic matter should be incorporated into silt loam or clay soils before planting to improve drainage. Plants do best in a soil with a pH of 6.0 to 7.0 but can adapt to higher pH soils as well. It is a good idea to test the soil to determine nutrient concentrations and to have a starting point for determining fertilizer needs.

Plants: Gooseberry bushes grow to be 3 to 5 feet tall. Flower buds form on 1-year-old wood and on short spurs of older wood. Each bud opens to yield one to four flowers. The flowers are self-fertile and are pollinated by wind and insects. Although there are a few thornless or almost thornless cultivars, most gooseberry plants have branches covered with thorns. Gooseberries are closely related to currants and, for some, can be challenging to correctly identify. The arrangement of berries on the stem can be a good identification tool. Gooseberry fruit are born singly or in pairs on very short racemes. Current fruit form on longer racemes with 10 to 30 fruit per cluster and hang similar to a grape cluster. Also, the tips of gooseberry branches are arched while current branches are straight. Currants are also thornless.

Planting and Spacing: Gooseberries are usually purchased as bare-root, 1- to 2-year-old stock. Make sure to purchase from a reliable nursery to ensure plants are disease-free. The best time to plant is either in the fall or very early in the spring, before plants begin to grow. Bare root plants should be placed in a bucket of water for about 1 hour to allow the roots to rehydrate before planting. Dig a hole slightly deeper than what they grew at in the nursery and wide enough to spread out the root system. Locate the soil ring on the stem of the bare-root plant that indicates the depth it was previously planted, and cover with soil to just above that point. Prune back to two to four buds to encourage vigorous growth.

Spacing will vary somewhat depending on cultivar, but in general, leaving 3 to 5 feet in the row and 8 to 10 feet between rows is sufficient. Do not plant bushes too close together or the arching branches will intertwine and become difficult to prune and harvest. Gooseberries can also be included in a landscape, as long as enough room is left around the plant for harvesting and it is placed with plants that have similar water and nutrient requirements.

Irrigation: Keep the soil moist but not waterlogged. With their fibrous, shallow roots gooseberries are ideal for drip system irrigation. Keep the plants watered all season, since they will not regenerate buds or leaves lost from drought stress. Additionally, water-stressed plants are more susceptible to mildew than a well-watered, healthy plant. Mulch at the base of the plant can help retain soil moisture as well as suppress weeds.

Fertilizer: For fruiting and disease resistance, potassium is a particularly important nutrient. A symptom of potassium deficiency is scorching of leaf margins. Deficiency can be avoided with an annual dressing of 2 tablespoons of potassium fertilizer per plant. Gooseberry plants also have a fairly high requirement for magnesium. Excessive amounts of nitrogen promote disease, especially mildew, so care should be taken when applying nitrogen to the soil. In general, about ½ cup of a balanced fertilizer (10-10-10 or 16-16-16) per plant can be applied to maintain a good balance between growth and disease tolerance.

Pruning: A gooseberry bush can quickly become over-grown and unhealthy without pruning. Keeping the center open to air and sunlight will also help reduce the occurrence of disease. Gooseberries bear fruit primarily on two and three year old branches. A good ratio of fruit bearing branches can be maintained by leaving 4 to 5 shoots each of 1, 2, and 3 year old wood, and pruning out any shoots older than 3 years. As with most woody plants, the best time to prune is late winter or early spring when the plant is dormant.

PROBLEMS

Pests and Diseases:

Pest/Disease	Identification	Control
Gooseberry Fruitworm (*Zophodia convolutella*)	Larvae are green with dark stripes on sides. They feed on multiple fruit and spin silken webbing, joining fruit and leaves together.	*Bacillus thuringiensis* (BT)
Imported Currant Worm (*Nebarus ribesii*)	Larvae grow up to 1.5 inches long and are green with yellow ends, have a black head and black spots. Strips plant of foliage. Appear in spring and a 2nd flush can occur mid-summer.	Apply chemical spray, azadirachtin or malathion, as soon as worms appear.
Powdery Mildew (*Sphaerotheca mors-uvae*)	Fungal disease that forms white patches of powder on leaves and stems.	Plant American types as they are less susceptible. Prune to improve air circulation and do not irrigate with sprinklers. Horticultural oils can help prevent further spreading.
Leaf Spot (*Anthracnose)*	Small brown spots on leaves appear in early summer and progress to larger, irregular lesions with light brown centers. Can also develop on fruit. Worse during wet periods.	Remove dead leaves and prunings from the site. Prune to increase air circulation. Eliminate overhead irrigation. Apply copper hydroxide, propiconazole, basic copper sulfate.

Weeds: Weeds can harbor pests and use valuable nutrients and water. Applying heavy mulch around each plant will help reduce weeds. Deep cultivation near the plants should be avoided, as gooseberries tend to have shallow and fibrous roots that can be easily damaged. A spring application of pre-emergent herbicide, such as dichlobenil or oryzalin, will minimize annual weeds. Control perennial weeds before planting, as control will become more difficult once gooseberries are planted.

Glyphosate is registered for used on gooseberries as a directed application. This means that the herbicide must not come in contact with the gooseberry leaves or stems, and caution should be taken to avoid unintended drift that will damage the plant. It is a good idea to use a shield between the plant and the sprayer during application.

HARVEST, STORAGE, AND USE

Harvesting: Most cultivars have thorns on the stems and wearing long sleeves and gloves during harvest is recommended. Harvest usually lasts over a four to six week period. Berries can be picked green and then cooked into a pie or other recipe, or you can wait until they are completely ripe and eat them fresh. Average yield from one healthy and mature gooseberry bush is between eight and ten pounds of fruit.

Storage: Gooseberries should be refrigerated as quickly as possible after harvest. Harvest into small, shallow containers to improve air circulation around the fruit and reduce bruising. With proper cooling and storage, fresh gooseberries can be stored for up to three weeks. Gooseberries can also be frozen or bottled for long-term storage.

Uses: Gooseberries used for culinary purposes such as tarts, pies, and jams are usually picked under-ripe. Allow fruit to fully ripen if eating berries fresh. A classic gooseberry dessert is a "fool," made by folding cream into the stewed fruit. Gooseberry fruit are prized for their health benefits, and are a good source of vitamin C and antioxidants.

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INTRODUCTION

There are over 50 species of kiwi, with only a few being of commercial importance. The most familiar kiwi, Actinidia deliciosa, is the fuzz-covered type commonly sold in grocery stores. It requires a long growing season and warm climate and cannot be grown successfully in Utah. Hardy kiwi, Actinidia arguta, sometimes called smooth kiwi or Chinese gooseberry, is a fruit-bearing vine that can be adapted to some areas of Utah. Where commercial kiwi fruit are covered with fuzz and need to be peeled before eating, hardy kiwi do not have fuzz and can be eaten out of hand. Hardy kiwis are about half the size of the commercial kiwi fruit, have a very powerful flavor and when fully ripe have high sugar content. A third species, A. kolomikta, is often grouped with the hardy kiwi and is very similar, but does have some differences. The fruit are typically slightly smaller than A. arguta but otherwise look the same. The fruit also have higher vitamin C and sugar content but may have a bitter taste. For the adventurous gardener looking to try something new, A. arguta or A. kolomikta are great options.

Plants: All kiwi plants are dioecious, meaning male and female flowers are on separate plants. In order for pollination to occur and fruits to develop, a male and female plant must be present. The kiwi plant is a perennial vine that requires support, similar to a grape vine, and can grow to be 40 feet long if left unpruned. The fruit of both A. arguta and A. kolomikta are typically green and are slightly larger than grapes. The skin does not need to be peeled before eating and when cut open, it looks very similar to a commercial fuzzy kiwi with the familiar bright green flesh and small black seeds.

A. arguta is hardy to -10 to -25°F and A. kolomikta is hardy to -40°F. It is important to realize that these temperatures are for midwinter hardiness. These species have a low chilling requirement, and as a result are prone to early bud break during the first spring warming. Unfortunately, the young shoots are then susceptible to freeze damage. However, frost protection methods may be effective at protecting these shoots and early blossoms. A. kolomikta is slightly more prone to early bud break than A. arguta.

A. kolomikta in particular is very ornamental with beautiful foliage and growth that looks wonderful on a pergola or trellis. For some landscaping purposes, only male plants are used to avoid fruit formation, and the vine is grown simply as an ornamental plant.

RECOMMENDED CULTIVARS

A. arguta: The hardy kiwi 'Ananasnaya', sometimes referred to as 'Anna', is only hardy to zone 5, but in a protected area can be grown in zone 4. Fruit are of a very good quality with excellent flavor and are green but can develop a purple-red tint in full sun. The vine is very vigorous. 'Issai' is the only self-fruitful hardy kiwi. It can produce fruit without a male pollinator, but fruit set is often increased with the presence of a male. The fruit are cylindrical and have a very good flavor and aroma and vines can bear fruit just one year after planting. It has less vigorous growth than other cultivars.

A. kolomikta: 'Arctic Beauty' is a good option for areas with very cold winters. The fruit are very sweet and the vines have moderate vigor. Male and female plants are sometimes sold as a set, simply called Arctic Beauty. 'Pautske' has large fruit and good quality and has a moderately vigorous vine. Many male plants and some females of A. kolomikta will develop variegated white and pink leaves that have excellent ornamental qualities.

Although male cultivars of one species may be able to pollinize the female blossoms of another species, it is recommended that the male pollinizer be from the same species as the female plants.

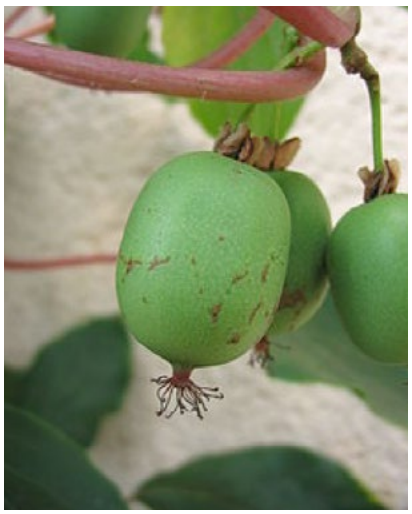
HOW TO GROW

Site Selection: Site selection is one of the most important parts of successfully growing hardy kiwis. Although the plants can withstand cold winter temperatures, the young shoots are very susceptible to spring freezes. When freeze damaged, the shoots will not bear fruit and all that is left is a pretty vine. Planting on a north facing slope or in a protected microclimate can reduce the risk of frost damage. Microclimates are areas that differ in climate from their general surroundings. Protected areas of the yard, such as those surrounded by mature trees or near the north or east side of a home, can slightly reduce the risk of frost. Most cultivars require a 150 day frost free period. To determine the typical number of frost free days in your area visit https://climate.usurf.usu.edu/.

Soil and Irrigation: Plants will perform best in a slightly acidic soil, pH level of 5 to 7. They can grow in a range of soil types but do best in a loamy soil. Incorporating organic matter into the soil before planting will help improve performance in a clay or sandy soil. Kiwi vines are sensitive to water-logged soils and root damage occurs if soils are too wet. Apply 2 to 3 inches of water each week throughout the summer months. With a very heavy crop load, additional watering may be necessary.

Planting and Spacing: Hardy kiwis need to have both male and female plants present for fruit to form. One male kiwi plant will provide enough pollen for about eight female plants. The male plant should not be more than 40 feet away from the females. Hardy kiwis are vigorous growers and producers. A mature vine can produce up to 100 pounds of fruit in one season. As such, it is critical to build a very sturdy support system at, or soon after planting. Plants should be placed every 10 to 14 feet within the row and a tall wooden stake driven into the ground by the base. Train one or two vines to go vertically up the stake without twisting. Leave 15 feet between rows if multiple rows are desired. Young plants benefit from trunk protection during winter and wrapping the trunks of plants younger than 5 years is recommended.

Trellising: Place one trellis post between each plant (about 10 to 14 feet apart) and at the ends of the row. Use trellis wire with at least 300 pounds of tensile strength. The cross-arm should be 5 feet long and centered on the support post, leaving 2.5 feet on both sides. This allows for five lines of wire to run along the top of the cross-arm. Use a good wire tensioner to achieve a strong tension. Place the cross-arm anywhere from 5 to 7 feet above the ground, depending on how tall you would like the vine to be. Train the main vine up the support stake to the cross-wire and then begin training the vines along the wire. Attaching the vine to the wire will help ensure vines stay put, particularly when it is windy.



Fertilizer: No fertilization is needed during the first year of planting, and should not be applied as the roots are susceptible to fertilizer burn. The second year, apply about ¼ cup of a balanced fertilizer (such as a 10-10-10) around the base of each plant. The amount of fertilizer can be increased each year, until you are applying 1 cup of fertilizer per plant by the fifth year after planting. Do not exceed this amount. Excessive fertilization leads to excess vegetative growth and can reduce overall fruit production. Do not use fertilizer containing chloride (such as KCl) since the plants are sensitive and can be damaged.

Training: Training begins the first year of planting. Establishing the trunks of the vine is important for a healthy, long-lasting plant. At planting, prune back to two buds. Place a stake next to the shoot to add support as you train it up to the wires of the trellis. Each bud will produce a shoot, select the healthier one of the two and train it to become the trunk. In year one, remove all other shoots during the growing season. Do not allow the trunk to wrap around the stake. Tie the shoot to the stake to help keep it in place. Let the trunk grow beyond the wire of the trellis and then prune back to just below the top wire. Choose two shoots near the wire and allow them to grow in opposite directions along the middle wire, forming the permanent lateral trunks (cordons). During the dormant season of the first year, head cordons back to ¼ inch diameter (see Figure 1).

During the second year, establish the two permanent cordons. As it grows, attach the shoot to the wire every 18 inches with tie tape. Leave shoots that come off of the main cordon every 8 to 12 inches and tie them to the outer trellis wires. Other shoots that grow between the selected During the second year, establish the two permanent cordons. As it grows, attach the shoot to the wire every 18 inches with tie tape. Leave shoots that come off of the main cordon every 8 to 12 inches and tie them to the outer trellis wires. Other shoots that grow between the selected ones should be removed. Again, during the dormant season prune the main cordons and the new lateral canes back to ¼ inch diameter wood. Fruit will form on shoots from these canes in the third year. As the lateral shoots continue to grow in the third year, do not allow them to wrap around the wire. Train laterals to be perpendicular to the cordon and then prune growth once they reach the outer wire. This will keep the vine manageable and reduce sunlight competition. After the first 3 years, the permanent vine is established and future pruning will be to renew canes and keep the planting manageable.

Pruning: Due to the hardy kiwi's vigorous growth, pruning is critical to maintain a balance between vegetative and reproductive growth and to allow for sufficient light penetration. Similar to grapes, a large percentage of wood (up to 70%) should be removed each year. Flowers develop on current-season shoots that come from last year's growth (1-year-old canes).

During the dormant season, remove all canes that fruited during the previous year. This will account for most of the wood removed. Also, remove any dead or diseased canes. New fruiting canes will have developed at the base of last year's lateral shoots. Every 8 to 12 inches along the cordon, leave the best replacement lateral canes. Tip these canes back, leaving about eight buds to force growth the next season and tie them to wires. Short fruiting branches called spurs often originate from the older wood. These do not need to be removed and will increase yield.

Male vines also require some pruning. The purpose of the male vine is to pollinize the female flowers. It is best to only lightly prune during the dormant season, just removing damaged and tangled shoots. However, after they flower in the spring, the same pruning techniques as were described for the females can be applied.

After the first 3 years of establishment, the cordon needs to be replaced every 3 to 4 years. To do this, lay a vigorous vegetative shoot from the trunk along the center wire in each direction one year before you plan to remove the old cordon. The following season, train lateral shoots from this new cordon the same as you did with the old one. Once the new cordon is established, the old one can be removed. Take care as you prune out the old one to minimize damage to the new laterals.

Protected Cultivation: As previously discussed, one of the biggest challenges for hardy kiwi production is the risk of freeze damage to new shoots. The plants begin growth very early and are extremely sensitive to cold temperatures. In some areas, protecting the vines by planting inside a high tunnel (an unheated greenhouse) has been successful. It might also be helpful to pull tarps or frost blankets over the trellis when spring freezes are predicted.

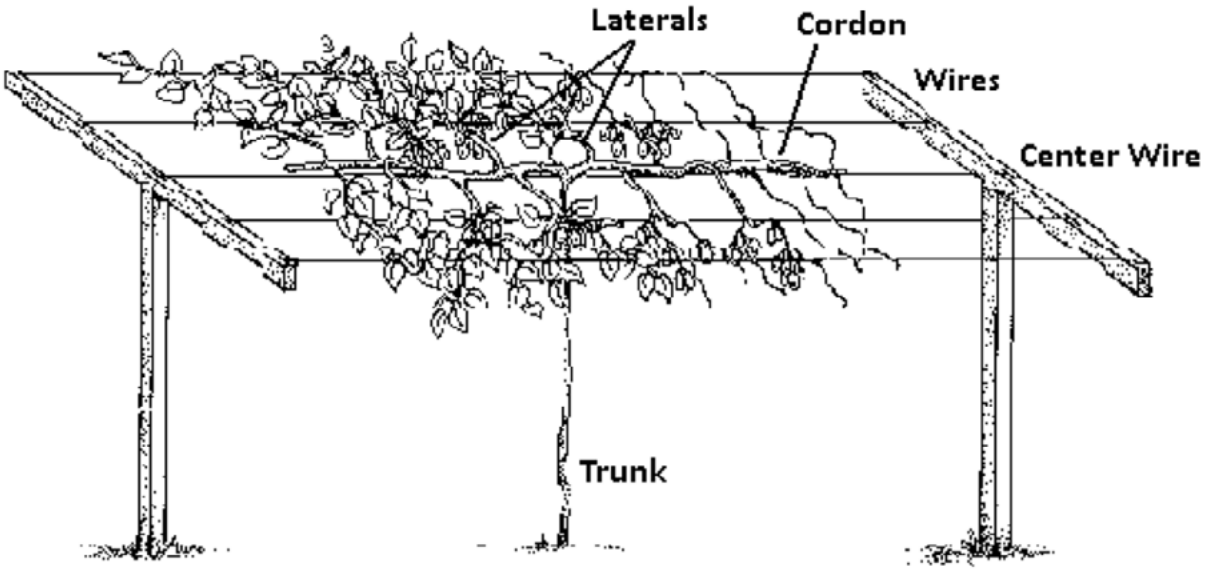


Figure 1. Kiwifruit vine in third growing season during fruiting. Leaves not shown on right to simplify drawing. Drawing reprinted with permission from Oregon State University Extension Bulletin PNW 507.

PROBLEMS

Insect/Disease	Identification	Control
Crown and Root Rot *Phytophthora* spp.	Weak plant growth and development of small yellow leaves, advanced cases have die back. Most common in heavy wet soils. Roots and crown turn black.	Avoid water-soaked soils and do not over irrigate. Remove infected plants and plant into a new site.
Two-spotted Spider Mites *Tetranychus urticae* Koch	Very small mite that feeds on the undersides of leaves. Has two dark spots on the back. Stippled leaves are a sign of mite feeding. Heavy infestations will have fine, silken threads on leaves and stems.	Keep dust levels low around plant. Use miticides registered for use on hardy kiwi.
Leafroller *Archips argyrospila*	Green caterpillars feed inside the protective shelter of a rolled leaf. Adults are mottled brown moths that lay eggs on stems.	Encourage natural enemies such as lacewing larvae or assassin bugs.

Weeds: To maintain plant health and vigor, weeds should be controlled. Before planting, eliminate perennial weeds through chemical control. Hardy kiwi plants benefit from a heavy mulch application at the base. This will reduce weed pressure (as well as keep soil more moist). Also, an early spring application of a pre-emergent herbicide will significantly cut down on annual weeds.

HARVESTING, STORAGE AND USE

Hardy kiwis may take up to 5 years before they start producing fruit, although many cultivars will fruit sooner. Kiwi fruit reach full size by mid-summer but usually are not ripe until late-August, September or even into October. Kiwi fruit should not be exposed to frost. If a frost is expected, harvest all of the fruit. Fruit ripen unevenly on the vine. Ripe fruit become very soft and will not store long after picking. The kiwi fruit will continue to ripen after it is harvested, even in the refrigerator. Harvesting the fruit just before fully ripe will help extend storage life, up to 3 weeks if kept cool. Fruit can be picked when they are still firm and the seeds are black; these store the longest and will ripen slowly in the fridge. Generally, the best time to pick at this stage is when some early fruit start to soften.

PRODUCTIVITY

A mature vine can produce 50 to 100 pounds of fruit each year (with the average being closer to 50 pounds), but remember that one of the vines will be a non-productive male plant., yield will be much lower during establishment, and in years when the blossoms are exposed to a spring frost.

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Authors: Tiffany Maughan, Research Associate & Brent Black, Extension Fruit Specialist

Haskap (Blue Honeysuckle) in the Garden

by Elisa Lauritzen, Tiffany Maughan & Brent Black

SUMMARY

Haskap berries are a relatively new crop in the United States and subsequently, the home garden. Haskaps, Lonicera caerulea L., are a long-lived, extremely hardy shrub. Fruits are an excellent source of vitamin C, with higher content than many other berries including blueberry, raspberry and strawberry.

Haskaps, also known as Blue Honeysuckle and Honeyberry, are native to northern Eurasia and Canada. The name "haskap" is used to indicate varieties that are a type of Japanese Blue Honeysuckle (subspecies emphyllocalyx), and the term "honeyberry" is the commercial name used for Russian and Kuril varieties of Blue Honeysuckle (subspecies kamtschatica and edulis). Japanese and Russian varieties respond differently to the Intermountain West's climate. These plants are native to very cold regions and experience scorching, mildew and pre-mature leaf drop when grown in warmer climates (above zone 6). Plants of Russian origin are more susceptible to summer injury in warm regions. In areas with intense summer heat, the Japanese varieties are better suited for planting. However, in colder, higher-elevation areas, the Russian types may be better adapted.

To avoid redundancy, the name "haskap" will be used here and is meant to include both the Japanese and Russian subspecies.

PLANTS

Haskaps are in the honeysuckle family and are a deciduous, cold hardy shrub that can live up to 30 years. They can grow to be 6 feet high and wide and the form varies significantly, from low-growing to upright, depending on the variety. Bushes do not sucker. Leaf shape varies dramatically among varieties and range from 1 to 4 inches long. Small, cream to yellow colored blossoms erupt in early spring and can withstand hard spring frosts down to 19 ˚F. The bush produces irregular shaped, dark blue fruits that vary from round to oblong (with many shapes in between) and range in size from ½ inch long to 2 inches or more, depending on cultivar. Berries ripen in early to mid-June, usually just before strawberries begin producing. Fruit can be tart to sweet with a flavor unique to itself but that some describe as a cross between raspberry, currant and blueberry.

Haskaps require cross-pollination with an unrelated cultivar that blooms at the same time. Due to the novelty of the plant, finding haskap at a local nursery may be difficult. Most purchases of these plants will need to be made through a catalog. Visit Cornell University's nursery list for a list of nurseries selling haskap plants. It is important to note that the most common cultivars available in plant nurseries are those that fall in the Russian subspecies and are commonly marketed as Honeyberries. Care should be taken when choosing plants to ensure that the cultivars are compatible for cross pollination. Choose reputable companies and be sure to inspect plants on arrival for damage, pests and healthy plant tissue.

RECOMMENDED VARIETIES

'Tundra' (4 to 5 feet tall) has firm skinned fruit that are fairly large. The plant is resistant to powdery mildew and is often used in commercial production because the berries have a dry picking scar and are quite firm. 'Borealis' (4 feet tall) is touted to be one of the best tasting cultivars. It produces large fruit and is well-suited for the home garden. 'Indigo Gem' (5 to 6 feet tall) produces fruit that is smaller and tangier than most other cultivars, and is a very heavy producer. Unfortunately, it is somewhat susceptible to powdery mildew. 'Blue Lightning' (5 feet tall) is a popular Russian cultivar and produces a heavy crop of sweet-tart dark blue berries. 'Kamchatka' (5-6 feet tall) is another Russian cultivar and produces large, abundant dark blue fruit.

HOW TO GROW

Soil: Haskaps prefer sunny locations with well-drained soils but do well in a variety of situations. Their native range includes calcareous soils with pH levels as high as 7.7, and may tolerate even higher pH levels. The plants grow naturally in river beds and marsh areas, giving them potential as a fruit crop that grows well in wet soils. Haskap has proven to be adaptable in a wide array of locations, light situations and soil types and will likely do well in many Utah gardens.

Soil Preparation: Soil preparation should be done before the arrival of the plants. It is recommended to have soil tested in order to add preplant fertilizer according to soil test recommendations. Additionally, organic matter is highly beneficial to all soil types in Utah and will increase nutrient availability and water-holding capacity in the soil. As with all garden plants, weed management should be a priority as weeds will compete for nutrients and water and can harbor unwanted pests and pathogens. Removing all existing weeds and controlling perennial weeds in the area before planting will provide long-term benefits in weed control.

Planting and Spacing: Fall is the best time to plant Haskap; however, spring plantings of dormant plants can be successful. Fall planting allows more time for root development helping plants survive summer heat. For most cultivars, leaving 3 to 4 feet between plants within the row and 6 to 10 feet between rows is sufficient. Some commercial growers plant bushes close enough in the row that they become a hedge, similar to a row of raspberries. Immediately after planting, thoroughly wet and disturb the soil to remove any air pockets that may remain around the roots.

Fertilization: Nitrogen fertilizers are recommended for spring application but discouraged after that time, as rapid growth late in the growing season can make the plant more susceptible to winter injury. One half cup per plant of a general, balanced fertilizer such as a 16-16-16 applied in the spring should be enough to meet the nutrient needs of the plant throughout the growing season.

Irrigation: Ensure that soils remain moist, but not overly wet, particularly during establishment. Haskap naturally grows near water and is not drought-tolerant. Drip irrigation is a particularly effective method as it keeps moisture off of the leaves and can be slowly applied, reducing runoff. Depending on the soil type, deep water the plant every 5 to 7 days. Frequent, shallow watering events discourage deep root development.

Pruning: Haskap plants need annual pruning to maintain vigor and encourage new, productive growth. The best time to prune is in late winter, while the bushes are still dormant. Pruning is minimal for the first three to four years: simply remove any dead, diseased or touching branches. Once the plant is well established and the canopy has filled in, pruning should also include thinning out the oldest branches to keep the canopy open and encourage new growth. Do not prune out more than 25% of the plant in any given year.

PROBLEMS

Haskaps have very few pests that affect fruit production. Sunscald on the fruit is an issue for high elevation plantings. Planting in an area protected from drying summer winds and late afternoon sun is recommended to help mitigate this issue. Deer seem to leave the plants alone, but birds can be a significant problem. Placing netting over plants in late May or early June will help reduce crop loss to birds.

Although it seldom affects the berries, in late summer the fungus powdery mildew (Sphaerotheca spp.) can develop. Watch for white powdery patches on the leaves in mid-summer. These patches will eventually turn brown. The best control option for powdery mildew is to plant resistant cultivars. Pruning to increase air circulation will also help keep disease occurrence low.

HARVEST, STORAGE, AND USE

Plants will likely produce only a handful of berries the first few years, but production will begin to increase by year 3 or 4. Yield potential depends on the cultivar, but can range from 5 to 15 pounds per plant each year once the plant is mature. Fruit will begin to change color in late May and early June and are usually ready for harvest a few weeks later. Fruit from some cultivars can 'bleed' from a picking scar and these cultivars have a shorter storage life than those that do not. Harvest is typically done by hand-picking each berry but with some cultivars, the fruit can be shaken off onto a tarp placed beneath the branches.

Haskap are great for fresh eating but do well in a plethora of processed foods. When frozen, the entire berry is reported to melt away in the mouth. Seeds are very small and similar to those of a kiwi. Haskap are commonly used in pies, jams, jellies, juices, and ice creams. They can be frozen, dried and bottled and are commonly used for winemaking.

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Authors: Elisa Lauritzen, Student, Tiffany Maughan, Research Associate & Brent Black, Extension Fruit Specialist

Hops

by Clark Owen & Dan Drost

SUMMARY

Hops are a perennial plant that can be harvested for many years. Growing hops is relatively easy if plants are grown in soil rich in organic matter and provided with sufficient vertical space for vine extension. Hops are a vigorous growing vine that requires a long growing
season and full sun. Hops are propagated from an underground stem planted in the spring after the danger of frost has past. The part of the plant that is used to brew beer is the cone, from the female plant. By purchasing and planting female plants, large seedless cones are produced. Cones are harvested in late August to early September and are ready for use once they are dried and become brittle and papery.

RECOMMENDED VARIETIES

When choosing hops plant it is important to select the right variety and purchase female plants. Selection depends on where you live and whether you want bittering or aroma varieties. American varieties like Galena, Mt. Hood, and Cascade grow best in Utah; European varieties don't have the flavor or aroma when they are grown in the United States.

Bittering Types	Aroma Types
Galena - most popular bittering hop (acid content of 11-13%)	Mt. Hood - medium vigor, improved yields (acid content of 3-4.5%)
Nugget - stores well, late to mature (acid content of 11-113%)	Tettnanger - early to mature (acid content of 4-5.5%)
	Cascade - early to mature, floral and spicy aroma (acid content of 5-7%)

HOW TO GROW

Where to Grow: Plant hops where there is space to grow the 20-30 foot long vine. Often a trellis is built to support the plant. Other areas can be on the side of a garage, up a chimney, or on a tall, long fence. Hops require full sun (12 hours), good air circulation, and well drained soil for high productivity.

Soil and Soil Preparation: Soil drainage is important, so a loose loam to a sandy loam (pH 6-7.5) is best. Add 3-6 inches of well composted organic matter and 2-4 tablespoons of all purpose fertilizer per plant to improve the fertility of the soil. Work the compost and fertilizer into the soil to a depth of 6-8 inches.

Planting: Plant no later than mid-April in warm areas and mid-May in cooler areas of Utah. Dig a narrow trench 12 inches deep and slightly longer than the rhizome. Plant one rhizome per hill with the buds pointed up and cover with 1 inch of loose soil. Space the rhizomes 3-4 feet apart and mulch the soil heavily. Mulch will aid in weed control and help conserve soil moisture.

Fertilization: Amend the soil with additional composted fertilizer each spring and side dress with some additional nitrogen at ½ tablespoon (21-0-0) per plant in June.

Growth and Training: From each rhizome, several shoots will emerge. When the vines are about 1 foot long, choose the two or three most vigorous shoots to grow and remove all remaining shoots. As the shoots elongate, train them onto the support structure by winding them in a clock wise direction, which follows their natural growth habit. Space out the vines as you train them to improve air circulation, light penetration, and help prevent diseases. The vines grow quickly, and will grow side branches when the plants reach 20 ft long. These side shoots produce the cones.

Insects and Diseases:

Insects	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. Aphids transmit virus diseases and secret honeydew making plants sticky and appear shiny and wet.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cutworms	Larvae feed near the soil surface and sever the emerging vines close to the ground. Most damage done at night.	Use barriers or collars around plants. Keep organic mulches way from young plants.
Spider mites	Adult and immature mites feed on leaves causing white speckling, bronzing, and defoliation. Adult have dark spots behind the eyes and are web spinners. Immature stages of the insect congregate on the undersides of leaves.	Control weeds which host over-wintering mites, apply strong water stream to dislodge the insect, use insecticidal soaps, appropriate insecticides as last resort.
Disease	**Symptom**	**Control**
Mildew	Growing vines darken, wilt and die. Associated with cool, wet weather.	Increase air circulation through vine pruning.

HARVEST AND STORAGE

Harvest occurs in late August and September. Hop cones are ripe when they feel dry, papery, and leaves are scented. Pick the cones over several harvests to assure that they are at the peak of maturity. Drying is normally done on window screens that are placed in the sun. This can take up to a week depending on temperature and humidity. To tell when the cones are properly dry, fold in half. If the stem breaks and the bracts shatter, the cone is dry. Store the hop cones in an airtight container and place in the freezer to preserve flavor until you are ready to use.

Vine Care: After harvest, cut the vines off the trellis leaving 2 feet of vine above ground. Bury this a few inches deep in a trench. The following spring the buried section will have produced buds and roots that can be used for propagation. The rhizome spreads over time, so you will need to contain it through soil cultivation and pruning.

Productivity: One hops plant will yield about 1-2 pounds of dried cones.

Authors: Clark Owen, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Horehound

by Becky Barton & Dan Drost

SUMMARY

Horehound (*Marrubium vulgare*) is a tender drought hardy perennial and a member of the mint family. This herb prefers full sun and well drained soils. Plant this herb in early spring, either from seed or transplants. Seeds are slow to germinate; therefore, sow shallow and keep moist for optimum emergence. Thin to 10 inches apart once established and harvest when the plant starts to bloom. Once established, horehound is very drought tolerant. Like all members of the mint family, it spreads rapidly and can become weedy. Horehound is used to make teas, candies and cough drops.

RECOMMENDED VARIETIES

Silver horehound has a whiter flower and has woollier leaves than the common horehound. Spanish horehound has a pink flower. Most plants are hardy to USDA Zone 4. Consult local specialty nurseries or seed catalogs for additional varieties. Horehound will generally survive winters unprotected, but may need some protection in colder areas of the state.

HOW TO GROW

Soils: Horehound grows in most soil types especially poor, dry and neglected soils. Horehound does best in full sun and sandy well drained soil. Most soils in Utah are well suited to horehound production.

Soil Preparation: Before planting, till the top 6 to 8 inches of soil and do not enrich the soil with fertilizer or compost.

Plants: Horehound can be started from seeds or cuttings in the early spring. Seeds should be sown just below the surface, about 1/4 inch deep, roughly 3 weeks before the frost free date for your area. Seeds are very slow to germinate. Once established, horehound readily self propagates if allowed to flower and set seed.

Planting and Spacing: After emergence, thin seedlings to 10 inches apart. Rooted cuttings can also be generated from young stems. Cut the stem just below a node, remove several of the lower leaves, dip in rooting hormone, and set the cuttings in warm, moist rooting medium. Once rooted, plants should be set about 1 foot apart. Horehound can also be propagated by root division of more mature plants.

Water: Horehound is a very drought tolerant plant. Excessive watering or standing water will kill the plant, especially if planted in a soggy site during the winter. During the summer, water no more than one time per week allowing the soil to dry between irrigations.

Fertilization: Horehound requires very little additional fertilizer during the year. Apply an all-purpose fertilizer early in the spring to encourage growth and some additional nitrogen after harvest to encourage new leaf growth using an organic or all-purpose liquid nitrogen. Avoid late season fertilizer applications so the plant hardens off before fall dormancy.

PROBLEMS

Weeds: Horehound has a tendency to be invasive in the garden, much like the mints. Many gardeners grow it in containers which are brought indoors later in the year. Horehound is a prolific seed producer so cut off the flowers before seeds set. Cultivate shallowly around the plants to control weeds and mulch with grass clippings, straw and newspapers.

Pests and Diseases: Horehound is not susceptible to many diseases or insects problems.

HARVEST AND STORAGE

Horehound generally does not produce flowers until the second year. Some leaves may be harvested the first year, removing only 1/3 of the leaves during the first year. Tie the harvested leaves together in a bundle and hang them indoors out of direct sunlight or in a shady place to dry. In subsequent years, flowers and leaves should be harvested at the peak of bloom. Once dry, chop the leaves and blooms and store them in an air tight container or jar. Dried horehound has a shelf life of about 1 year.

Productivity: Production depends on the variety planted and number of plants grown. Plant two to three plants for fresh use and an additional two to three plants for storage.

Uses/Nutrition: Horehound is an immune booster and contains vitamins A, B, C, E, essential fatty acids, iron, and potassium. The leaves and flowers have a minty-menthol flavor and are used in teas, candies, and cough drops. Many herbs are used for their claimed health benefits. For more information on herbal medicines, refer to a reliable information source for details on the benefits or hazards to using an herbal medicine. One such source is the National Institutes of Health's herbal medicine website:

http://www.nlm.nih.gov/medlineplus/herbalmedicine.html

ADDITIONAL RESOURCES

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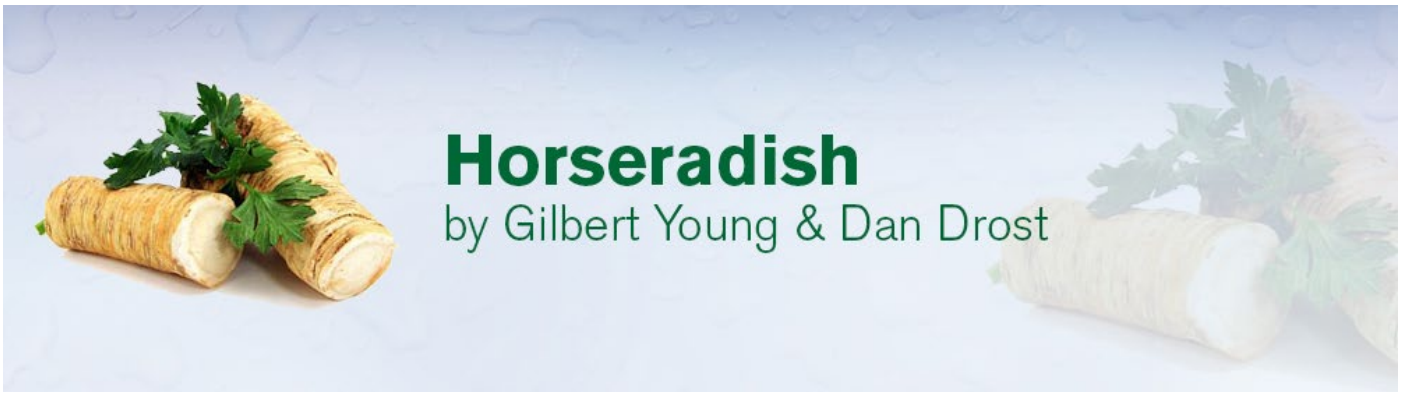
Authors: Becky Barton, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist



Horseradish

by Gilbert Young & Dan Drost

SUMMARY

Horseradish is a hardy perennial vegetable that is grown for its thick yellowish to white taproot. It is cultivated from crown or root cuttings planted in the early spring. Horseradish will grow about anywhere, but the roots are larger, tastier, and less branched when given proper care and cultivation.

RECOMMENDED VARIETIES

Maliner Kren is a German variety that has the most vigorous growth and largest roots. New Bohemian is a variety that may lack the root quality and yield of other varieties, but is resistant to white rust and mosaic. Variegata is a cultivar that is less invasive, has cream variegated leaves, and tolerates partial shade. Very few garden centers stock horseradish roots so look for them on the internet or get a root cutting from a gardener or friend who grows the plants.

HOW TO GROW

Soils: Horseradish will grow in all soil types provided they are well drained, high in organic matter, and fertile. The recommended pH is 6.0 to 7.5.

Soil Preparation: Before planting, incorporate 4-6 inches of well-composted organic matter and 2 ounces of all-purpose fertilizer (16-16-8) per square yard of planting area. Double dig this into the soil to provide a good rooting environment for the plants.

Plants: Horseradish grows best at cool temperatures (60-65°F). Horseradish also requires a fairly cold fall, when the root size and flavors develop. During the growing season, remove any of the bottom leaves that turn brown.

Planting and Spacing: Horseradish is propagated from crown or root cuttings. For areas with short growing seasons, use the crown method. Dig a plant and split the root into four equal pieces containing some leaf and root tissue. Let the wounds heal for several days before planting at a 45-degree angle, with the crown positioned 1 to 2 inches below the soil surface. Root cuttings are pencil sized pieces of root collected from larger roots. Cut the end close to the main root square and the other end on an angle. Plant the square end of the root higher than the angled end. Plant these root pieces 2-3 inches deep and 1 foot apart. To keep horseradish from spreading, some gardeners plant the roots in buried pots or in 12 inch wide and 24 inch long PVC plastic pipes. Plant in late March or early April, for the average garden, four to six plants are sufficient to meet the family's needs.

Water: Horseradish is quite drought tolerant, but the roots become woody and has a weak flavor if stressed too much. The roots become very soft and have a strong flavor if over watered. Water horseradish once a week (1-2 inches of water) so it penetrates to a depth of 18-24 inches.

Fertilization: In addition to the fertilizer and at planting, apply 1 teaspoon per plant of nitrogen (21-0-0) 4 and 8 weeks after planting. Too much nitrogen will cause excessive top growth and root branching.

Handling: To produce smooth, strong roots, some gardeners dig around the plant after growth starts to remove all additional leaf shoots except the one at the top. After the leaves reach 1 foot in height, they will also dig around the plant to uncover the upper part of the root and carefully remove all of the larger lateral (branch) roots. These procedures help ensure that the main root grows vigorously.

M**ulches and Row Covers:** Mulching with compost or leaves during the year will help retain moisture and suppress weeds.

PEST CONTROL

Weeds: Hoeing between horseradish plants is recommended during the early growth when plants are small. When it matures, it is difficult for weeds to grow near horseradish.

Insects and Diseases: Few pests or diseases affect horseradish. Root rot is common if plants are over watered.

HARVEST AND STORAGE

In regions with long growing seasons (150 days), horseradish can be harvested at the end of first year. Horseradish is harvested in the autumn and the root is stored until the next spring when plants are replanted. It is important to dig all the roots during harvest since small roots from the horseradish can become a weed in the garden. Harvest begins after several frosts which helps improve flavor. Dig up the plant, trim off the tops and side roots and scrub root clean. For immediate consumption, grate only as much as you will use in a month and store in the refrigerator. Intact roots will retain their flavor for up to 3 months if stored properly. Horseradish roots should be stored in moist sand or sawdust in a dark root cellar, or they can be put in a plastic bag with moist sand and stored in the refrigerator. Save the side roots for planting the next spring.

Productivity: Horseradish produces from 3 to 7 pounds per square yard of planted area. One root will make about a half-pint of horseradish sauce.

Nutrition: Horseradish provides potassium, calcium, vitamin C, phosphorus, iron, and vitamin B. Horseradish also has antibiotic properties.

FREQUENTLY ASKED QUESTIONS

Can horseradish leaves and roots be fed to livestock? Do not feed animals horseradish, the volatile oils in the plant cause acute inflammation of the stomach and can be fatal.

Authors: Gilbert Young, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Kale

by Dan Drost & Michael Johnson

SUMMARY

Kale is a cool season vegetable that prefers a sunny location and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep. Thin seedlings or transplant kale 12-18 inches apart in the row with rows 2 feet apart. Plant out 4-5 weeks before the last frost. Kale tastes best when plants grow rapidly and mature before the heat of summer or after fall frosts occur. Avoid water or fertilizer stress during growth. Irrigation should be deep and infrequent. Control insects and diseases throughout the year. Harvest kale when the leaves reach full size.

RECOMMENDED VARIETIES

There are many good kale varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Vates Blue Scotch Curled (55 days), Red Russian (60 days), and Winterbor (65 days) have excellent production, eating quality and cold hardiness.

HOW TO GROW

Soils: Kale prefers fertile, well-drained soil rich in organic matter for best growth. Most soils in Utah are suitable for kale production.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Kale can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants are used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted kale should be spaced 12-18 inches between plants in the row with rows 2 feet apart. Kale grows best when temperatures do not exceed 75°F. Young plants are not seriously damaged by temperatures down to 25°F. Mature plants are extremely hardy and can withstand very cold temperatures without damage. Transplants should be planted 4-5 weeks before the last frost free date for the growing area. Seeded kale may be planted at the same time. For fall maturing kale, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 2-3 weeks after the first fall frost. Plants can be left in the garden throughout the winter to supply greens out of season. High summer temperatures reduce growth, decrease quality, and cause bitter or off flavors to develop.

Water: Water kale deeply and infrequently while trying to maintain even soil moisture. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Applying mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations will cause leaves to become tough and develop off flavors.

Fertilization: Apply 1/2 cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or thinning to encourage rapid plant growth. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weed growth and allow earlier planting and maturity, especially with transplants. Fabric covers are used to protect seedlings and transplants from frosts and insect pests. Apply organic mulches when temperatures increase. Mulches will help keep the soil cool and will reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small and be careful not to damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms and loopers are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in kale heads.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Controls with appropriate insecticides at seeding or after seedlings have emerged from the soil.

HARVEST AND STORAGE

Kale should be harvested when the leaves reach full size. Older leaves are generally stripped off the plants first allowing the young leaves to continue to grow. Frosts help improve the flavor of the fall planted crop. Kale can be stored for 2-3 weeks at 32°F and 95% relative humidity. Many gardeners leave kale growing in the garden throughout the winter.

Productivity: Plant 5-10 feet of kale per person for fresh use and an additional 15-20 for processing. Expect 30 pounds per 100 feet of row.

Nutrition: Kale has no fat, is high in vitamin A and vitamin C, is a good source of calcium and iron and is considered one of the most nutritious of vegetables.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

Kohlrabi

by Dan Drost & Michael Johnson

SUMMARY

Kohlrabi is a cool season vegetable that prefers a sunny location and fertile, well-drained soil. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-¾ inch deep, 1-2 weeks before the last frost in the spring. Thin seedlings or transplant kohlrabi 6 inches apart in the row with rows 1 foot apart. Irrigate regularly, and avoid water or fertilizer stress during growth. Kohlrabi is the least hardy of the cabbage like vegetables. Temperatures below 45°F will cause the plant to flower. Hot weather causes the stem to become woody and tough. Control insects and diseases throughout the year. Harvest kohlrabi when the stem enlarges to 2-3 inches in diameter.

RECOMMENDED VARIETIES

There are many good kohlrabi varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Rapid (45 days, purple skin), Grand Duke (50 days), White Vienna, and Purple Vienna (60 days) have excellent production, eating quality, and flavor.

HOW TO GROW

Soils: Kohlrabi prefers fertile, well-drained soil rich in organic matter for best growth. Most soils in Utah are suitable for kohlrabi production.

Soil Preparation: Before planting, incorporate 15-20 lbs of well-composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet.

Plants: Kohlrabi can be grown from seed or transplants. Seeds should be planted ¼-¾ inch deep and thinned to the final stand when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas. Transplants can be used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting. Generally 4-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted kohlrabi should be spaced 6 inches between plants in the row with rows 1 foot apart. Kohlrabi grows best when temperatures do not exceed 75°F. Young plants may be damaged by hard frosts. Mature plants will flower if average temperatures during growth are less than 45°F. Transplants may be planted 1-2 weeks before the last frost date for the growing area. Seeded kohlrabi may be planted at the same time. For fall maturing kohlrabi, select early maturing cultivars and plant 50 days before the anticipated maturity date. The maturity date can be timed for 2-3 weeks after the first fall frost. High summer temperatures reduce growth, decrease quality, and cause the enlarging stems to become tough and woody. In hot areas it is best to grow kohlrabi as a spring or autumn crop.

Water: Water kohlrabi frequently, since roots are shallow. About 1-2 inches of water are required per week. Use drip irrigation if possible to conserve water. Applying mulch around the plant also helps conserve soil moisture and reduces weed growth. Moisture fluctuations will cause the stems to become tough and woody.

Fertilization: Apply 1 cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 3 weeks after transplanting or thinning to encourage rapid plant growth. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weed growth and allow earlier planting and maturity, especially with transplants. Fabric covers are used to protect seedlings and transplants from frosts and insect pests. Apply organic mulches when temperatures increase. Mulches will help keep the soil cool and will reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspaper also help control weeds.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Be sure to control weeds when plants are small and be careful not to damage roots when cultivating.

Insects and Disease:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms and loopers are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in kohlrabi leaves.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

HARVEST AND STORAGE

Kohlrabi should be harvested when the stems reach 2-3 inches in diameter. Larger stems tend to be tough and woody. The young leaves can also be eaten like cabbage or kale. Kohlrabi can be stored for 2-3 weeks at 32°F and 95% relative humidity. When prepared, the outer skin is peeled off and the inner flesh is eaten raw or cooked. Kohlrabi tastes like turnips with a texture like water chestnuts.

Productivity: Plant 3-5 feet of row per person for fresh use and an additional 5-10 feet of row for storage or processing purposes. Expect 50-75 lbs per 100 feet of row.

Nutrition: Kohlrabi has no fat, and is a good source of fiber and potassium.

FREQUENTLY ASKED QUESTIONS

Some of my kohlrabi is tough and woody. Is that normal? Kohlrabi should be harvested when the enlarged stem is 2-3 inches in diameter, otherwise it will become woodier as it continues to grow.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Michael Johnson, USU Extension Grand County Agent

SUMMARY

Leek is a hardy cool-season biennial that prefers full sun and fertile, well-drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ¼-½ inch deep, 3-4 inches apart in the row, and 8-16 inches between rows. Side dress leeks with nitrogen in May and June to ensure good growth and high yields. Leeks require regular watering, so maintain soils near field capacity. Water stress will reduce yields and plant size. Organic mulches help conserve water, supply extra nutrients and reduce weeding. Control weeds, insects and diseases throughout the year. Leeks may be harvested and used when larger than 1 inch in diameter. In more mild areas of Utah, leeks can be stored in the garden by hilling up the soil around the plants and covering them with mulch. In very cold areas, harvest the plants and store in cold (32-40°F), humid conditions to maintain best quality.

RECOMMENDED VARIETIES

Excellent varieties include Large American Flag and King Richard. Check with local garden centers or seed catalogs for other varieties that perform well in your area.

HOW TO GROW

Soils: Leeks will grow in all soil types provided they are rich, well drained, moist, and fertile.

Plants: For earlier production, use transplants for planting out in early April. Seeds may be started indoors or in a greenhouse. Transplants need 6-8 weeks of growth before planting in the garden.

Planting and Spacing: If using seeds plant seeds ¼-½ inch deep. After emergence, seeds should be thinned to 4-6 inches apart in rows 8-16 inches apart. Transplants should be planted at the same spacing as seeds. Plant seeds in late March or transplants in April. When transplanting, place 10-12 inch tall plants in a 6-inch deep dibble hole and water them into place. During the growing season, hill around the plants with soil 2-3 times with 2-3 inches of banked up soil. Hilling encourages taller growth thus producing a larger blanched edible stem. Transplanting with the dibble method partially eliminates the need for multiple hilling.

Water: Leeks require regular watering throughout growth for best production. Soils need to be maintained near field capacity. Moisten the soil thoroughly to a depth of 18 inches every 7 days. Water needs are critical since rooting depth in leeks is shallow. Drought stress during growth will decrease yield.

Fertilization: In addition to the fertilizer used at planting, leeks needs additional nitrogen fertilizer to produce optimum yields. Side dress leeks with nitrogen at 1/2 lb (21-0-0) per 100 square feet in late May and June.

PROBLEMS

Weeds: Control weeds through regular cultivation but avoid root damage that slows plant growth by damaging shallow roots. Weed control is particularly important during the first 2 months of growth when plants are growing slowly and compete poorly. Mulching with compost, grass clippings or leaves will conserve water and smother weeds.

Insects and Disease:

Insect	Identification	Control
Thrips	Tiny, slender insects that feed on leaves. Leaves turn silver or gray, may twist and die. Thrips hide near where the leaf and bulb meet.	Spray with registered chemicals
Onion Maggot	White worm that feeds on seedlings, roots or bulbs.	Use crop rotation, avoid excessive amounts of organic matter, and apply appropriate insecticide at planting if maggots have been a problem in the past..
Wireworm	Larvae of chick beetle. Dark brown to yellowish, jointed hard-shelled and cylindrical. Feeds on roots, seeds, and underground stems.	Use crop rotation, avoid excessive amounts of organic matter, and apply appropriate insecticide at planting if a problem in the past. Rotenone or wood ashes also provide some control.

HARVEST AND STORAGE

Leek varieties vary in their maturity times. Leeks may be harvested as early as 60 days after seeding but generally require 100-120 days to mature. Leeks are ready to eat when the stalks are 1 inch in diameter. Leeks can be overwintered in the garden in most areas. Hill up the soil around the plants and cover them with a heavy layer of mulch and soil. In very cold areas, store harvested leeks in cold (32-40^{o}F), humid conditions (wet sand) to minimize moisture loss.

Productivity: One leek seed or transplant will yield one sheath 6-8 inches long and 1-2 inches wide. Plant 3-6 feet of row per person per family in order to have sufficient for fresh and storage purposes.

Nutrition: A 1-cup serving of leeks is low in sodium, and very low in saturated fat and cholesterol. They are a good source of dietary fiber, vitamin B6, iron and magnesium, and a very good source of vitamin A, vitamin C and folate.

FREQUENTLY ASKED QUESTIONS

What are leeks used for? Leeks are used in a variety of delicious dishes including, but not limited to, soups, salads and casseroles.

Can leeks be frozen as a storage method? Leeks can be frozen, pickled, canned or dehydrated. When freezing leeks, trim and then blanch for 2 to 3 minutes in boiling water. Cool rapidly, towel dry and place in freezer bags.

Authors: Dan Drost, USU Extension Vegetable Specialist

Lemon Balm

by Hyrum Gillespie & Dan Drost

SUMMARY

Lemon balm (*Melissa officinalis*), also called heart's delight, lemon mint, balm mint, blue balm, garden balm, or sweet balm, is a useful perennial herb for your garden. Lemon balm has heart-shaped or slightly rounded leaves, square stems, and has a strong lemon aroma and flavor. Plant 18 inches apart in the early spring in an enriched soil. Water regularly, but fertilize sparingly, throughout the year. Regular harvest will help contain its growth. Use lemon balm fresh, or dry for storage. Lemon balm propagates easily, is a low maintenance plant, and will make a nice addition to your home garden.

RECOMMENDED VARIETIES

Common varieties include "Aurea" (leaves are light green with blotches of gold) and "All Gold" (completely golden leaves). There are other species of lemon balm like plants from the Mediterranean and Asian regions, but only Melissa officinalis L. is cultivated. Check for seed or plant availability with your local garden center or from various seed catalogs.

HOW TO GROW

Soils: Lemon balm grows in most soil types provided it is rich, humus filled, moist, and well-drained.

Plants: Lemon balm is propagated from seeds or transplants grown from stem and root cuttings (divisions) or by layering. To grow lemon balm from seeds, sow in the early spring (around March). Since the seeds are very small, cover them with a fine layer of soil and keep the area moist. The most reliable method to propagate lemon balm is by layering. Select a 6 to 12 inch long, low-growing flexible stem and make a small cut on the underside of the stem. Stake the stem to the ground and cover it with 3 to 4 inches of soil. Roots will grow from the stem near the cut in 1 to 2 months. Plant division is one of the easier ways to propagate lemon balm. Root pieces, containing three or four buds, are taken from older plants that are dug up and divided. Plant them in August or September so they can establish new growth before the first frost and then mulch heavily for the winter.

Planting and Spacing: Lemon balm grows from 2 to 3 feet high and should be spaced 18 to 24 inches apart. Lemon balm prefers full sunlight but will grow in light shade. Plants grown with some shade tend to produce larger and more succulent leaves.

Water: Lemon balm is a hardy perennial herb that grows best when it is not water stressed. Keep the soil moist, but not wet, or the plants will get root rot. Supply water through drip or overhead irrigation and mulch around the plants to conserve soil water.

Fertilization: Lemon balm responds to general all-purpose fertilizer. Feed in the spring to encourage new growth and again after harvest to encourage additional leaf growth. Over-fertilization causes excessive growth and poor flavor development.

Mulching: Mulching helps conserve soil moisture, control weeds, and aids in plant survival over the winter. Organic mulches include grass clippings, bark, leaves, compost, or shredded newspapers.

PROBLEMS

Weeds: Weed control is very important because the presence of weeds in the dried product will reduce the quality of the herb. Lemon balm does spread rapidly (becomes weedy) and can take over an herb bed. Growing plants in containers can help control

this problem. If planted in the soil, harvest the leaves regularly, remove the flowers before they set seed, and dig around the plant edges to reduce root spreading.

Insects and Disease: Lemon balm is generally not bothered by insects or diseases because of its high natural oils concentration. Powdery mildew and root rots can be a problem if plants are over-watered. There have been reports of aphid and mite problems affecting plant growth.

HARVEST AND CURING

Frequent harvest encourages branching and will keeps lemon balm bushy and compact. Harvest about one-third of the foliage at monthly intervals to encourage healthy growth. Harvest before the plant starts to bloom, being careful not to bruise the leaves. After harvesting, tie the stems in a bundle and hang them indoors out of direct sunlight or in a shady place to dry. Dried leaves retain their green color, but are not as fragrant as when used fresh. Carefully strip the dried leaves from the stems and store in airtight containers.

Productivity: Production depends on the variety planted and number of plants grown. Plant two to three plants for fresh use and an additional two to three plants for storage.

Nutrition: Lemon balm has a variety of culinary, medicinal, and ornamental purposes. Fresh sprigs are used to flavor drinks and as garnishes in salads and main dishes. Dried leaves can be used for teas, soup flavorings, and for medicinal purposes. The oil of lemon
balm is also used to make perfumes. Many herbs are used for their claimed health benefits. For more information on herbal medicines,
refer to a reliable information source for details on the benefits or hazards to using an herbal medicine. One such source is the National Institutes of Health's herbal medicine website:

http://www.nlm.nih.gov/medlineplus/herbalmedicine.html

ADDITIONAL RESOURCES

The following fact sheets provide additional information on improving soil conditions in the home garden. Go to:

http://extension.usu.edu/htm/publications/by=category/category=112

Using Mulches in Utah Landscapes & Gardens
- Solutions to Soil Problems: III Drainage
- Solutions to Soil Problems: IV Soil Structure (Compaction)
- Solutions to Soil Problems: V Low Organic Matter
- Selecting and Using Inorganic Fertilizers
- Selecting and Using Organic Fertilizers

Lesley Bremness. 2002. Smithsonian Handbooks: Herbs. Dorling Kindersley Publishing, 304p.

Authors: Hyrum Gillespie, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Lemongrass

by Terra Linse & Dan Drost

SUMMARY

Lemongrass (*Cymbopogon citratus*) is an easy to grow herb that requires warm, humid conditions, full sunlight and plenty of moisture. It is a tender perennial that is commonly grown as an annual in cooler areas of Utah. Plant lemongrass after the last frost or grow it in a pot and move it outdoors after temperatures warm in the spring. Nurseries and seed companies will generally sell small starter plants. Fresh stalks of lemongrass (leaves and roots absent) can be purchased at grocery stores specializing in Asian cuisine and will root in a glass of water in about 2 weeks. Water and feed regularly from June through September to maximize growth. Bring potted plants indoors when temperatures cool in the fall.

LEMONGRASS VARIETIES

Only two of the 55 species of Cymbopogon are used as lemongrass. The East-Indian lemongrass (Cochin or Malabar grass) and the West-Indian lemongrass are typically used for cooking. Check with specialty nurseries and garden centers for available plants.

HOW TO GROW

Soils: Lemongrass prefers well-drained, moist, rich loam soil with high organic content. It will tolerate poor soils if provided adequate moisture and good drainage. Water logged soils should be avoided.

Soil Preparation: Before planting, amend soils with 2 to 4 inches of organically rich compost. Work it 4 to 6 inches deep into the soil. For outdoor grown potted plants, apply a ½ strength solution of a nutrient balanced water soluble fertilizer every week to 10 days to maximize growth.

Plants: Divide last year's lemongrass clumps or purchase starter plants from local nurseries. Lemongrass is rarely grown from seed. Plant the divisions after the danger from frost has passed. Lemongrass grows slowly until the heat of summer arrives, then it increases in size dramatically. Typically plants will produce several harvestable stalks by the end of the summer.

Planting and Spacing: Lemongrass divisions should be spaced 3 feet apart in the garden since it can grow 3 to 6 feet tall and 3 feet wide, if water, fertilizer and growing conditions are optimal. In cooler areas of northern Utah, lemongrass should be planted in a pot.
After harvest or before the first fall frost, save a 6 inch section of the bulbous shoot base. These sections with attached roots can also be divided and potted the following year. Smaller container plants can be overwintered indoors. Divided or containerized plants need to be grown in a warm, bright, sunny location.

Water: Lemongrass is native to tropical climates, so it prefers regular rainfall and more humid conditions. In Utah's dry climate, it should be misted and regularly watered. Water lemongrass by hand or use flood irrigation rather than irrigate with sprinklers. If grown in a container, water regularly so the pots do not dry out.

Fertilization: Like other grasses, lemongrass requires lots of nitrogen during the summer. It should be feed weekly with a half-strength solution of a balanced soluble fertilizer from June through September. Supply a similar fertilizer monthly for plants in the ground.

PROBLEMS

Weeds: Weeds don't compete well with mature lemongrass. Hand weeding may be required when plants are small.

Insects and Diseases:

Insects	Identification	Control
Spider Mites	Piercing type pest that feed on plants cell contents causing tiny yellow or white speckling. Problem mostly on indoor plants.	Use insecticidal soaps, registered insecticides or spray plant with a forceful jet of water to dislodge the insects.
Diseases	**Symptom**	**Control**
Leaf Blight	Reddish brown spots on leaf tips and margins; appear to be prematurely drying.	Spray with registered fungicides if positively identified or hand remove blighted leaves.
Little Leaf or Grassy Shoot	Stunted growth of normal inflorescence.	Spray with registered fungicides if positively identified.

HARVEST AND STORAGE

In cooler areas of Utah, harvesting occurs at the end of the growing season just before the first fall frost. However, lemongrass can be harvested at anytime, once the plant stalks have reached ½ inch thick. To harvest, cut stems at ground level, or push an outside stem to the side, twist and pull off or cut with a knife. Discard the outer woody layers and the leaves. The entire plant of the lemongrass can be used for cooking. Plant stalks are quite hard, so they are usually mashed and simmered in water to extract the lemony flavor. Stalks can also be crushed and placed in the bottom of foil wrappings with meat or vegetables. Once cooked the tender interior core can be sliced and used in a variety of dishes. The lemongrass leaves are used to flavor teas, soups and sauces. Dry lemongrass leaves in the sun or oven and use like bay leaf in soups and teas. Lemongrass can be frozen up to 6 months.

Productivity: Stalk productivity depends on how well plants are maintained. It grows rapidly if supplied with sufficient water, fertilizer, sunlight and humidity. Productivity can be improved by dividing older plants. Older stalks should be harvested first to promote new stalk growth. Lemongrass grown indoors will not produce as many stalks, due to low light conditions. It comes back quickly when returned to the garden the next spring.

Nutrition: Lemongrass oil is used in soap, perfume, makeup, hair products, a cleaning agent, antifungal agent, incense and potpourri. It is also used as an effective, non-toxic insect repellent. Lemongrass is rich in vitamin A and reportedly has many medicinal benefits. For more information on herbal medicines, refer to a reliable information source for details on the benefits or hazards. One such source is the National Institutes of Health's herbal medicine website:

http://www.nlm.nih.gov/medlineplus/herbalmedicine.html

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Authors: Terra Linse, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Lettuce

by Dan Drost

SUMMARY

Lettuce is a cool-season vegetable that prefers sunny locations and fertile, well-drained soil. Plant seeds ¼-½ inch deep, 2-3 weeks before the last frost. Final spacing for head lettuce should be 8-12 inches apart in the row with rows 12-18 inches apart. Lettuce tastes best when plants grow rapidly and mature before the heat of summer. Avoid water or fertilizer stress during growth. Control insect and diseases throughout the year. Harvest lettuce when the leaves or heads reach full size.

RECOMMENDED VARIETIES

Lettuce comes in a variety of head types, leaf colors and textures. Planting a range of different types makes salads more interesting. Varieties vary greatly in maturity, flavor, texture, and tolerance to garden conditions. There are many good varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Here are a few selections to try.

Head Type	Varieties
Crisphead	Summertime, Salinas, Great Lakes, Iceberg
Butterhead	Buttercrunch, Esmeralda
Cos (Romaine)	Lentissima, Cimmaron Red Romaine, Italian Blonde Romaine
Leaf	Red Sails, Oakleaf, Salad Bowl, Black Seeded Simpson

HOW TO GROW

Soils: Lettuce prefers fertile, well-drained soils rich in organic matter for best growth. Most soils in Utah are well suited for lettuce production.

Soil Preparation: Before planting, incorporate 2-4 inches of well composted organic matter or apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Lettuce can be grown from seed or transplants. Lettuce can be sown after soils reach 40°F though seeds germinate best at 55-65°F and will emerge in 7-10 days. Temperatures above 80°F reduce seed germination. Seeds should be planted ¼-½ inch deep and thinned when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas if some roots are maintained. Thinned plants can also be eaten. Transplants provide an earlier harvest. Transplants should have 4-6 mature leaves and a well developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted lettuce should be spaced 8-12 inches between plants in the row with 12-18 inches between rows in a location that will receive full sunlight. Dense plantings will reduce weed pressure. Lettuce grows best when temperatures do not exceed 75°F. Temperatures down to 32°F do not seriously damage young plants. Transplants should be planted near the last frost-free date for the growing area. Seeded lettuce may be planted 2-3 weeks earlier. High summer temperatures reduce growth, decrease quality, and cause bitter or off flavors to develop. For fall lettuce, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 1-2 weeks before the first fall frost. Plants can be left in the garden after light frosts.

Water: Water lettuce regularly supplying 1-2 inches per week. Water requirements depend on soil type and temperatures. Use drip irrigation if possible to conserve water. A mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations will cause leaves to become tough, slow head development and contribute to off-flavors. Wet and dry periods favor the development of tipburn, a browning of the edge of some of the internal leaves.

Fertilization: Apply 1/4 cup of a nitrogen based fertilizer (21-0-0) per 10 foot of row 4 weeks after transplanting or thinning to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches and Row Covers: Plastic mulches help conserve water, reduce weeding and allow for very early maturity, especially with transplants. Fabric covers are used to protect seedlings and transplants from frost. Apply organic mulches such as grass clippings, straw, and newspapers to cool the soil when temperatures increase, reduce water stress, and help control weeds.

PROBLEMS

Weeds: Lettuce does not compete well with weeds. Weed control is particularly important during establishment. Closely spaced plants will help control weeds. Cultivate shallowly and avoid root pruning to ensure uninterrupted growth.

Insects	Identification	Control
Spider Mites	Piercing type pest that feed on plants cell contents causing tiny yellow or white speckling. Problem mostly on indoor plants.	Use insecticidal soaps, registered insecticides or spray plant with a forceful jet of water to dislodge the insects.
Diseases	**Symptom**	**Control**
Leaf Blight	Reddish brown spots on leaf tips and margins; appear to be prematurely drying.	Spray with registered fungicides if positively identified or hand remove blighted leaves.
Little Leaf or Grassy Shoot	Stunted growth of normal inflorescence.	Spray with registered fungicides if positively identified.

Pests and Diseases: Most lettuce is fast growing and is not susceptible to many production problems. Rotating locations from year to year helps control most diseases.

HARVEST AND STORAGE

Lettuce can be harvested almost any time during growth. Crisphead lettuce should be harvested when heads are firm. Butterhead and cos lettuce are harvested when heads are in the early heading stage. Leaf lettuce may be picked anytime after leaves form, but before the seed stalk forms. Older leaves are often stripped off the plants first, allowing the young leaves to continue to grow. Lettuce can be stored for 1-2 weeks if refrigerated. Some gardeners grow lettuce hydoponically throughout the winter under artificial lights.

Productivity: A 10-15 foot of row will yield 6-10 pounds of lettuce. Plant 10-20 feet of row per person.

Nutrition: Lettuce is low in fat, sodium, and cholesterol. It is a good source of fiber, vitamins A, C, B6, folate, calcium, iron, and potassium.

FREQUENTLY ASKED QUESTIONS

How do you prevent lettuce from browning when stored several days in the refrigerator? To prevent browning, store at low temperature (ideally 34-36°F) and elimination excess moisture on the leaves. Leaf spotting will also occur if lettuce is stored with ethylene producing fruits like apple or pear.

How do I prevent my lettuce from going bitter? Avoid water stressing the plants and growing lettuce in temperatures above 80°F. Wash and store the leaves in the refrigerator for a day or two. Much of the bitterness will disappear.

Author: Dan Drost, USU Extension Vegetable Specialist

Mint

by Kristie Buckland & Dan Drost

SUMMARY

Mint is a rapid growing perennial herb with many varieties that grow up to 3 feet tall and are quite invasive. Mint grows best in full sun to partial shade, should be planted early in the growing season and is generally hardy to -20° F. Mint prefers moist soil conditions, but excess water will promote root and leaf diseases. Harvest leaves and stems throughout the season, or cut back within an inch of the ground about three times a season, just before the plant blooms.

RECOMMENDED VARIETIES

Use care when selecting mint varieties. The tastes and smells vary greatly between most varieties and some may have adverse side effects if consumed in excess. For cold areas of Utah, peppermint, spearmint, and apple or woolly mints are very hardy. All varieties are well suited to those areas of Utah with more mild winters. Culinary varieties include those listed above and those with mint-like flavors like red raripila mint, ginger mint (redmint), horsemint, and pineapple mint. Medicinal mint types widely used in teas and medicinal preparations include watermint, corn or field mint, and pennyroyal.

HOW TO GROW

Soils: Mint prefers rich, moist and slightly acidic soils and grows best in full sun or partial shade. Most soils in Utah are suited to mint provided they are amended with compost. If growing a variegated variety (pineapple mint), full sun may scorch the leaves.

Soil Preparation: Before planting, apply 2 to 4 inches of composted manure and ½ tablespoon of all-purpose fertilizer (16-16-8) per square foot of planting bed. Work this into the top 6 inches of soil.

Plants: Mint can be grown from seed or transplants. Since mints readily hybridize between different types, plants grown from seed often fail to be true to type. For specific cultivars or varieties, buy established plants from reputable sources, take cuttings, or divide an established plant. Divide and replant established plants in the spring before growth starts or early in the fall.

Planting and Spacing: Sow seeds ¼ inch deep and then thin seedlings once they emerge. Transplants should be planted with roots just beneath the soil surface. Row spacing should be at least 2 feet apart to allow for growth.

Water: Water regularly during the growing season, supplying up to 1 to 2 inches per week, depending on temperatures, exposure and soil conditions. Avoid over watering as it leads to disease.

Fertilization: One early spring application of a slow release, complete fertilizer incorporated into the soil will supply adequate nutrients for mint. Apply 1 teaspoon of a 16-16-16 fertilizer to each plant as growth resumes in the spring. Over watering and fertilizing promotes rust and diminishes mint oil production.

PROBLEMS

Aggressive Growth: Mint is best planted in containers or where roots are confined due to its aggressive growth habits. Mint spreads quickly in open garden areas and will out-compete most garden plants.

Pests and Disease: Most diseases can be minimized or eliminated by appropriate watering and ensuring proper sunlight to plants. Consider drip irrigation as an excellent method to provide regular water and keep foliage dry. As the mint grows and multiplies, thinning or dividing may be essential to maintain healthy plants.

Insects	**Identification**	**Control**
Aphids	Green or black soft-bodied insects that feed on leaves. Foliage curls, puckers, yellows or becomes stunted.	Use insecticidal soaps, registered insecticides or spray plant with a forceful jet of water to dislodge the insects.
Flea Beetle	Small, shiny black beetles that chew tiny holes in leaves.	Control with registered insecticides or cover plants in spring with row covers.
Cutworm	Larvae feed at or below ground level and sever stems of seedlings or transplants.	Protect individual plants with a collar or trap, use registered insecticides.
Disease	**Symptom**	**Control**
Anthracnose	Small water soaked spots on leaves and stems.	Rotate planting areas, remove diseased plants, prune healthy plants to the ground in fall.
Mint Rust	Small whitish, slightly raised spots that turn reddish orange or brown on underside of leaves.	Avoid wet leaves over night. Use drip irrigation or apply overhead water before mid-day.
Verticillium Wilt	Leaf yellowing starting at the margin. Leaves eventually curl up and die.	Rotate planting areas, remove infected plants, and do not over fertilize plants.

HARVEST AND STORAGE

Fresh leaves may be harvest throughout the growing season once the plants reach 3 to 4 inches tall. Use a sharp knife or scissors to remove leaves and stems. The youngest, most tender leaves and stems are the most flavorful. Cut the stems to within 1 inch of the soil, picking late in the morning on dry and sunny days. Fresh mint may be stored up to a week in water in the refrigerator.

Drying: Harvest fully grown stems and leaves and hang the cuttings upside down in a hot shady location until brittle, or spread on a screen in the shade to dry. Store dried mint in an airtight container for up to 1 year.

Freezing: Individual leaves do not freeze well. To maintain taste when thawed, freeze chopped mint leaves with water in an ice cube tray.

Productivity: One or two plants will supply sufficient fresh cuttings for daily use. Several additional plants will provide for drying and storing. Each plant can be harvested two to three times per season.

Nutrition: Mint is high in fiber, iron, vitamins A and B6, folate, calcium, magnesium and manganese. A serving of dried mint will be significantly higher in nutritional values than fresh mint.

FREQUENTLY ASKED QUESTIONS

How can I stop the mint from taking over my garden? Prior planning is important before planting mint. Consider separate beds or grow mint in buried containers to contain the spreading rhizomes. Containers should extend 10 to 12 inches below the soil surface to ensure containment.

Should I allow the mint to bloom and how should I prune? If allowed to bloom, the oil content in the leaves decreases and is less flavorful. Pinch the blossoms back as they show or simply cut back the plants to within 1 inch of the soil two to three times a year. It is very difficult to over-prune a mint plant. Before winter, cut each plant back to the ground to discourage pests and diseases.

Authors: Kristie Buckland, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Mustard

by Dan Drost & Michael Johnson

SUMMARY

Mustard is a cool season vegetable that prefers a sunny location and fertile, well-drained soils. Plant seeds ½-1 inch deep. Thin seedlings or transplant mustard 3 inches apart in row with rows 12 inches apart. Plant 2-3 weeks before the last frost for your production area. Mustard greens tastes best when plants grow rapidly and leaves mature before the heat of summer. Minimize water or fertilizer stress during growth to ensure uninterrupted growth.

Mustard is best grown as a spring and fall vegetable. Control insects and diseases throughout the year. Harvest mustard when the leaves reach full size.

RECOMMENDED VARIETIES

Mustard comes in a variety of leaf types, colors, and textures. Plant a range of different types to make salads more interesting. There are many good varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Florida Broadleaf, Green Wave, Giant Curled, and Giant Red have a variety of leaf colors and shapes.

HOW TO GROW

Soils: Mustard prefers fertile, well-drained soil rich in organic matter for best growth. Most soils in Utah are suitable for mustard production.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well-composted organic matter and apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil. Work soils in the fall for very early spring plantings.

Plants: Mustard can be grown from seed or transplants. Mustard can be sown after soils reach 40°F. Seeds germinate best at 55-65°F and require 7-10 days to emerge. Temperatures above 80°F reduce seed germination. Seeds should be planted ½-1 inch deep. Thin stands when plants have 3-4 true leaves. Plants removed at thinning can be used to transplant adjacent areas if some roots are maintained. Thinned plants can also be eaten. Transplants are used to provide earlier harvest. Transplants should have 4-6 mature leaves and a well-developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted mustard should be spaced 3 inches between plants in the row with rows 12 inches apart. Dense plantings will reduce weed pressure. Mustard grows best when temperatures do not exceed 75°F and temperatures down to 32°F do not seriously damage young plants. Transplants should be planted near the last frost-free date in the spring for a growing area. Seeded mustard may be planted 3-4 weeks earlier. High summer temperatures reduce growth, decrease quality, and cause the plants to go to seed and cause bitter or off-flavors to develop. For fall planted mustard, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 2-3 weeks after the first fall frost. Fall plantings are usually of higher quality because they mature under cooler conditions in most locations.

Water: Water mustard regularly to maintain a uniformly moist soil. Water requirements depend on soil type and temperatures. Mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations will cause leaves to become tough, slow leaf development and contribute to off-flavors.

Fertilization: Apply ½ cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or thinning to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches and Row Covers: Fabric covers are used to protect seedlings and transplants from frost and may protect plants from insect damage. Organic mulches help offset temperature increases. These will cool the soil and reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspapers also help control weeds.

PROBLEMS

Weeds: Mustard does not compete well with weeds. Weed control is particularly important during establishment. Closely spaced plants will help control weeds. Cultivate shallowly to avoid root damage which ensures uninterrupted plant growth.

Insects and Disease: Most mustard is fast growing and is not susceptible to many production problems. Rotating locations from year to year helps control most diseases.

Pests	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become yellow, crinkled, and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Cabbage Worms and Loopers	Worms and loopers are light to dark green. Adult loopers are gray or brown moths while cabbage worms are white butterflies. Worms and loopers chew holes in leaves and hide in kohlrabi leaves.	Control these insects with appropriate insecticides or biological measures such as Bt or parasitic wasps.
Slugs	Soft-bodied or shelled mollusks that chew holes in leaves.	Control with appropriate pesticides or traps. Avoid moist conditions that favor these pests.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

HARVEST AND STORAGE

Mustard should be harvested when the leaves reach full size. Leaves may be picked anytime before the seed stalk forms. Older leaves are often stripped off the plants first allowing the young leaves to continue to grow. Provided the growing point is not damaged, all leaves can be cut off to within 2 inches of the soil. Mustard can be stored for 1-2 weeks at 32°F and 95% relative humidity.

Productivity: A 10 foot row at recommended spacing will product 4 to 6 pounds of mustard greens.

Nutrition: Mustard is low in calories, fat, and cholesterol. Mustard is a very good source of dietary fiber, and contains large amounts of iron, beta carotene, and vitamin C.

FREQUENTLY ASKED QUESTIONS

How do you keep mustard from developing a bitter flavor? Avoid growing mustard in temperatures above 75°F as high temperatures cause the undesired bitter flavor.

What causes flowers to develop in my spring mustard? Mustard is a cool-season vegetable that naturally flowers during the long, warm days of summer. Harvest before hot weather arrives and preferably, before flower stalks develop. Plant a second crop in the fall when temperatures cool.

Authors: Dan Drost, USU Extension Vegetable Specialist & Michael Johnson, USU Extension Grand County Agent

New Zealand Spinach

by Jill Samuelson & Dan Drost

SUMMARY

New Zealand spinach is a warm season alternative to regular spinach that does well in hot, dry conditions. Soak seeds in water for 24 hours prior to planting to hasten germination. Seeds should not be planted directly outside until after the last frost date, or start transplants inside 3-4 weeks prior to the last frost. Plant seeds ½ inch deep in loose, fertile soil that has had organic matter incorporated prior to planting. Space plants 3 feet between rows, and every 12 inch after thinning within rows. Although New Zealand spinach is drought tolerant, water consistently for the best flavor. Fertilize frequently with a high nitrogen fertilizer.

Mulches and row covers can help in starting plants outside earlier. Mulches also help with weed control and retaining soil moisture. Leaves should be harvested frequently to encourage new, lush growth. Cut the tips and eat raw or cooked.

RECOMMENDED VARIETIES

Most sources offer only the generic species, Tetragonia tetragonoides. However, occasionally the variety Maori is listed.

HOW TO GROW

Soils: New Zealand spinach prefers welldrained, sandy soils that are rich in organic matter, with a pH ranging from 6.8 to 7.0. However, in Utah's typical alkaline soils, New Zealand spinach will still grow well.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter into the top 6 inches of the soil. Fertilizer should be broadcast and worked into the soil prior to seeding, at a rate of 3 lbs per 100 ft² of 10-10-10 fertilizer. If fertilizer is banded at seeding it should be placed along each side of the rows 2-3 inches below the level of the seed and 6 inches to the side of the row. Sidedress with two or more applications of 0.3 oz per 10 ft of row of 10-10-10 fertilizer.

Plants: Seeds can be either directly sown after frost danger has passed; or they may be started inside 3-4 weeks before the last frost date, then transplanted after the danger of frost has passed. New Zealand spinach germinates slowly, but soaking the seeds in water for 24 hours before planting hastens germination. Seeds take up to 2 or 3 weeks to emerge and do not emerge uniformly. Seedlings can be transplanted when they are 1-2 inches tall.

Planting and Spacing: Seeds should be planted ½ inch deep in fine soil. The soil should be kept moist until the seedlings begin to emerge. Plant in rows 3 feet apart, with seeds 2 inches apart within the row. When plants are 1-2 inches tall, thin to 12 inches apart.

Mulches: Mulches help retain soil moisture and suppress weeds. Plastic is a good mulch because it can increase the soil temperature and make it possible to plant at an earlier date. Lay black plastic down in rows, covering the edges with soil, then punch holes in the plastic and plant seeds or transplant previously started plants. Grass clippings, leaves, or shredded newspaper are other mulch options.

Row Covers: Hotcaps, plastic tunnels, and fabric covers can protect seedlings and transplants from cool air temperatures. Row covers make it possible to place plants outside before the last frost date, thereby extending the harvest season because of getting an early start.

Water: Although the flavor is best with consistent moisture, New Zealand spinach will still do well with little water without causing plants to bolt or producing a bitter taste. New Zealand spinach is heat and drought tolerant and does well in the warm summer/fall months when regular spinach will not produce.

Fertilization: New Zealand spinach needs generous fertilization, otherwise it can seed early. Fertilizing monthly at the highest rate will produce the best results. Apply 3 pounds of 10-10-10 per 100 ft^2.

PROBLEMS

Weeds: Weeds can be a problem when plants are first getting established. Plastic mulches can greatly reduce the competition of weeds. New Zealand spinach has a spreading habit and will fill in well, choking out most weeds.

Insects and Disease: New Zealand Spinach has very good disease and insect resistance. Leaf miners are a common problem in growing regular spinach, so New Zealand spinach is recommended as a resistant alternative. It has been found that various chewing beetles may feed on the leaves, causing small, round holes to appear. Generally plants grow rapidly enough that control is not necessary.

HARVEST AND STORAGE

From seed to harvest takes 50-70 days. Only the young leaves and tips are gathered for use. Regular trimming and good fertilization of the plants encourage lush growth. Cut the tips back at 4 inches and allow new leaves to replace the older leaves. New Zealand spinach can be eaten raw or steamed. Before the next harvest, store at 35° F and 95-100% humidity for 2-3 weeks. The seeds can be saved for up to 5 years.

Productivity: Plant 2-3 plants per person for fresh use and an additional 6-8 plants for canning.

Nutrition: New Zealand spinach is valued because of its high vitamin A, vitamin B1, vitamin B2, and vitamin C content. It is low in fat and fiber content. New Zealand spinach does have a high oxalate content, which can be dangerous at high concentrations. It is recommended that the leaves be blanched for 3 minutes, the water disposed of, and then the greens refreshed in iced water before consuming. However, many still use it raw as a salad green.

FREQUENTLY ASKED QUESTIONS

What are oxalates? Can they really harm me? Is New Zealand spinach a bad choice to plant? New Zealand spinach contains antioxidant carotenoids that are responsible for much of its nutrition. Because of the form they are in, it makes it harder for the body to digest them. By blanching the leaves, the nutrients can be converted to a form that the body can easily absorb.

I've heard New Zealand spinach referred to by many names. What is a name I can easily recognize? Referring to plants by their common names can be confusing. New Zealand spinach is also referred to as Warrigal greens or Native Australian Bushtucker. It is better to use its botanical name, Tetragonia tetragonoides. New Zealand spinach was formerly named Tetragonia expansar, but has been recently reclassified and is now referred to as Tetragonia tetragonoides.

Why plant New Zealand spinach if it looks and tastes like regular spinach? New Zealand spinach is a warm season vegetable that grows well in hot weather and dry conditions. Regular spinach goes to seed and becomes bitter during warm summer months.

Spinach also has many disease and pest problems, while New Zealand spinach is relatively pest and disease free.

Authors: Jill Samuelson, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Onions
by Dan Drost

SUMMARY

The onion is a cool-season biennial that prefers full sun and fertile, well-drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting.

Plant seeds ¼-½ inch deep in rows 8-16 inches apart. Seeds, sets or transplants should be 3-4 inches apart in the row. If planted at closer spacing, thin to the suggested spacing and use the pulled plants as green onions. Sidedress onions with nitrogen in May and June to ensure good growth and high yields. Onions require regular watering, so maintain soils near field capacity. Water stress will reduce yields and bulb size. Organic mulches help conserve water, supply extra nutrients and reduce weeding. Control weeds, insects and diseases throughout the year. Harvest onions when the tops have fallen over and papery skins have formed. Bulbs store best in cold, dry conditions to maintain best quality. Excellent varieties include Utah Sweet Spanish, Fiesta, Sweet Sandwich, and Walla Walla.

RECOMMENDED VARIETIES

Evergreen White Bunching is a good mild green onion. Utah Sweet Spanish, Fiesta, Walla Walla, and Sweet Sandwich are excellent bulb onions. These will store for 2-4 months. Crystal White Wax is a nice pickling onion. Many of these varieties come as seeds, sets or transplants so check for availability with your local garden center or seed catalog.

HOW TO GROW

Soils: Onions will grow in all soil types provided they are rich, well drained, moist, and fertile.

Soil Preparation: Before planting, incorporate 4-6 inches of well-composted organic matter and 1-2 lb of all-purpose fertilizer (16-16-8) per 100 square feet. Work compost and fertilizer into the soil to a depth of 6-8 inches.

Plants: For early production, use transplants or sets for planting out in late March or early April. Transplants need 6-8 weeks of growth before planting in the garden. Plant onion seeds ¼-½ inches deep in late March or early April.

Planting and Spacing: After seeds emerge, thin to 3-4 inches apart in rows 8-16 inches apart. Thin before plants compete with each other or they start to bulb. Transplants and sets should be planted at the same final spacing as seeds. Green onions can be left at closer spacing and the plants thinned as they are used. High-density plantings will reduce bulb size unless adequate water and nutrients are supplied. If you plan to store transplants or sets, plant out in late April. Later plantings are less likely to produce seed stalks. Onion seeds can also be planted in mid to late August for over wintering. Overwintered onions should be mulched late in the year to minimize winter damage. Overwintered onions generally mature in June or July.

Water: Onions require regular watering throughout growth for best production. Soils need to be maintained near field capacity. Moisten the soil thoroughly to a depth of 18 inches every 7 days. Water needs are critical since rooting depth in onions is shallow. Drought stress during growth will decrease yield, reduce bulb size and affect flavor. Stop watering when the plants start to mature (tops fall over). Excess water as the crop matures delays curing and may cause storage problems.

Fertilization: In addition to the fertilizer used at planting, onions need additional nitrogen fertilizer to produce optimum yields. Side dress onions with ½ lb of nitrogen fertilizer (21-0-0) per 100 square feet in late May and June. Do not fertilize after mid-July as extra nutrients stimulate late season growth and reduce storage potential of dry onions.

PROBLEMS

Weeds: Control weeds through regular shallow cultivation to avoid root damage that slows plant growth by damaging shallow roots. Weed control is particularly important during the first 2 months of growth when plants are growing slowly and compete poorly. Mulching with compost, grass clippings or leaves will smother weeds.

Insects and Disease:

Insect	Identification	Control
Thrips	Tiny, slender insects that feed on leaves. Leaves turn silver or gray, may twist and die. Thrips hide near where the leaf and bulb meet.	Spray with registered chemicals
Onion Maggot	White worm that feeds on seedlings, roots or bulbs.	Use crop rotation, avoid excessive amounts of organic matter, and apply appropriate insecticide at planting if maggots have been a problem in the past.
Disease	**Symptom**	**Control**
Neck Rot	Fungal disease that occurs during storage. Watery decay inside the bulb..	Avoid excess moisture near harvest. Cure bulbs well before storing.
Basal Rot	Fungal disease that attacks the area where roots and leaves join. The area rots and plant growth is slow and weak.	Use 5-year crop rotation. Solarize the soil where onions are to be planted. Avoid over-watering.

HARVEST AND STORAGE

Onions vary in their maturity times. Green onions may be harvest as early as 50 days after seeding. Bulb onions generally require 100-120 days to mature. Leave bulb onions in the ground until the tops fall over. Once the tops fall over, lift the bulbs but leave them in the garden to dry for 2-3 weeks. The tops will help protect the bulbs from the sun. When fully cured the onionskin should be papery and the roots dry. Mature bulbs may be braided into onion ropes or stored in open meshed sacks. Cut off the leaves about 1-2 inches above the bulb. Onions store best in cold (32-40^{o}F), dry conditions. Check regularly and use bulbs that are softening or sprouting first.

Productivity: One set, transplant, or seed will yield one onion. Plant 15-25 feet of row per person.

Nutrition: One cup of raw chopped onions is very low in saturated fat, cholesterol and sodium. It is also a good source of dietary fiber, vitamin B6 and folate, and a very good source of vitamin C.

FREQUENTLY ASKED QUESTIONS

Why can't I get my onions to form a bulb? Onions form bulbs under long days and hot weather. If planted in June, most will grow leaves and never form a bulb.

Is it best to plant onion seeds, onion transplants or onion sets in the garden? Onion sets are easiest to handle and develop quickly for green onions as well as onions for winter storage. Onion transplants are slower to develop but also produce good crops. Seeds for onions must be planted early in the garden and thinned after they emerge. The thinned plants are suitable for green onions the remaining plants will produce bulbs for storage in September.

Is there any way to prevent onions from going to seed? Plant onion sets of bulbs no larger than 5/8 inch in diameter. Larger bulbs have a greater tendency to bolt in the garden.

Author: Dan Drost, USU Extension Vegetable Specialist

Parsnips

by Dan Drost & Wade Bitner

SUMMARY

Parsnips are cool season vegetables that prefer sunny locations and fertile, deep, well-drained soils. Incorporate plenty of organic matter and an all-purpose fertilizer into the area before planting. Plant seeds ¼-½ inch deep. Thin seedling parsnips to 3 inches apart in row with rows 12-18 inches apart. Plant 2-3 weeks before the last frost. Parsnips taste best when plants have been exposed to several weeks of cool, frosty weather. Avoid water or fertilizer stress during growth. Irrigation should be frequent and uniform to ensure good growth. Control insect and diseases throughout the year. Harvest parsnips when the leaves reach full size.

RECOMMENDED VARIETIES

There are many good parsnip varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Good varieties include Harris Model, All American, Andover, Lancer, and Cobham Marrow.

HOW TO GROW

Soils: Parsnips prefer fertile, well-drained, deep, sandy soils rich in organic matter for best growth. Most light soils in Utah are well suited for parsnip production. Heavy soils need to be amended with plenty of compost and should be double dug to allow good root development.

Soil Preparation: Before planting, incorporate up to 2-4 inches of well composted organic matter and apply 2-4 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Parsnips are always grown from seed. Always purchase fresh seed as parsnips lose viability rapidly after one year. Parsnips can be planted after soils reach 40ºF. Seeds germinate best at 55-65ºF and require 14-21 days to emerge. Temperatures above 80ºF reduce seed germination. Parsnips grow best when temperatures do not exceed 75ºF. High summer temperatures reduce growth, decrease quality, and cause bitter or off-flavored roots. Temperatures down to 32ºF do not seriously damage plants.

Planting and Spacing: Seeds should be planted ¼-½ inch deep. Crusting soils will limit seedling emergence and affect plant stands. Plant seeds on soil surface then cover seed with compost or fine sand to help with stand establishment. Maintain a uniform and moist soil surface to ensure good plant stands. Over-seed parsnips, then thin to 4-6 inches between plants after emergence. Plant rows 12-18 inches apart. Dense plantings will reduce weed pressure. Planting radishes with parsnips helps minimize the crusting problem and identifies where the planted rows are located. Parsnips can be left in the garden after light frosts and are often overwintered under heavy mulches. Wait until the fall when cool conditions improve flavors before harvesting.

Water: Water regularly, applying 1-2 inches per week depending on weather. Water requirements depend on soil type. Use drip irrigation if possible. Mulching around the plants helps to conserve soil moisture. Avoid over-watering as hairy roots form and forking may occur. Moisture fluctuations also cause root disorders, slow leaf development, and contribute to bitterness. Wet and dry periods favor root cracking.

Fertilization: Apply ¼ cup per 10 foot of row of a nitrogen-based fertilizer (21-0-0) 6 weeks after emergence and again 4 weeks later to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches: Apply organic mulches during summer when temperatures increase. Mulches cool the soil and reduce water stress. Organic mulches such as grass clippings, leaves, straw, and newspapers also help control weeds. For over-wintering parsnips, mulch heavily with straw or compost, as with carrots.

PEST CONTROL

Insects and Diseases:

Insect	Identification	Control
Parsnip Fly	Small white maggots that feed on and burrow into the developing root.	Use soil applied chemicals at planting or cover young emerging seedlings with fabric row covers to exclude egg-laying adults.
Disease	**Symptom**	**Control**
Leaf Blights	Fungal diseases that cause spotting on infected leaves.	Occur when foliage remains wet for long periods.
Root Rots and Spots	Fungal diseases that cause decay and rotting of the root. Leads to forking and off-shaped roots.	Crop rotation. Soil solarization.
Yellows	Yellow discoloration of plants.	Carried by leafhoppers. Cover plants with fabric mulch. No known control.

HARVEST AND STORAGE

Parsnips can be harvested when the roots reach full size. Generally roots are mature 100-120 days from seeding. Use digging fork to loosen soil and pull up needed plants by the tops and trim off leaves. Wash and store at 32ºF and 95% relative humidity for 2-4 weeks. Parsnips can be stored in the garden under heavy mulch or dug and stored in moist sand in a cool cellar for several months. Do not store parsnips with apples or pears as the fruit gasses cause the parsnip roots to go bitter.

Productivity: Plant 10 feet of row per person for fresh use and 10 feet for storage. Expect 75 pounds of roots per 100 linear feet of row.

Nutrition: A cup serving is low in fat, moderately high in carbohydrates and fiber with an abundance of flavor and crunch.

FREQUENTLY ASKED QUESTIONS

Why do parsnip seeds germinate so poorly? Parsnip seeds germinate very slowly even under the best conditions and also lose their germination potential after the first year. Always buy and plant fresh seed.

Can parsnips be left in the soil over winter? If you leave parsnips in the soil over winter, throw a few inches of soil over the crowns after the first fall frosts. Stored starches are changed to sugar in early spring as the old plants prepare for new growth, thus roots harvested in early spring are especially tender and sweet. The roots lose flavor and become "woody" if you do not harvest them before new leaves begin to grow.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Wade Bitner, Horticulture Student

Peanuts

by Taun Beddes & Dan Drost

SUMMARY

Peanuts are not commonly grown in Utah, but certain types can be productive when the frost free growing season is at least 110 to 130 days.

Peanuts grow best in light, sandy soil, but can be grown in most other soil types if compost is incorporated to sufficiently loosen the soil.

Peanuts ripen seeds (nuts) in pods underground. After the flowers are pollinated, a structure called a peg, located just behind pollinated flowers, extends into the soil where peanuts ripen.

Newly harvested peanuts (Photo: Magnus Manke)

Peanuts are harvested when leaves start to yellow at the end of the growing season. When seeds are treated before planting with rhizobium bacteria, peanut plants add nitrogen to the soil like peas and beans. Additionally, once peanuts are harvested in the autumn, the remaining plant material can be incorporated back into the soil or composted.

INTRODUCTION

Peanuts are native to South America and have been used as a food crop for thousands of years. They are popular worldwide. A unique feature of peanuts is that pods containing seeds (nuts) mature underground. Once flowers are fertilized, a structure called a peg that forms the pod extends underneath the soil surface. If the peg does not penetrate the soil or get covered, the pods will not develop and produce seeds. Peanuts are very nutritious as they are rich in protein, unsaturated fat and many vitamins and minerals.

PEANUT VARIETIES

Variety	Days to Maturity	Seed Characteristics and Comments
Valencia	120-130	Produces three small nuts per pod, and has a sweeter flavor than other varieties. Best for areas with fewer frost free days. Little breeding has occurred for disease resistance, but Valencia types are still fine for use by the home gardener practicing sound garden management practices.
Early Spanish	90-130	Produces two to three small nuts per pod. Has greater oil content than other varieties. Commonly used for peanut butter and in candy bars.
Early Virginia, Jumbo Virginia	120-130	Produces one to two large nuts per pod. Virginia peanuts are commonly roasted in the shell; sold as shelled, salted/flavored nuts; used in cooking and processed foods due to larger nut size.
Runner Types	125-165	Runner type uses are similar to Virginia varieties. Some earlier ripening varieties exist including 'AT 215'. Sometimes referred to as "beer nuts."

HOW TO GROW

Soils: Peanuts prefer light, humus rich, sandy soil. However, most soils are suitable for production when amended with enough compost to allow for good root growth, peg penetration and pod development. A soil analysis reveals potential soil problems and can be useful for those beginning a garden. For more information on how to test soil, visit the USU Analytical lab at www.usual.usu.edu.

Soil Preparation: Before planting, incorporate 2 to 4 inches of well-composted organic matter 6 inches deep into the soil.

Plants: Peanuts are grown from seed and not transplants. Seeds can be purchased online, via mail order or possibly from a local vendor. One pound of seeds will seed a 75 foot row.

Planting and Spacing: Seeds can be left in the shell (hull) or removed. When removed, seeds germinate more quickly, but if the thin, red seed coat is cracked or damaged, the seed is most likely dead. Sow seeds 1½ inches deep, 18 inches apart, with 4 seeds per mound when soil temperatures are above 65° F (usually around the last frost). Rows should be spaced every 24 inches.

It is possible to obtain greater yields by using season extending gardening techniques. These include use of hoop houses, cold frames and/or floating row cover. If plastic mulches are used, they must be removed from the soil when plants begin to flower.

As plants grow, hill them in the same fashion as potatoes. This involves mounding 6 inches of soil around plants when they reach a foot tall. Hills allow room for the underground pods to develop and provide added soil drainage. After hilling, place 3 to 4 inches of compost or grass clippings around and between plants. This will help retain soil moisture, control weeds and keep the soil at an even temperature.

Irrigation: Peanuts require uniform soil moisture levels throughout the year, so apply 1 to 2 inches of water per week. Mulch around the plant will conserve soil moisture. Irrigate so that moisture goes deeply into the soil. Irregular watering (over or under) can cause plants to become unhealthy and will reduce yields.

Fertilization: The application of nitrogen fertilizer to peanuts is usually not necessary because they obtain sufficient nitrogen via a beneficial relationship formed with nitrogen fixing rhizobium bacteria. These bacteria, while living in nodules formed on the roots, convert nitrogen from the air into a usable form for the plant. For this to occur, peanuts must be pretreated with an inoculant containing the bacteria prior to being planted. Compatible bacteria may be purchased through mail order or online through garden vendors. Powder inoculants may be better for the home gardener due to ease of use as compared to liquid forms.

When peanuts are not previously inoculated with bacteria, they may benefit from applications of 16-16-16 or 20-0-0 at a rate of 1 lb of fertilizer per 100 square feet. Apply when they are first planted and again 1 month later. More specific soil testing information canbe obtained through soil analysis. Information about this can be found at www.usual.usu.edu.

PROBLEMS

Weeds: Use 2 to 3 inches of mulch around plants to control weeds. If weed control is needed after pegs have penetrated the soil, cultivate no more than a few inches deep to protect developing underground seeds.

Insects and Other Pests: Peanuts are usually not impacted by insect pests. Some of the more common pests that may be seen include wire worms, army worms, cut worms, aphids, thrips and corn ear worm. If these problems arise, contact your local Extension office for assistance.

Mice and other ground dwelling animals sometimes feed on developing seeds while still underground. Additionally, harvested, drying nuts may be fed on by various animals. Exclusionary measures may be needed to protect developing and harvested nuts from these animals.

Diseases: Locally, peanuts do not commonly contract many diseases. Maintain proper plant health to minimize risk. If plants exhibit disease symptoms, help identifying the disorder can be at your local Extension office.

HARVEST AND STORAGE

Peanut plants should be lifted from the ground in the fall when plant leaves begin to yellow. This is usually around the first autumn frost. Check the soil from around the pulled plants to ensure all pods have been collected.

Peanuts should be left on the plant and dried for 1 to 2 weeks in a well ventilated area. Remove pods from the plants after this period of time, and dry for an additional 2 to 3 weeks in shallow trays in a warm area with low humidity (preferably below 60%-70% relative humidity).

Total drying time will be around 4 weeks under average conditions. Do not store nuts at temperatures above 95°F. Throw away any diseased or otherwise unhealthy looking nuts.

Once sufficiently dry, nuts can be roasted by placing them on cookie sheets or in shallow pans and cooking in the oven at 350°F. This will loosen the seed coat surrounding the nut.

Roasting time will vary from 13 to18 minutes. Shelled nuts require a shorter amount of time. Roast a few test batches before processing the entire harvest to determine an appropriate roasting time.

Store roasted nuts in air-tight containers. At room temperature, self-harvested nuts should be consumed within 3 to 4 weeks. Refrigerated, roasted nuts can be stored for 6 to 12 months at 40°F. Peanuts can also be stored in air-tight, freezer safe containers for at least a year.

Productivity: Trials performed in Wisconsin and Ontario, Canada, found that between 4 to 7 lbs of nuts in pods can be obtained per 100 square feet of plants.

Nutrition: Peanuts are rich in protein and unsaturated fat which can lower LDL-cholesterol levels. Additionally, they are a good source of vitamin E, niacin, folate, thiamin, magnesium, copper phosphorus, potassium, zinc and iron.

FREQUENTLY ASKED QUESTIONS

How can I increase peanuts yields? Peanuts grow best at temperatures around 85°F. To increase yields, avoid planting in frost pockets and consider using season extending gardening methods.

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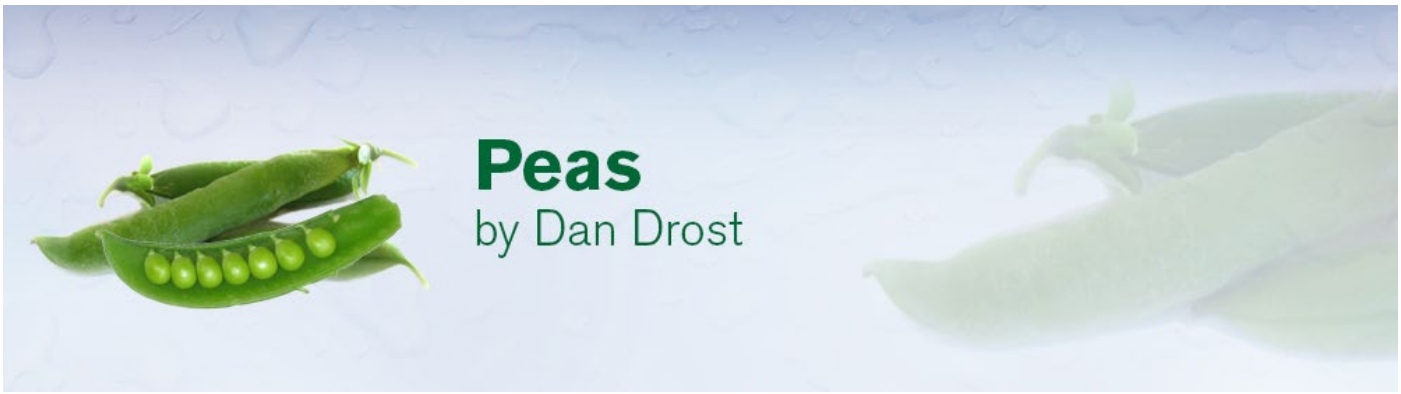
Notes



Peas

by Dan Drost

SUMMARY

Peas require full sun and fertile, well drained soil for maximum yield. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. When soils are above 40ºF, space rows 12-24 inches apart and plant seeds 1 inch deep and 1-2 inches apart in the row. Plant peas until April 1 in warm areas and until May 1 in the cooler areas of Utah. Peas require regular watering particularly at flowering, so maintain soils near field capacity during this time period. Hot temperatures and water stress will reduce yields and pod quality. Organic mulches help conserve water, supply extra nutrients, and reduce weeding. Control insects and diseases if they occur. Harvest snap peas when pods are plump and garden peas when the pods are full but before seeds mature. For dry peas wait until pods are yellow and the seeds are dry. Use fresh peas immediately for best quality.

RECOMMENDED VARIETIES

There are many good pea varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Pod shape and size vary among varieties. Here is a list of some potential varieties and plant types that have performed well in Utah.

Pea Types	Selected Varieties
Garden Pea	Dual, Early Frosty, Green Arrow, Lincoln, Little Marvel, Perfection Dark Seeded, Sparkle, Waldo
Snap/Snow Pea	Dwarf Grey Sugar, Oregon Sugar Pod, Snowflake, Sugar Daddy, Sugar Sprint, Super Sugar Snap
Dry Pea	Most garden pea varieties can be grown for dry seed production.

HOW TO GROW

Soils: Peas will grow in all soil types that are rich in organic matter, well drained, and fertile.

Soil Preparation: Before planting, incorporate 2-3 inches of well composted organic matter and 1 lb of all-purpose fertilizer (16-16-8) per 100 square feet of garden area. Work compost and fertilizer into the soil to a depth of 6 inches.

Plants: Peas are cool weather, frost tolerant vegetables that require soil and air temperatures to remain below 80ºF for best germination and plant growth. Start planting peas as soon as you can till the soil in the spring. Seedling will emerge in 7-10 days when planted in soil of 55-65ºF. Peas do poorly when temperatures exceed 80ºF.

Planting and Spacing: To plant 100 feet of row, you will need about 2-3 ounces of seed. Extra seed can be stored and used the next year. Plant seeds 1 inch deep, spaced 1-2 inches apart, in rows 12-24 inches apart. No thinning is necessary if plant stands are too thick. Plant garden and dry peas every 14-21 days until April 1 in warm regions and May 1 in cooler regions. Peas require 60-70 days to mature depending on variety. Snap peas generally produce pods over a longer time period so only one planting is necessary. Garden peas can be planted again around mid-August in Northern Utah and mid-September in warm areas of Southern Utah for fall production. Mulching the crop during the summer will improve soil water loss and increase nutrient availability. Yields of fall grown peas are not as good as the spring sown plantings.

Support: Most pea varieties are self-supporting during growth. Taller pea varieties are more productive and easier to harvest if caged, trellised, or fenced. Wooden poles, wire cages, or other fencing materials make ideal supports for peas. Snap and snow peas climb naturally so little additional work is required other than constructing the supports.

Water: Peas require regular watering throughout growth for best production. Soils should be allowed to dry until half of the available water is used before returning the soil to field capacity. Do not overwater as wet soil promotes root rot diseases and slows plant growth. Water needs are most critical after flowering. Drought stress will decrease yield due to pod abortion and reduce seed size, increase pod stringiness, and alter seed quality. Watering amounts depend on soil type and organic matter content.

Fertilization: Peas do not require additional fertilizer if an all-purpose fertilizer and compost was applied at planting. Additional applications of nitrogen will over-stimulate leaf growth, and will delay flowering, and reduce pod set. Most peas fix some nitrogen from the air via soil bacteria attached to the plants roots.

Mulches and Row Covers: Fabric row covers help protect very early plantings from frosts. Apply organic mulches such as grass clippings, straw, and shredded newspaper in the heat of summer to help control weeds, improve soil water holding capacity, and reduce soil temperatures in autumn pea plantings.

PEST CONTROL

Weeds: Control weeds with regular cultivation especially when plants are small. Cultivate shallowly around plants to avoid root damage that slows plant growth. Weed control is most essential during the first 6 weeks of growth.

Insects and Diseases:

Insect	Identification	Control
Pea Aphid	The pea aphid is a large green to pinkish species. It forms large colonies on the undersides of leaves near the tips of new growth. This insect transmits the Pea Enation Virus, which causes curling, mottling, and deformation of the leaves.	Plant virus resistant peas. Wash aphids from plants with a strong stream of water. Destroy infested plants after harvest. Liberal nitrogen applications increase aphid populations. Treat plants with appropriate insecticides.
Army Worms and Cutworms	These are green, reddish, or black caterpillars up to 2 inches long. Army worms will climb the plants and feed on leaves and stems. Cutworms do most of their feeding near the soil surface.	Control weeds and debris in the garden that provide cover for worms. Use appropriate insecticides if populations are high.
Pea Weevil	The pea weevil is a brown flecked beetle with a short, broad snout. Adult females lay eggs on young pea pods and the larvae burrow into the pod and feed on the seed.	Early planting and harvest minimizes exposure. Pick off adults when found and apply appropriate chemicals if populations are high.

Disease	Symptom	Control
Fusarium Wilt	Fusarium wilt causes a downward curling of leaves and stems become brittle. Cut stems and roots show yellow-orange discoloration within the vascular tissue. The disease becomes a problem when soil temperatures exceed 70ºF.	Plant resistant varieties. Plant early, so the crop develops before the soil reaches the optimum temperature for wilt development.
Pea Enation Mosaic	Aphid transmitted virus disease. Leaves are mottled, crinkled, and stunted and show white flecking on leaves and pods. Pods may be badly distorted.	Plant resistant varieties. If using susceptible varieties, plant early to avoid aphid infestation. Control aphids with appropriate insecticides.
Powdery Mildew	A powdery white fungus grows on the leaf and stem. Plants are dwarfed if infested early. Affected pods may develop small brown to black necrotic spots.	Plant early-maturing or resistant varieties. Spring seedings have less mildew problems than autumn plantings.
Root Rot and Damping Off	Infected plants are stunted, and lower leaves are yellow. Gray, red, or black lesions form on lower stem and roots.	Avoid compacted and/or wet soils. Seed in spring when soil is below 65ºF. Avoid using too much nitrogen.

HARVEST AND STORAGE

Snap peas are harvested before the pods are fully mature. Pods should be full size, with small seeds, and have firm, crisp flesh when picked. Snap peas are ready for harvest about 5-8 days after flowering. Pick regularly as the plant will flower and mature the pods for 3-4 weeks. Garden peas are ready for harvest about 18-21 days after flowering. Pick the pods when the seeds are plump and shell before use. Use snap or garden peas immediately for best quality and flavor. Refrigerate if not used immediately. Dry peas are harvested when the pods are fully mature and they are beginning to dry. Pull up the plants and lay in a row in the garden for 5-7 days. Once plants are dry, remove the pods, shell out the seeds, and allow additional time for the seeds to dry further. For long term storage, keep in sealed containers in a cool dry place.

Productivity: Expect 20 lb of shelled peas per 100 feet of row from garden types and 30 lb of pods from snap or snow pea types. Plant 15-20 feet of row per person for fresh use and an additional 40-60 feet of row per person for canning or freezing. With dry peas expect about 15-20 lb of seed per 100 feet of row.

Nutrition: Green garden peas are a valuable source of protein, iron, and fiber. Sugar snap peas contain less protein, but are an excellent source of iron and vitamin C. Dry peas are high in lysine and tryptophan, an excellent source of protein and carbohydrates, but are low in fat and fiber.

FREQUENTLY ASKED QUESTIONS

I have problems getting my peas to emerge early in the year. Peas generally germinate and emerge better when soil temperatures are above 40ºF. For very early plantings seeds can be germinated prior to planting. These establish more rapidly. As soils warm, you can plant directly to the garden. Finally, older seed or poorly stored seed may not germinate and emerge.

Why are the flowers falling off my plants? Plants may have been water or heat stressed just prior to or after the flowers open. Pea flowers are very sensitive to temperatures above 80ºF and if dry conditions occur, the plants will shed their flowers. Keep the soil moist and mulch later plantings to minimize these stresses.

Why do pea pods get stringy? Stringy peas are further evidence of heat or water stress. Fibers in the pods get tougher making the pods less palatable

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Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Peppers
by Dan Drost

SUMMARY

Peppers prefer a sunny location, long growing season, and fertile, well-drained soil for best yields. Plant pepper seeds directly in the garden 10-14 days before the last frost date. For earlier maturity, transplant peppers through black plastic mulch. Use row covers or hot caps to protect the plants when transplanting before the frost free period. Side dress with additional nitrogen fertilizer to help grow a large plant. Irrigation should be deep and frequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75°F. Control insect and diseases throughout the year. Harvest peppers when the fruits are fully colored but still firm. At the end of the season, gather all mature green and slightly colored fruits and store at 55°F.

RECOMMENDED VARIETIES

Peppers can be categorized by maturity class (early, mid-season or late), fruit types (cherry, bell, wax, pimento, paprika, cayenne, jalapeno), fruit color (green, red, yellow, orange, purple), or pungency (non-pungent, mildly, moderate, or highly pungent). When selecting varieties, consider your growing environment, primary use, and how much space you have available to grow the plants. Most varieties grow well in Utah, but all are not available. Most garden centers and nurseries carry varieties that produce high quality, flavorful fruits for local conditions.

Fruit Type	Suggested Varieties
Sweet	Ace, Banana Supreme, Bell Boy, Big Bertha, California Wonder, Gypsy, Keystone Resistant Giant, King Arthur, Lilac Bell, Pimento, Sweet Red Cherry, Yolo Wonder L,
Hot	Anaheim, Ancho, Early Jalapeno, Hungarian Yellow Wax, Habanero, Long Thin Cayenne, NuMex Big Jim, Seranno Hot, Slim Jim
Specialty	Prairie Fire, Riot (edible ornamental), Paprika Supreme

HOW TO GROW

Soils: Peppers prefer organic, rich, well-drained, sandy soil for best growth. Most soils in Utah will grow peppers provided they are well drained and fertile.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well-composted organic matter or 2-3 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting. Work this into the top 6 inches of soil.

Plants: Peppers can be grown from seed or transplants. Seed should be planted in the garden 2 weeks before the last frost. Transplants should have 6-9 mature leaves and a well developed root system. Transplants mature about 4 weeks before seeded peppers and are generally recommended for the cooler growing areas of Utah. When growing transplants, allow 8-10 weeks to grow the plant. Germinate at 80°F until the root emerges from the seed, then plant the seeds in sterile seeding mix and grow out at 65-75°F. Adequate light is essential to produce a quality plant. Cool white fluorescent tubes placed 2 to 3 inches above the plants and lit for 14–16 hours per day will ensure plants grow large and healthy. Water regularly and feed weekly with ½ strength soluble complete fertilizer.

Planting and Spacing: Plant 4-6 pepper seeds ½ inch deep and 18 inches apart in the row. After the seedlings have two leaves, thin to a single plant. Peppers should be transplanted when soils are 60ºF or after all frost danger has past. Transplants should be planted 18 inches apart in row, with rows 18-24 inches apart. Transplants that are stocky, dark green, have 6-9 leaves and are 5-8 inches tall, grow most rapidly. Plants with fruits establish slowly and yield poorly.

Mulches: Black plastic mulch warms the soil, conserves water, and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. After amending the soil with compost or fertilizer, lay the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out several weeks before the last frost date. Do not apply organic mulches such as grass clippings, straw, or newspapers around the plants until soils are warmer than 75ºF. Organic mulches help conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels, fabric covers, and other devices protect seedlings and transplants from cool air temperatures. Row covers enhance growth and earliness. Peppers grown under row covers require ventilation when air temperatures exceed 80ºF. High temperatures during flower development and early fruit growth can cause flower and fruit abortion.

Water: Water peppers deeply and infrequently, applying 1-2 inches per week. Use drip irrigation if possible. Mulch around the plant will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. Irregular watering (over or under) can cause flower drop or blossom-end rot, a dark leathery spot on the bottom of the fruit.

Fertilization: Avoid heavy fertilization of peppers which encourages excessive foliage growth and delays flowering and fruit maturity. Side dress with nitrogen (21-0-0) using 1/3 tablespoon (1 teaspoon) per plant at 4 and 8 weeks after transplanting. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Higher density plant spacing will also smother weeds. Shallow cultivation will help avoid root damage especially around young plants.

Insects and Diseases:

Insects	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. Aphids transmit virus diseases and secret honeydew making plants sticky and appear shiny and wet.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at planting or after seedlings have emerged from the soil.
Hornworms and Fruit worms	Larvae feed on leaves and fruits causing defoliation and fruit damage. Look for damaged leaves and black fecal matter.	Control worms with appropriate insecticides or biological measures. Pick off worms by hand.

Diseases	Symptoms	Control
Leaf Blights or Spots	Dark spots on stem, leaves or fruits. The diseases eventually spread to all plant parts. The foliage eventually dies, exposing fruits to the sun, which causes premature ripening.	Diseases promoted by cool, wet conditions. Don't apply over-head irrigation late in the day and let soil dry between watering. Apply appropriate fungicide once disease identified.
Wilt Diseases	Leaves wilt from the bottom of the plant and plants often die. Look for vascular discoloration, slime formation, or gummy exudates visible on or in stems. Diseases are caused by different pathogens.	Identify the causal disease. Plant resistant varieties if available. Crop rotation and soil solarization can help reduce wilt diseases.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. Viruses can be transmitted by aphids, brushing against infected plants, or tobacco on the hands.	Control aphids. Destroy infected plants, weed, and don't use tobacco products when handling plants.
Disorders	**Symptoms**	**Control**
Blossom End Rot (BER)	Blossom-end-rot is caused by a localized calcium deficiency brought on by poor water management, excessive nitrogen, root pruning, and drought stress. Affected fruits become dry, brown or black on the flower end.	Better water and nutrient management can reduce BER. Maintain uniform soil moisture during hot weather particularly when plants are flowering.
Sunscald	Sunscald is caused when fruits are exposed to direct sunlight during hot, dry weather. Exposed areas over-heat, dry out, and do not color uniformly.	Maintain uniform soil moisture during hot weather. Plants with good leaf cover have less sunscald problems.

HARVEST AND STORAGE

Pepper fruits require 35-45 days to mature from flowering to full color (red, yellow, orange) depending on the temperature and variety. Fruits are generally picked green (immature, 20-30 days after flowering) or fully colored (ripe). Fruits should be firm, plump, and smooth skinned for best flavor and quality. Pick fruits as they mature. At the end of the season, harvest all fruits that are mature green or colored slightly. Peppers will store for 1-2 weeks if held at 50-55°F. Fruits are subject to chilling injury so do not store for long periods in the refrigerator.

Productivity: Plant 3-4 pepper plants per person for fresh use and an additional 5-10 plants for pickling, canning, drying, or freezing. Expect 75 lbs of fruit per 100 feet of row depending on variety.

Nutrition: Pepper is very nutritious, low in calories and fat and is an excellent source of vitamins A and C.

FREQUENTLY ASKED QUESTIONS

What causes the flowers to drop off my pepper plants? During unfavorable weather (nights lower than 55°F, or days above 90°F), Pepper fruits do not set and flowers abort. The problem usually disappears as the weather improves.

My peppers often have pointed, cupped, twisted, and irregular shaped leaves. What causes these symptoms? Your peppers may have been injured by 2,4-D or a similar growth regulator weed killer. Never use the same sprayer in your vegetable garden that you use for weed control in your lawn. Use caution when applying lawn care chemicals near the vegetable garden. If you apply grass clippings to the garden, make sure they have not been treated with herbicides not recommended for the garden.

On some of my pepper plants, the leaves are turning yellow and the plants are no longer growing. What is wrong? Peppers with these symptoms may be infected with the curly top virus or one of several wilt disease. Once infected there is very little you can do. Curly top severity varies from year to year. Plant a few more plants to compensate for the yield loss. For wilt diseases, make sure you are not over-watering.

Why do some of the fruits have dry, brown patches on them?
Pepper fruits with these symptoms have been sunburned. Sunburned fruits are one exposed to direct sunlight which super-heats the fruit wall causing cell death. Shading fruits helps reduce sunburn. Shade cloth, growing plants closer together, and planting near taller growing plants helps create shade. Extra water can also reduce sunburn damage.

Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Plums in the Garden

by Michael Caron, Taun Beddes & Brent Black

INTRODUCTION

Three types of plum are commonly grown in Utah: European, Japanese and American species. These species vary in where they are successfully grown and for what the fruit will be used for. Before planting in the home orchard, planning helps ensure success. The following provides useful information concerning care and selection of plants the home gardener should consider.

SPECIES AND CULTIVARS

European Plums: European plum (Prunus domestica) trees are upright and somewhat vase-shaped. Prunes are a type of European plum with a higher sugar content, which makes the fruit more suitable for drying. Prune-type plums have oval shaped fruit, blue or purple skin, and yellow flesh. These types are usually dried before being eaten and not consumed fresh. Fresh-eating cultivars are much juicier than prune-types and are more rounded with red or yellow flesh (Olcott-Reid and Reid, 2007). Ornamental purple-leaf plum such as the cultivar 'Newport', are common in home landscapes and periodically produce fruit that can be processed. European plums are grown in USDA Zone 5 to 8. Many European plums are self-fruitful, but are more productive with a cross pollinizer. Possible pollinizers include almost any other European plum including 'Stanley', 'Italian', and 'Green Gage'.

Some common European prune-type cultivars include 'Early Italian', 'Improved French', and 'Stanley'. Good plum-type cultivars include 'Damson', 'Green Gage', and 'Seneca'.

Japanese Plums: Japanese plum trees (Prunus salicina) are more rounded and spreading than European plums. Many cultivars on the market today are Japanese-American hybrids. They produce fruit that is juicy and fairly large. The plums are round and skin color can range from yellow to red with some being almost black. The flesh of the fruit is yellow or red. Japanese plums are primarily consumed as a fresh fruit but they can successfully be processed as jam, jelly or fruit leather. (Olcott-Reid and Reid, 2007). Japanese plums are grown in USDA Zones 5 to 9. Pollinizers are necessary. Plant near another Japanese or American cultivar to pollinize, as European Plum pollen is not compatible with Japanese plums. Recommended Japanese plum cultivars include 'Satsuma', 'Santa Rosa' and 'Shiro'.

American Plums (bush plums): American plums (Prunus americana) are less common in the marketplace, but are a viable option for the home garden, especially for colder areas of the state. They are hardy to USDA Zones 3 or 4 depending on the cultivar. American plums are often shrubby and may sucker, but growth habit depends on the cultivar. They are also more tolerant of alkaline soil (North Dakota State University, 2013) and have smaller fruit size, but fruit quality and yields are good. The fruit are the smallest among cultivated plum species. Skin and flesh color varies from yellow to red. Most American plums commercially available are actually hybrids between Japanese plums and several closely related North American species. Cultivars generally available through online sources include: 'Pipestone', 'Underwood', 'Tecumseh', 'La Crescent', 'Superior', 'Monitor', 'Waneta', 'Ember' and 'Redglow'. 'Alderman' and 'Superior' require thinning to improve fruit size. 'Toga' and 'Kaga' (sometimes commercially sold as Bubblegum) are good pollinizers for other American and Japanese-American hybrid plums. 'Kaga' is especially popular.

'Pottawattamie' was once an extremely popular American plum cultivar (Hedrick, 1910). It was grown in hedgerows from pioneer times through the 1940s. Many people that remember eating it are still fond of its flavor. Plum hedgerows that still exist in rural areas are assumed to be this cultivar. Unfortunately, these plants are most likely from seed and differ in characteristics from the original. However, most are still tasty and can be used. 'Pottawattamie' is no longer commercially available, although the name is used regionally to refer to seedling American types.

Plum-Apricot Hybrids: Plum and apricot readily cross pollinate and the resulting seeds will produce trees that are interspecific hybrids, with a wide range of these hybrids available in the marketplace. Plum-apricot hybrids range in genetic background and characteristics from predominantly plum to predominantly apricot, and are known in commercial trade as Plumcot, Pluot®, Aprium®, etc. (trademarks of Zaiger Genetics).

GENERAL INFORMATION

Japanese and European plums grow in tree form while American plums grow either in tree or shrub form, depending on the cultivar. Japanese and American plums bloom just as apricots finish flowering in the spring. European plums bloom 10 to 14 days later. Most flowers are produced on spurs on branches 3 years and older, but also somewhat on 1 year old wood, like peaches. Almost all plum cultivars require, or are greatly benefited, by cross pollination from a different cultivar. Even though Japanese and American plums are more susceptible to frost damage than European plums, they produce profuse amounts of blossoms and a partial crop is generally obtained. When trees have a full crop load, European and Japanese plums should be thinned just after the danger of frost has past so that fruit are spaced 4 to 6 inches apart along the branch. American and American hybrids generally do not require thinning unless larger fruit is desired.

HOW TO GROW

Soil Preparation: Plums grow in most Utah soils as long as soil drainage is sufficient. However, soil testing can help determine the appropriate amendments to add to a site before planting. Apply any deficient nutrients as indicated from soil tests and till into the soil. Visit the USU Analytical Laboratory website for more information on soil testing (www.usual.usu.edu). Plums, like peaches and apricots, have little tolerance of wet and heavy soils and will get root-rotting diseases easily in such conditions, especially when irrigation is not carefully managed. Plums are somewhat prone to iron chlorosis in the alkaline soils of Utah. Overwatering will significantly increase the risk of chlorosis and general tree decline as a result. Deep, infrequent irrigation and use of EDDHA chelated iron may help considerably. For more information on iron chlorosis management see the USU Iron Chlorosis in Berries fact sheet.

Planting and Spacing: Trees should not be planted in lawns, because irrigation and fertilization needs for each are very different. Grass is usually watered more often than is ideal for trees. Grass also aggressively competes for nutrients such as nitrogen, and can slow the growth of fruit trees. The location should also be free of perennial weeds such as field bindweed and quackgrass.

Space trees 18 to 22 feet apart. Prepare a hole for planting two to three times the width and the same depth as the container. Planting the tree at the same height as the root ball is important. If too shallow, the root ball will dry out. If too deep, lack of soil oxygen will cause root loss and trees will decline. For bare-root trees, prepare a hole slightly wider than the roots, and deep enough so that the root flare is just above ground and the graft is 2 to 4 inches above ground. Never allow the roots to dry out. Immediately after planting, water thoroughly to settle the soil and eliminate any air pockets around the roots. In windy areas, bare-root trees should be staked for 1 year. The stake should not remain for more than a year. For more specific information, see the YouTube video "USU Extension - How to Plant Bare Root Trees."

Irrigation: During the first season, irrigate at an interval that will keep the soil moist but not wet. Depending on rainfall and temperature, irrigate about two times per week to ensure establishment. For the next few years, maintain a biweekly watering program that will allow water to penetrate 1-2 feet deep. This can be reduced if there is significant rainfall accumulation. Although established plum trees are somewhat drought tolerant, irrigation improves yield and fruit quality. Irrigation methods such as drip systems, soaker hoses, or hand watering that apply water near the drip-line of the tree will keep the canopy dry and help prevent foliar disease.

Fertilization: There are no specific fertilizer recommendations for plums grown in a home orchard. Newly planted plums should not be fertilized in the first year they are transplanted. Young plum trees should produce new shoots that average 10 to 20 inches in length each year. For older trees, growth slows to 8 to 10 inches of new growth per year. Fertilization is not needed if growth rates are adequate. The most common limiting nutrient is nitrogen, and when inadequate, trees will not produce sufficient new growth. If planted near a lawn or garden that is fertilized, trees will usually get plenty of nutrition from those areas. Many factors including irrigation, diseases, soil type, and pests affect plant performance. If any of these factors reduce vigor, fertilizer is not helpful. When trees are not growing satisfactorily, soil testing may be helpful in determining fertilization needs. It is important to understand that fertilizer is not a cure-all that solves all plant problems. When nitrogen is needed, apply ½ to 1 cup 20-0-0 around the dripline of trees younger than 5 years old. If phosphorus and potassium are also deficient, apply a similar quantity of 16-16-16, or an equivalent balanced fertilizer. For older trees apply 1 to 2 cups per tree.

Pruning: Prune European plums using the modified central leader system (Figure 1). Ideally, the modified central leader system has four or five lateral branches chosen for the framework ideally spaced 8 to 10 inches apart vertically on the trunk and positioned uniformly around the tree. What about the second and third set of branches? Where should they be on the tree? What about removing the top part of the truck? The lowest set of branches should be at least 24 inches above the ground.

Figure 1. Example of a modified central leader training system (before annual pruning). Photo by Michael Pace.

Each lateral should occupy a specified section of the tree.

Japanese plums are pruned using the open center (open vase) system (Figure 2). An open vase training system is done by selecting three to four main branches 24 to 30 inches off the ground in compass directions, and removing the central stem or trunk completely. As the branches fill out with new growth, they can be pruned to form the canopy.

Depending on the cultivar, American plums can be pruned as either shrubs or small trees. American plums maintained in shrub form should be renewal pruned, removing 20% of the branches from the base each year, so that the oldest branches are no more than five years old. If maintained in tree form, prune using a modified central leader system.

Annual pruning on new and established trees is needed and should be done in late winter or early spring time. Late summer and fall pruning can reduce dormancy and may force late season growth.

This is potentially damaging, especially when we get an early winter.

Begin pruning by removing any dead, diseased, or damaged branches. For established trees remove about 25% of the branches to allow light penetration, increase fruit quality, and encourage new branch development. Remember plums produce most fruit on short spurs on wood that is 2 to 5 years old, but will also produce some fruit on the basal buds of 1 year old wood, similar to peaches. Remove suckers (shoots coming from the roots or stem below the graft) on a regular basis. For more information see the USU Extension Bulletin Pruning the Home Orchard.

Figure 2. Example of an open-vase training system. Photo by Michael Caron.

HARVEST, STORAGE AND USE

Plums ripen in late summer to early fall, dependent on cultivar. Yields of 3 to 5 bushels per tree may be expected, depending on cultivar. American plums may yield slightly less. When ripe, fruit softens and usually changes from green to blue, purple, or red, also depending on cultivar. Green varieties often develop yellow highlights when ripe. Refrigerate plums once ripe and use within 3 weeks. Near-ripe fruit may be stored at room temperature until ripe. Do not refrigerate until plums are ripe.

Plums can be prepared and eaten in many ways including eating fresh, canned, frozen, dried, and processed into jam, jelly, and syrup.

Please see the USU Extension Fact Sheet on Home Drying of Foods for more information on preserving fruit such as plums/prunes.

PROBLEMS

For current and specific pest and disease information please visit the Utah Pests IPM Website (www.utahpests.usu.edu) and subscribe to the tree fruit updates.

Disease	Identification	Control
Coryneum Blight (Shot Hole)	Round, purple-tinted lesions on leaves turn black and centers fall out leaving many small holes in leaves. Similar lesions on fruit eventually turn black. Black cankers form on branches which will eventually die.	Prune out heavily infected branches. Clean up debris including leaves in fall. Time fungicide sprays just after petal fall in spring and at 50% leaf drop in autumn. See also the USU Coryneum Blight Factsheet.
Cytospora/Pseudomonas Canker	Wounds/cankers that ooze or produce amber-colored gummy sap. Leaves may suddenly wilt due to the plugging of conductive tissue. Bark may have areas of dark discoloration.	Avoid tree injuries. Protect trunk and lower limbs from winter sun injury. Fruit thinning also prevents branch cracking, eliminating wounds open to infection. Prune out infected wood 1 foot below where last symptoms are seen as soon as symptoms appear. Fall pruning is not recommended for northern Utah. Fungicides are also not generally recommended for these diseases.
General Root Diseases	Yellowing leaves, general decline and lack of vigor. Branch dieback. Extremely common with newly planted trees due to unintentional overwatering.	Manage irrigation carefully based on soil type, most critical on heavy soils. Ensure good drainage. Avoid planting in turf. See the USU Peach Irrigation fact sheet.

Insect		
Greater Peach Tree Borer	Clear wing moth species lays eggs on bark near the base of the tree. Borers are often present in the roots to lower limbs. Multiple generations per year.	Subscribe to USU Pest Lab updates for spray timing and registered products at www.utahpests.usu.edu/ipm. Prevention is the best approach, keep trees healthy and do not damage bark and roots.
Aphids	Multiple species infest trees. Early season leaf curl and deformation and stick leaves are signs of aphids or other sap feeding insects. Can occur throughout the growing season.	For minor to moderate infestations treat with an insecticidal soap, or summer weight horticultural oil or neem. Infestations rarely require stronger insecticides.
Spider Mites	Leaves develop a mottled or stippled, dusty appearance. Over time branch dieback is common. Webs may be observed as populations build. Especially common on trees excessively sprayed with a pyrethroid or carbaryl due to natural predators being killed.	For minor to moderate infestations treat with an insecticidal soap, or summer weight horticultural oil or neem. Infestations rarely require stronger insecticides.
San Jose Scale	Small insect with hard protective covering that infests branches and fruit. Colonies may look somewhat like bark ridges but develop a gray or black color late in the season. Usually two to three generations per year.	Apply a horticultural oil/carbaryl mix at the delayed dormant stage. Monitor infested branches for larval crawlers late spring to early summer using double sided tape. Most registered insecticides easily control crawlers. When spraying older protected insects use a surfactant or a spreader/sticker in combination with a registered insecticide.

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Notes

Popcorn

by Heidi Mitchell & Dan Drost

SUMMARY

Whether you are looking for a healthy snack or a vividly colorful autumn decoration, you can find both in one garden product. Popcorn is a fun and practical crop to add to the garden because it will store for several months after harvest. This vegetable takes relatively little preparation and maintenance and, if uniformly planted, can be harvested at one time. Popcorn can be classified by: un-popped kernel shape (pearl or rice), popped kernel shape (butterfly or mushroom), and color. Butterfly popcorn is the kernel shape recommended for eating while mushroom popcorn is best for confectionary uses. Kernel color in popcorn is generally white, small-yellow, or large-yellow although there are now many different specialty varieties available including blue, red, black, brown, and calico colored kernels.

RECOMMENDED VARIETIES

It is possible to select varieties based on personal color, flavor, and size preferences. Varieties include: Yellow, White, Midnight Blue, Ruby Red, Mixed Baby, Turquoise, Mushroom Flake, and Strawberry. Each offers a certain flavor, hull color, and differs in kernel size and shape when popped. Most garden centers may carry varieties that perform well under local conditions. You can also order from reputable seed companies.

HOW TO GROW

Soils: Popcorn will grow in all Utah soil types provided they are moist, nutrient rich, well-drained, and have neutral pH. Poorly drained soils increase the probability of lodging and thereby decrease yields.

Soil Preparation: Before planting, incorporate 15-20 lbs of well composted organic matter and 1 lb of all-purpose fertilizer (16-16-8) per 100 square feet of planting area. Work the compost and fertilizer into the top 4-6 inches of soil.

Plants: Corn is a warm weather vegetable that requires soil and air temperatures above 60ºF for best germination and plant growth. Popcorn does not transplant well, therefore it is best to sow seed directly into the soil. When choosing a planting date, consider both spring soil temperature and the particular variety's date of maturity. To get an earlier yield, some growers sow seeds 3-4 weeks before
frost-free date by planting through or under clear plastic mulches.

Planting and Spacing: For a 100 foot row, you will need approximately 3-4 ounces of seed. Planting corn in a series of short rows increases pollination and yield compared to planting in two or three long rows. Plant seeds 1–2 inches deep spaced 8-10 inches apart in the row with 24-30 inches between rows. Plant density for popcorn is greater than that of sweet corn because plant size and yield per plant are smaller. Popcorn generally matures in 85 to 120 days and may not be suitable for all areas of Utah. Do not grow sweet corn and popcorn in the same garden because cross-pollination will occur resulting in unfavorable flavors and poor popping in popcorn.

Water: Uniform soil moisture levels are very important for a high yield. Water requirements are most critical during tasseling, silking, and ear formation. Drought stress at these times will decrease yield and kernel quality as well as cause an uneven harvest. Water amounts depend on soil type. Apply 1½-2 inches per week especially during ear growth.

Fertilization: Popcorn has a high fertilizer requirement and responds to nitrogen fertilizer. Nitrogen promotes stalk and ear growth and kernel quality. Sidedress popcorn with ¼ lb of nitrogen fertilizer (46-0-0) per 100 square feet when plants have 8-10 leaves and with an additional ¼ lb when the silks appear. Place the fertilizer to the side of the row and irrigate it into the soil.

PROBLEMS

Weeds: Weeds can compete with corn seedlings for space, nutrients, light and water. To control weeds, cultivate the corn patch regularly being careful not to damage the roots of the growing crop.

Insects and Diseases: Insect and disease problems in popcorn are similar to those of sweet corn.

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on leaves, tassels and ears. Plants become crinkled, curled, and growth is stunted when plants are small. Honeydew makes plants and ears sticky.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge the insects. Aphids cause cosmetic damage to the ears.
Corn Earworms	Larvae feed on silks and ears of corn. Damage symptoms include holes in ear tips, loss of silks, and damp excrement near silk.	Spray with BT or appropriate insecticides. Regular applications are necessary to protect the plants. Apply mineral oil to silks. Remove damaged part of ear at harvest.
Cutworms or Army Worms	Larvae feed near the soil surface and sever the plants close to the ground. Most damage done at night.	Use barriers or collars around plants. Keep organic mulches way from young plants.
Disease	**Symptom**	**Control**
Root Rots and Damping Off	Seedlings darken, wilt and die. Associated with cool, wet conditions in the spring.	Use treated seed. Allow soils to dry before re-watering.
Smut	White fungal galls that form on the tassel, stem, or ear. Early plant infection will stunt growth and deform ears.	Remove and destroy galls and severely infected plants. Plant resistant varieties.
Wilt Diseases	Wilting leaves, streaking and drying of leaves, stalk rotting, and plant lodging may occur. Plants often die.	Remove infected plants. Maintain clean garden practices.

HARVEST AND STORAGE

Unlike sweet corn, popcorn is harvested after the kernels are completely dry and the husks are tan and brittle. When mature ears are ready for harvest, pick all the ears and remove the husks off the ear. Place the shucked ears in a mesh bag and dry them in a warm, well-ventilated room. Kernels and cobs have high moisture content at harvest so additional drying is necessary. By drying the ears, moisture will decrease to a safe storing range of 12-15%. After about 2 weeks, shell a cob and pop the kernels in the microwave (place in a paper bag), air popper, or on the stovetop. Sample ears each week until favorable popping is achieved. If the popped kernels are chewy or have many jagged edges, the seed moisture content is still too high. If there are many un-popped kernels, the popcorn is too dry. Add 1 tablespoon of water to 1 quart of kernels and let sit 1-4 days, and then try popping some again. When the ears are properly dried, shell the kernels off the ears and store them in an air-tight container. Popcorn can be stored for several years if refrigerated.

Productivity: Expect one or two ears of popcorn per plant. Two plants will provide one serving per person. Plant approximately a 20 foot row per person.

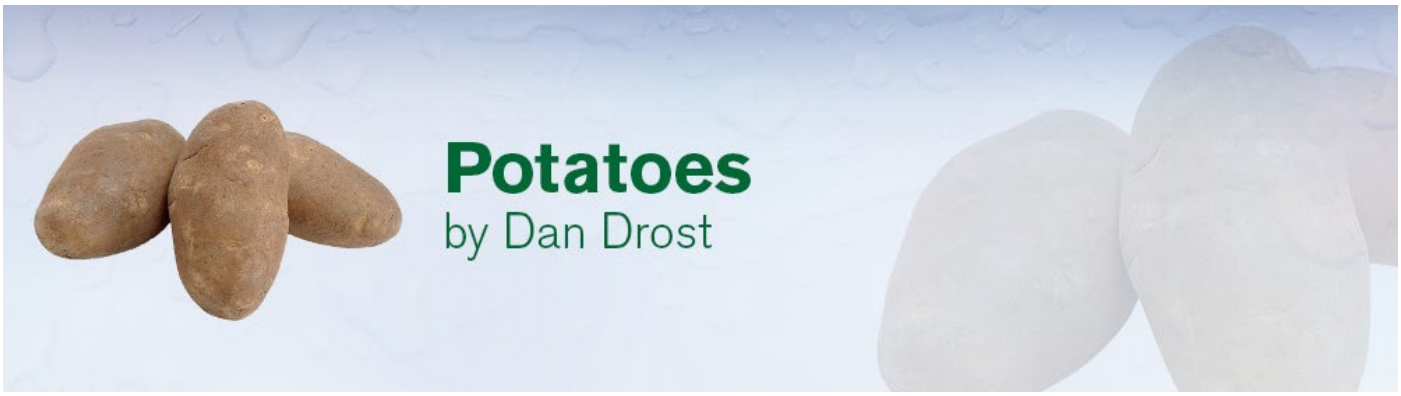
Nutrition: Popcorn can be a healthy snack depending on how much butter and salt you to add. One cup of air popped popcorn is low in calories and fat and provides some protein and carbohydrates.

FREQUENTLY ASKED QUESTIONS

I would like to grow Indian corn as well as popcorn, what are the differences? The environmental and cultural requirements for Indian corn are exactly like popcorn, the differences lie in the harvest and storage requirements. Indian corn is left on the stalk until it is fully dry. When ears are ready, cut or tear them from the stalk along with the stem. Shuck the ears without detaching the husk. Display the ears for as long as they look presentable then discard. Kernels can also be ground into corn flour.

Why does colored kernel always pop out white? The popcorn kernel is covered with a thin, hard colored (yellow, white, red) shell called the hull. When heated, water inside the kernel heats and becomes steam. The pressure rises quickly to the point that the hull breaks and seed's contents burst out. The soft, fluffy part of popcorn that we eat is actually the exploded endosperm. The endosperm does not contain pigmentation and so is white.

Authors: Heidi Mitchell, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist



SUMMARY

Potatoes prefer a sunny location, long growing season, and fertile, well drained soil for best yields. Plant potato seed pieces directly in the garden 14-21 days before the last frost date. For earlier maturity, plant potatoes through a black plastic mulch. Side dress with additional nitrogen fertilizer to help grow a large plant. Irrigation should be deep and frequent. Organic mulches help conserve water, reduce weeding, and keep the soil cool during tuber growth. Control insect and diseases throughout the year. Harvest potatoes as soon as tubers begin forming (new potatoes) or as they mature. Dig storage potatoes after the vines have died, cure them for 2-3 weeks, and then store the tubers in the dark at 40-45ºF.

RECOMMENDED VARIETIES

Potatoes can be categorized by maturity class (early, mid-season or late), use (baking, frying, boiling), or tuber skin characteristics (russet, smooth, or colored). When selecting varieties, consider your growing environment, primary use, and how much space you have available to grow the plants. Most varieties grow well in Utah but all are not available. Most garden centers and nurseries carry varieties that produce high quality, productive seed tubers adapted to local conditions.

Skin Type	Suggested Varieties
Russet	Butte, Gem Russet, Ranger Russet, Russet Burbank
Smooth	Chipeta, Katahdin, Kennebec, Yukon Gold
Colored	All Blue, Caribe (blue), Cranberry Red, Red Norland, Red Pontiac, Rose Finn, Viking,

HOW TO GROW

Soils: Potatoes prefer organic, rich, well-drained, sandy soil for best growth. Most soils in Utah will grow potatoes provided they are well drained and fertile.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well-composted organic matter and 1.5 pounds of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting. Work this into the top 6 inches of soil.

Plants: Potatoes are grown primarily from whole or partial seed tubers. When buying seed tubers, ask for certified seed as this will help reduce the potential for introducing disease into the garden. If the seed tuber is particularly large, it can be cut into smaller pieces. When cutting, make sure the seed piece weighs at least 2 ounces and has one or more "eyes." You will need 8-10 pounds of seed potatoes for every 100 feet of planted row. Tubers should be planted in the garden 2-3 weeks before the last frost.

Planting and Spacing: Plant potato seed pieces 4-6 inches deep and 10-12 inches apart in the row. Space the rows 30-36 inches apart. Potato should be planted when soils are at least 50ºF. Generally, soil is hilled or mounded around the plants as they grow. Hills provide room for the tubers to develop, provide added soil drainage, and minimize tuber greening later in the year. It is best to hill around the plants within 4 weeks of planting.

Mulches: For very early potatoes, some gardeners grow potatoes under black plastic mulch. Plastic mulches warm the soil, reduce weeding, allow earlier planting and maturity, and help conserve water. You can also apply a thick layer of organic mulch such as grass clippings, straw, or newspapers around the plants. These "mulched" potatoes are planted 10-12 inches apart in the row with

rows 30-36 inches apart but are planted only 1-2 inches deep. After planting, cover with 4-6 inches of mulch, adding additional mulch throughout the year as settling or decomposition occurs. Organic mulches also help conserve water, control weeds, and maintain a more uniform temperature. Tubers are easy to harvest since many are above the soil.

Water: Potatoes require good soil moisture levels throughout the year, so apply 1-2 inches per week. Most of the water used by the plants is taken up from the top foot of soil. Use drip irrigation if possible. Mulch around the plant will conserve soil moisture. Irrigate so that moisture goes deeply into the soil. Irregular watering (over or under) can cause abnormal tuber growth like knobs and cracks. Near the end of summer when the plants begin to yellow and the leaves start dying, reduce the amount of water applied. Wet conditions late in the year contribute to tuber rot in storage.

Fertilization: Avoid heavy fertilization of potatoes which encourages excessive foliage growth and delays tuber growth. In addition to the pre-plant fertilizer, side dress with nitrogen (21-0-0) applying 0.5 pounds per 100 square feet of planted area 6 weeks after they emerge. Place the fertilizer to the side of the plants and irrigate it into the soil.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Higher density plant spacing and good plant growth will also smother weeds. Regularly mounding soil around the plants buries small weeds, loosens and aerates the soil, and reduces tuber greening. Shallow cultivation will help avoid root and tuber damage.

Insects and Diseases:

Insects	Identification	Control
Colorado Potato Beetle	Yellow and black striped beetle, about ½ inch long and ¼ inch wide. Larvae are reddish orange, with rows of black spots on each side. Yellow egg clusters are found on the undersides of leaves. Larval feeding defoliates the plants.	Hand pick adults from the plants and rub out egg masses as they appear. Beetles have a high degree of resistance to insecticides so use chemicals sparingly.
Flea Beetles	Small, shiny black beetles that feed on seedlings. Adults chew tiny holes in leaves of young plants. Beetle feeding reduces plant vigor and decreases yield.	Control beetles with appropriate insecticides at planting or after seedlings have emerged from the soil.
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Aphids transmit virus diseases that affect the plant growth. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.

Diseases	Symptoms	Control
Early Blight	Brown to black "target" spots on leaves. Dark area fades to a normal green giving it a bull's eye look. Lower, older leaves are infected first. They droop and dry as the disease progresses. If spots are numerous, leaves will die.	Maintain good fertility and water management. Avoid watering late in the day and let the soil dry between irrigations. Apply appropriate fungicide after proper disease identification.
Late Blight	Brown or black water-soaked spots on leaves and stems that enlarge rapidly. Under wet conditions, a white mold may appear at the lesion edge. Cool, wet conditions favor disease development and spread.	Use certified disease-free seed. Irrigate early in the day to allow leaf drying. Apply appropriate fungicide after proper disease identification.
Fusarium or Verticilium Wilt Diseases	Leaves wilt from the bottom of the plant and plants often die. Look for vascular discoloration, slime formation, or gummy exudates visible on or in stems. Diseases are caused by different pathogens.	Identify the causal disease, Plant resistant varieties if available. Crop rotation and soil solarization can help reduce wilt diseases.

Diseases	Symptoms	Control
Tuber Greening	Exposure of potato tubers to light in the garden or storage will induce the formation of green pigments on the tuber surface. The chemicals produced (solanin) tastes bitter after being cooked.	Keep tubers covered with soil in garden. Store in a dark, cool place. A small amount of green can be cut away but discard very green tubers.
Tuber Disorders	Rough skins; cracking; small, irregular tuber shapes. Primarily caused by wet/dry sods or high soil temperatures.	Maintain uniform moisture conditions. Mulch heavily to regulate soil water and temperature.

HARVEST AND STORAGE

Potatoes can be harvested as soon as they begin forming (new potatoes) or as they mature. Determine the size of the tubers by digging into the side of the hills. Consume new potatoes quickly as they have thin skins and dry out rapidly. For storage potatoes, dig them after the vines have died, the tubers are full sized, and the skins are mature. Mature potato skins are difficult to remove when rubbed. Allow the soil to dry, brush it off, and do not wash the tubers until ready to use. Cure the tubers at 55-60°F with high humidity for 2-3 weeks after harvest. Curing helps heal any bruises or wounds that occur during harvest. After curing, store tubers in the dark at 40-45°F throughout the winter. Good air circulation will reduce rotting and sprouting. Do not store potatoes with apples or pears as the ethylene fruit produces will cause the tubers to sprout.

Productivity: Plant 50 feet of row per person for fresh use and an additional 50 feet for storage. Expect about 75-100 lbs of tubers per 100 feet of row.

Nutrition: Potatoes are very nutritious, low in calories with many different minerals and vitamins, and are an excellent source of starch.

FREQUENTLY ASKED QUESTIONS

I generally have low yields with lots of small, odd-shaped tubers. What is the problem? It is most likely due to unfavorable weather conditions (soils above 90°F). Tuber set and fill is inhibited by high temperatures. Heavy mulching and good water management can help reduce soil temperatures and thus increase tuberization.

On some of my potato plants, the leaves are turning yellow and the plants are no longer growing. What is wrong? Potatoes with these symptoms may be infected with one of several wilt diseases. Potatoes can be infected with a variety of diseases so proper identification is critical. Practice crop rotation, use certified seed, make sure you are not over-watering, maintain proper soil fertility, and plant a few more plants if you have had problems in the past.

I have a bunch of tubers from last year that are sprouting. Can I plant these in place of buying new seed potatoes? No, saving your own seed potatoes leads to a buildup of viruses and diseases that eventually will cause serious problems in the garden. Whenever possible, purchase and plant certified seed to help control many of the problem diseases potatoes experience. The only exception would be if the variety is an heirloom that is not available from some other source.

Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Pumpkins

by Rick Hefelbower & Dan Drost

SUMMARY

Pumpkins prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant 4-6 seeds, 1-2 inches deep, in mounds 4 feet apart when soils are 65ºF. Thin the mounds after emergence to two plants. Transplant pumpkin 2 feet apart through black plastic for early maturity. Use row covers to protect the plants when planting before the frost-free period. After the vines develop runners, side dress with additional nitrogen fertilizer. Irrigation should be deep and infrequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75ºF. Control insect and diseases throughout the year. Harvest pumpkins when the skin is hard and not easily broken when pressure is applied with a fingernail.

RECOMMENDED VARIETIES

Autumn Gold, Connecticut Field, and Spirit Hybrid are large (18-25 lb) fruited orange pumpkins that can be used for pies and carving. Jack Be Little, Wee-B-Little and Baby Bear are small (0.5-1.5 lb) orange fruited types suited for small children. Lumina is a medium (8-14 lb) white skinned pumpkin used for painting. Big Max and Big Moon can produce fruits that weigh in excess of 200 pounds. There are many other good pumpkin varieties for sale at local gardening outlets and through seed catalogs. Most grow well in Utah.

HOW TO GROW

Soils: Pumpkins prefer organic, rich, well-drained, sandy soils for best growth. Most soils in Utah are fine provided they are well drained.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter. Apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting.

Plants: Pumpkins can be grown from seed or transplants. Seed should be planted 1-2 inches deep. Transplants should have 3-4 mature leaves and a well developed root system.

Planting and Spacing: Pumpkins should be planted when soils are 65ºF or after frost danger has past. Plant 4-6 seeds in mounds 4 feet apart. After they have two leaves, thin to two plants per mound. Transplants should be planted 2-3 feet apart in the row with rows 4-6 feet apart. Avoid damaging the roots when planting which slows establishment and growth.

Mulches: Black plastic mulch warms the soil, conserves water, and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. Lay down the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out 2 weeks before the last frost. Do not apply organic mulches until soils are warmer than 75ºF. Grass clippings, straw, newspapers, etc., also conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels and fabric covers protect seedlings and transplants from cool air temperatures. Row covers enhance growth and early maturity. Covers need to be removed when plants start to flower or when temperatures exceed 90ºF.

Water: Water deeply and infrequently, 1-2 inches per week. Use drip irrigation if possible. Mulch around the plants will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. Reduce watering amounts as the fruits ripen.

Fertilization: After the vines develop runners, side dress with a nitrogen fertilizer (21-0-0) using 1-2 tablespoons per plant or mound. Incorporate the fertilizer at least 6 inches away from the plant.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Hand weeding is needed to control weeds within the row. Heavy vine growth by pumpkins will also smother weeds.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet, or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Squash Bugs	Adults are gray or brown and 5/8 inch long. Adults and immature forms suck the sap from leaves leaving them speckled before they wither and die.	Trap adults under boards, check each morning and kill pests. Hand pick adults, immatures and eggs off leaves.
Cucumber Beetles	Adults have stripes or spots and feed on leaves and vines which reduces vigor. May transmit bacterial disease. Larvae bore into roots and stems causing plants to wilt and die.	Application of chemicals at first appearance is needed to control this pest.
Disease	**Symptom**	**Control**
Powdery Mildew	White fungal patches start on older leaves. The disease eventually spreads to all plant parts. The foliage dies, exposing fruits to the sun, which causes premature ripening.	Plant resistant varieties.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on stems. Diseases are caused by different pathogens.	Identify causal disease. Treat disease as recommended once identified.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. An aphid transmitted disease.	Control aphids. Destroy severely infected plants.

HARVEST AND STORAGE

Pumpkins take 45-55 days to mature after flowering. Pumpkins are mature when they are fully colored, when the vine begins to die back, and when the rind is hard and impervious to scratching from a fingernail. Mature fruits should be harvested with the stem attached and stored where they will not freeze.

Productivity: Plant 1-2 hills per person for fresh use. Expect 25-50 fruits per 100 feet of row depending on variety and fruit size.

FREQUENTLY ASKED QUESTIONS

How can I grow pumpkins that weigh more than 100 pounds? First, you need to plant a variety that produces very large fruits. Allow at least 100 square feet of garden space per hill. Plant 6-8 seeds per hill and later thin to the best one or two plants. After flowering starts, remove the first two or three female flowers to keep the plants growing more leaf are before setting fruit. Allow a single fruit to develop and pick off all remaining female flowers that form on the plant. Keep the soil well watered and feed the plant regularly. Control all insects and disease. By keeping the stresses to a minimum, the plant can then put all of its growth into the development of the large fruit.

Do pumpkins, squash and gourds cross-pollinate with each other? Pumpkins, squash and gourds are members of the botanical genus classification of Cucurbita. The varieties within the same botanical species can cross-pollinate. Varieties from different species generally do not. For example, zucchini can cross with pumpkin, acorn or spaghetti squash because they are all members of the same botanical species (Cucurbita pepo). Cross-pollination does not affect the taste, shape or color of the current season's fruit. However, if you save your own seed from these fruits, you may see oddities the next year. Since bees carry pollen for many miles, pollinate fruits by hand then bag the flowers to make sure out crossing with a different variety doesn't happen.

Authors: Rick Hefelbower, USU Extenion Washington County Horticulture Agent, & Dan Drost, USU Extension Vegetable Specialist

Radishes

by Dan Drost & Wade Bitner

SUMMARY

Radishes are cool season vegetables that prefer sunny locations and fertile, deep, well-drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant seeds ½-1 inch deep. Thin radishes to 1-3 inches apart in row with rows 12 inches apart. Plant 2-3 weeks before the last frost in spring and again in early September for fall production. Radishes taste best when grown in cool weather. Avoid water or fertilizer stress during growth. Irrigation should be frequent and uniform to ensure good growth. Control insect and diseases throughout the year. Harvest radishes when the roots reach full size.

RADISH VARIETIES

There are many good radish varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Root shape, size, and color vary among varieties. Radish varieties include Champion, Cherry Belle, Daikon Long White, Icicle, and Easter Egg.

HOW TO GROW

Soils: Radishes prefer fertile, well-drained, deep, sandy soils rich in organic matter for best growth. Most light soils in Utah are well suited for radish production. Heavy soils need to be amended with plenty of compost to allow good root development.

Soil Preparation: Before planting, incorporate up to 2-4 inches of well composted organic matter and apply 2-4 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Radishes are always grown from seed. Radishes can be sown after soils reach 40ºF. Seeds germinate best at 55-75ºF and require 5-10 days to emerge. Seeds should be planted ½-1 inch deep. Maintain a uniform and moist soil surface to ensure good plant stands.

Planting and Spacing: Radishes grow best when temperatures do not exceed 80ºF. Plant radishes at 10 day intervals to maintain a steady supply throughout the year. Fall plantings should start in mid- to late August to avoid summer heat. Thin closely spaced plants to encourage good root size. Radishes should be thinned to 1-2 inches between plants in the row with rows 10-12 inches apart. High summer temperatures trigger flower stalk development in many varieties. Hot weather also causes bitterness, increases "hot" flavors and causes root hollowness. Cooler conditions improve root flavor and quality.

Water: Water radishes regularly. Water requirements depend on soil type. Mulching around the plants helps to conserve soil moisture. Use drip irrigation if possible. Moisture fluctuations cause root cracking, slow leaf development, and contribute to "hot," bitter roots. Stress during the first 6 weeks of growth often leads to premature flowering and low yields.

Fertilization: Apply ¼ cup per 10 foot of row of a nitrogen-based fertilizer (21-0-0) after emergence to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

PROBLEMS

Weeds: Radishes do not compete well with weeds. Weed control is particularly important during germination and early establishment when plant growth is slow. Avoid deep cultivation around the plants as root pruning and damage will affect growth and yield.

Insects and Diseases: Most radishes grow rapidly and are not susceptible to many production problems. Rotate the planting location in the garden from year to year to help control many diseases.

Insect	Identification	Control
Root Maggots	Small white maggots that burrow into the root and bulb. Lowers yield and quality	Use soil insecticides.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Feeding injury reduces plant stands or may kill seedlings.	Control with chemicals at seeding or after seedlings have emerged from the soil. Use floating row covers to exclude pests.
Disease	**Symptom**	**Control**
Root Rots	Fungal diseases that cause decay and rotting of the root. May affect plant stands.	Use crop rotation, improve soil drainage, and apply seed treatment to provide effective control.

HARVEST AND STORAGE

Radishes can be harvested when the roots reach full size. Generally roots are mature 25-45 days from seeding depending on variety. Pull up plants by the tops and trim off leaves. Wash and store in plastic bags in a refrigerator for 2-4 weeks. Radishes should be harvested before heavy frosts or freezes.

Productivity: Plant 3-5 feet of row per person for fresh use. Expect about 50 bunches of radishes per 50 linear feet of planted row.

Nutrition: The popular red radish is low in calories with an abundance of flavor and crunch. A 1/2 cup serving of radishes (about 12 medium) provides plenty of potassium, vitamin C, folate and fiber. Winter radishes such as daikons are similar in nutrients.

FREQUENTLY ASKED QUESTIONS

What causes radishes to crack and split? Old radishes will generally split, so harvest them when they are younger. A heavy application of water after a dry period will also cause mature roots to split.

Why do my radishes grow all tops but no roots? There are several reasons for this problem. First, when planted too thickly and not thinned properly, plants fail to grow sizeable roots. Second, when temperatures are too hot (planted too late or unseasonable weather in spring) bulbing may be suppressed. Finally, if grown in too much shade, roots will not fill out completely.

What causes my radishes to be so "hot"? The "hotness" of radishes results from the length of time they have grown. Radishes that grow too slowly, are heat stressed, or are very old are often "hot."

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Red Currants in the Garden

by Sheriden Hansen, Tiffany Maughan & Brent Black

SUMMARY

Red currants are hardy and relatively easy to grow in Utah. A few plants will produce enough to supply a family with plenty of antioxidant-rich berries. They are easy to tuck into a landscape and are a wonderful addition as a border plant or on their own in the garden. They can even be cultivated in a pot and added to a container garden.

Red currant (Ribes rubrum) is a member of the genus Ribes and part of the gooseberry family (Grossulariaceae). It is native to Western Europe and has long been cultivated in the United States. In the early 1900s, currants were banned in the northern United States to prevent the spread of white pine blister rust. However for most states, including Utah, the ban was lifted in 1966. Most red currant varieties are actually immune to the disease, with black currant being much more susceptible. This ban is largely the reason that consuming currants is not part of the U.S. culture, as it is in many areas of Europe.

Figure from USDA plant database

RECOMMENDED CULTIVARS

Common and popular cultivars include 'Red Lake', 'Perfection', and 'Wilder'. These cultivars are vigorous and produce red berries borne in clusters, which make picking easy. Most cultivars bear fruit from mid-June to July, and with some simple pruning they remain productive and are long lived.

HOW TO GROW

Site Selection: Most cultivars are cold hardy to zone 3 or 4. Currants perform well in an area with morning sun, afternoon part-shade and good air circulation. Areas with poor air circulation increase the incidence of powdery mildew, a foliar disease. Air temperatures above 85 °F can cause damage to the plants, and intense sun can sunburn the leaves. Plants tend to bloom very early in the spring and should not be planted in a site that is prone to late frosts. Areas with winter shade, such as North-facing slopes or on the north side of fences, are ideal for planting as they protect plants from late frosts by slightly delaying spring bloom.

Soil: Ideal conditions for growth include rich soils with good water holding capacity, but well drained. Silt and clay loams are ideal for growing and should be rich in organic matter. In heavy clay soils, incorporate organic matter and plant on raised beds to improve drainage and aeration. Sandy soils are prone to becoming warm and will require additions of organic matter and frequent irrigation. The ideal soil pH is 6.5, but currants are very adaptable to a range of pH and soil conditions, including alkaline soils.

Plants: Currant bushes are usually about 3 to 5 feet tall and wide and the leaves have 3 to 5 lobes. Unlike gooseberries, a close relative, the canes of currant are smooth (no thorns), light yellow in color and do not bend at the tips. The flowers are green with a hint of purple and form on long racemes. The fruit has a smooth skin and a translucent-red color. Pink and white currants are color variations of the red currants. A well cared for plant can remain productive for 20 years

Plants and Spacing: Currants are often sold as bare-root starts or as potted plants. Obtain either one- or two-year-old vigorous stock from a reputable nursery. Transplant to the garden either in the late fall, or early in the spring before the plants begin to

grow. Incorporating some stable manure or a balanced fertilizer into the soil prior to planting will increase nitrogen and other nutrient release into the soil as plants establish. Set the plants slightly deeper than they grew in the nursery. Remove any damaged roots on bare-root plants and cut back the tops to 6 to 10 inches long. Space the plants 3 to 5 feet apart in a row with 8 to 10 feet between rows, depending on the vigor of the cultivar selected. After planting, spread a mulch of straw, wood chips, or peat around the base to control weeds and help keep the soil cool.

Flowers that develop during the first year should be removed to promote strong structural and root growth. Allowing the plant to fruit the first year will result in poor plant development. Most plants are self-fruitful but can benefit from cross pollination, so a second plant of a different variety will improve fruit production. During the second year of growth, the plants should produce a light crop. Expect a full crop the third year.

Fertilizer: Currants are heavy nitrogen feeders, and stable manure is a good fertilizer for red currants. Green manure or mulch can also be used. Young plants do not require heavy fertilization. For synthetic fertilizers, lightly broadcast about 1/4 to 1/3 pound of 10-10-10 or 12-12-12 fertilizer per plant each year to promote good growth.

Irrigation: Due to a shallow fibrous root system, currants grow well under drip irrigation. Drip irrigation also helps keep the canopy of the plants dry, reducing disease occurrence. Keep plants well watered with 1 to 2 inches of water per week until fruits are harvested, at this point they stop active growth and watering frequency can be reduced. Plants that are stressed for water are more susceptible to mildew.

Pruning: Plants should be pruned in late winter or early spring during dormancy. Remove any damaged branches or branches that are contacting the ground. After the first year of growth, remove all but six to eight of the most vigorous shoots. At the end of the second growing season, leave four or five of the best one-year-old shoots. At the end of the third year, prune so that approximately three or four canes of each age of wood remain. By the fourth year, the three or four oldest canes should be removed to the ground and the three or four strongest new canes allowed to grow with the remaining new canes removed. Fruiting is strongest on two and three year-old canes. A strong and healthy plant should always have about eight bearing canes, with younger canes growing each year to replace the older ones.

Propagation: Currant seeds easily germinate if stratified for three to four months at temperatures just above freezing. Seedlings are often prolific and will bear fruit when 2 to 3 years old but will not develop true to parentage and are genetically different from the parent plant. Propagation from cuttings ensures the new plant will be the same as the parent plant. Currants can be propagated from hardwood (fully mature, dormant wood taken in late winter) and semi-hardwood cuttings (partially mature wood of current season's growth, taken mid-July to first freeze). Rootstocks are available, but there is no advantage to grafting.

PROBLEMS

Weed Control: A heavy mulch around each plant will help reduce weeds. Avoid cultivating near the plants, as currants tend to have shallow and fibrous roots that can be easily damaged. Keeping weeds clear around the plant will minimize competition and the currant plant will have improved performance. A spring application of pre-emergent herbicide, such as dichlobenil or oryzalin, will minimize annual weeds. There are several herbicides registered for use on currants. It is important to always follow the label closely. Glyphosate and fluazifop-butyl are effective for weed control, but caution should be used when applying systemic herbicides to insure that none of the herbicide comes in contact with leaves or stems of the currant bushes. Using a board to shield the plant while spraying will reduce the chance of damaging the bush. Wick applications can also be effective.

Insect	Identification	Control
Currant Aphids (*Cryptomyzus ribis*)	Green, soft-bodied insect causes leaves to become cupped and distorted, often turning a reddish color. Sticky honeydew covers foliage and fruit.	Apply acetamiprid, malathion, petroleum oil or pyrethrin.
Currant Fruit Fly (*Epochra canadensis*)	Emerges from the soil in May and lays eggs in the fruit. The adult fly is 1/5 inch long and has dark brown striped winds. Larva are yellow. Larvae eat inside developing fruit.	Shallow cultivation under bushes. Apply rotenone after bloom every 3 weeks.
Imported Currant Worm (*Nebarus ribesii*)	Larva grow up to 1.5 inches long and are green with yellow ends, have a black head and black spots. Strips plant of foliage. Appear in spring and a 2nd flush can occur mid-summer.	Apply chemical spray, azadirachtin or malathion, as soon as worms appear.
Currant Borer (*Synanthedon tipuliformis*)	Yellow foliage and wilting during late summer and fall. Clear wing moth adults lay eggs on canes in May and pale yellow larvae feed on canes in summer, boring and tunneling up and down. Severely weakens canes.	Prune out and burn infested canes. Apply azadirachtin.
Powdery Mildew (*Sphaerotheca mors-uvae)*	White powdery patches appear on leaves in early spring and eventually turn rusty brown. Also forms on fruit and stems. Plant may be stunted and fruit unmarketable.	Prune to increase air circulation. Apply sulfur, paraffinic oil, or phosphorus acid during wet weather or at the first sign of disease. Avoid over-head irrigation.
Leaf Spot (*Anthracnose)*	Small brown spots on leaves appear in early Summer and progress to larger, irregular lesions with light brown centers. Can also develop on fruit. Worse during wet periods.	Remove dead leaves and prunings from the site. Prune to increase air circulation. Eliminate overhead irrigation. Apply copper hydroxide, propiconazole or basic copper sulfate.

HARVEST, STORAGE AND USES

Currants ripen over a two-week period in mid-June to mid-July, depending on local climate, and change color to a bright red when fully ripe. Fruits develop in clusters that are easily picked from the two and three year old branches. Red currants have tender skins that will tear when picked. To avoid this and increase storage life, harvest the whole cluster at once. Fruit do not need to be harvested as soon as they turn red, as they hold well on the plant. In fact, for fresh eating, leaving the fruit on the bush for an additional 2 or 3 weeks after coloring will enhance flavor and sweetness. Depending on cultivar, mature plants should yield about 3 to 10 pounds per bush.

Red currant fruits can be used fresh in salads, jellies, drinks, and desserts. In Austria it is used as the most common filling in the Linzer Torte. It is often used to make wine and juices in Russia.

Fruits are a good source of potassium, manganese, vitamin A, B, and C. They are high in flavonoids, but low in calories and salt. They also boast high antioxidant levels and may help fight against various forms of cancer.

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Authors: Sheriden Hansen, Student, Tiffany Maughan, Research Associate & Brent Black, Extension Fruit Specialist

Red Raspberries

by Tiffany Maughan & Brent Black

INTRODUCTION

Raspberries are a favorite fruit for many Utahns. The plants can be grown across much of Utah, but require special care in some areas. With proper planning, management and care, a raspberry planting can provide fresh fruit for many years. This fact sheet will provide a general guide to raspberry production that can be adapted for both home use and for small-scale commercial production.

PLANTS

Raspberry plants have a perennial root system. However, cane growth is biennial. This means that an individual cane typically lives only 2 years and then dies. New canes emerge from the roots in the early spring and continue growth throughout the summer. Second-year canes do not grow taller, but grow short lateral branches containing several leaves and a terminal flower cluster that leads to fruit formation. After producing fruit, the second-year canes die. A first-year cane is called a primocane, and the second-year cane is called a floricane. While the floricanes are producing fruit, primocanes are developing and will become the next year's fruiting floricanes. In this way, the planting may produce fruit every year.

Some cultivars will produce flowers and fruit on the upper portion of the primocanes (first year canes) in the fall. For these "primocane-fruiting" types, the primocane ceases growth in mid-summer, with lateral buds opening to form fruiting side shoots, beginning at the tip and progressing down the cane. Typically, the buds in the top third to top half of the cane produce flowers and fruit before the plants go dormant for the winter. The remaining lower portion of the cane still has the potential to produce a floricane crop during the following season. These primocane-fruiters are also referred to as fall-bearing, ever-bearing or double-cropping. Primocane-fruiting types require somewhat different management than the summer-bearing (floricane-fruiting) types that will be discussed below.

Figure 1. Winter damage on raspberry.

Cultivated raspberries can have red, black, yellow or purple fruit color. Raspberries are self-fruitful and are pollinated by insects or wind. Along the Wasatch Front and in Utah's Dixie, fall-bearing raspberries tend to be better adapted, as the fruit ripens after the hottest part of the summer is over, thus avoiding fruit sunburn. For higher elevations with colder climates, the growing season is typically too short for fall-bearing types, so summer-bearing raspberries are better adapted. For these locations, it is important to select cultivars with good cold hardiness, as winter injury to the canes will result in crop loss.

PLANT SELECTION

Although it is a fairly common practice to share raspberries plants with neighbors, it is best to avoid this to prevent the spread of plant viruses and soil-borne diseases. Money saved in free plant material will not be worth the problems of trying to rid your planting of disease. It is best to obtain plants that are true to name and that are free of known diseases by purchasing certified virus-free plants from reputable nurseries.

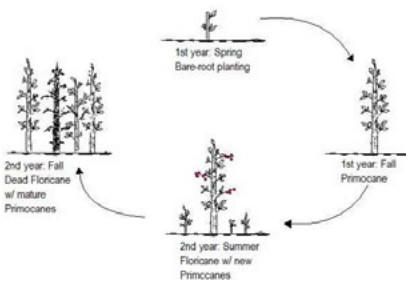

Figure 2. Summer-bearing raspberry life-cycle.

Place catalog orders or reserve plants at local nurseries early in the season to get the best varieties. Specify a shipping date to allow planting at the right time. Planting bare-root plants in the spring is better than using potted plants later in the season, as potted starts are more expensive and the quality is often inferior. Dormant bare-root plants can be planted as soon as the ground can be tilled in the early spring. Selecting cultivars that

perform well in your area is critical. Some cultivars cannot survive severe freezes and significant winter damage can occur. Figure 1 shows an example of raspberry canes with partial die-back resulting from winter injury.

Table 1. Summer-bearing raspberry cultivar recommendations.

Cultivar	Size	Flavor	Yield	Cold Hardiness
Canby	Med.	Excellent	High	Fair
Cascade Delight	Large	Excellent	High	Good
Cowichan	Med.	Good	High	Good
Killarney	Large	Good	Med.	Fair
Reveille	Large	Good	High	Good
Jewel (Black)	Small	Excellent	High	Fair
Royalty (Purple)	Large	Fair	High	Excellent

SUMMER-BEARING

Summer-bearing raspberries only produce fruit on the second-year canes (floricanes). Primocanes can grow 4 to 8 feet the first year under ideal conditions. The canes flower and produce fruit in the second year. Figure 2 illustrates the typical life-cycle of a summer-bearing raspberry. The middle three-fifths of the canes usually produce the largest quantity of fruit, and often the best-quality fruit. Fruit production starts in June and continues to the end of July, depending upon the cultivar and weather conditions.

Table 1 lists several summer-bearing raspberry cultivars that have performed well in Utah. Cultivar selection is critical for a successful raspberry operation. When selecting a cultivar consider these factors. If you know of a raspberry disease that has affected your area, try to find a cultivar with resistance to that disease. Utah has harsh winters that can cause significant winter die-back in many cultivars. If you live in an area where winter injury is a concern, look for cultivars that have good cold hardiness. For more detailed information on summer-bearing raspberry cultivars in Utah see USU fact sheet Horticulture_ Fruit_2015-02pr.

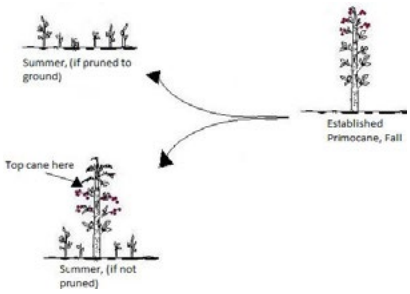

Figure 3. Fall-bearing raspberry lifecycle.

FALL-BEARING

Fall bearing raspberry primocanes emerge from the soil in early spring, but stop terminal growth and begin flowering in mid-summer, with fruit harvest beginning in late summer or early fall and continuing until the first fall freeze causes the plants to stop bearing fruit and begin dormancy. The height at which fruiting begins depends on the cultivar and the vigor of the plant. As shown in Figure 3, if canes are not completely removed during winter pruning, the lower portion of the remaining cane will produce a summer floricane crop the following season. The yields for the primocane crop depend on earliness and when the first fall freeze comes. In areas with a growing season less than 125 freeze-free days, primocane yields may not be sufficient to justify planting these cultivars.

Table 2. Fall-bearing raspberry cultivar recommendations.

Cultivar	Size	Flavor	Yield	Season
Caroline	Large	Good	Med.	Mid
Josephine	Med.	Excellent	Med.	Late
Polana	Med.	Good	Med.	Early
Joan J	Large	Excellent	High	Early
Polka	Large	Excellent	Med.	Very Early

Table 2 lists fall-bearing raspberry cultivars that grow well in Utah. For more detailed information on fall-bearing cultivars in Utah see USU fact sheet Horticulture_Fruit_2013n-01pr.

ESTABLISHMENT

Spacing: Raspberries grow by root suckering, as shown in Figure 4, and have a tendency to spread if not kept in check. Raspberries should be strip cultivated or side pruned annually to maintain row widths. Rows should be no wider than 2.5 feet to allow for adequate light penetration. More narrow rows give higher yields and larger berries per square foot. Distance between the rows should be determined based on equipment width, but typically should not be less than 8 feet. Allow sufficient space for hand cultivation or tilling between the rows, as well as room to maneuver during harvest. Initial in-row spacing should be 1.5 to 2 feet, to allow rows to fill in quickly.

Figure 4. Characteristic new growth from root suckering.

Site Selection: Choose a location with at least 8 hours of direct sunlight to plant raspberries. Although some air movement to hasten leaf drying is important for keeping disease occurrence low, provide protection from strong winds that can increase winter damage through desiccation, damage leaves, and increase berry drop. It is a

good idea to avoid planting in a site that has recently had cane berries, solanaceous crops (tomatoes and peppers), or fruit trees. This is to reduce potential infection by soil-borne pathogens.

In the hot summer conditions of the Wasatch Front, fruit sunburn is a common problem which shows up as a bleached appearance on the sun-exposed portion of the fruit, see Figure 5. This damage can be minimized by planting the patch where it receives some afternoon shade, such as on the east side of a fence or building. Some commercial farms use shade cloth over the patch during fruit ripening to reduce sunburn.

Figure 5. Sunburn on raspberry fruit.

Soil Preparation: Soil is one of the most important factors to consider before planting raspberries. Raspberries require well-drained soils. Most of the roots are in the top 20 inches of soil and are easily damaged by overwatering. Before planting, add organic matter to improve soil drainage and nutrient holding capacity. In heavy soils, planting on raised beds can also help improve water drainage out of the top of the bed. A bed about 10 to 12 inches high is sufficient. Raspberries prefer a soil pH of 5.5 to 7.0, which is lower (more acidic) than is typical of Utah soils. Iron chlorosis often results from this, (see below). Modifications and amendments can be made to the soil that will help manage alkaline soils.

Weed control, particularly of perennial weeds, before planting is critical as a raspberry planting will be in the same place for many years and most herbicides used to control perennial weeds cannot be used on raspberry plantings without damaging the crop.

Figure 6. Well-maintained raspberry planting.

Planting: Plant dormant bare-root raspberries as early in the spring as possible, once soil moisture content is such that plowing or disking results in few clods. It is important to never let bare-root plants dry out. Immediately before planting, soak the roots in water for 1 to 2 hours. Plant them at the same level they were planted before (a soil line should be visible), taking care to cover the crown of the plant with soil. Spread roots out laterally along the row and water immediately. Some nurseries also sell plug plants, already rooted plantlets. These are typically more expensive per plant than bare-root plants but are less at risk of drying out and establish easily.

MANAGEMENT

Care: Water management is critical for the first 6 weeks after planting. Keep the soil moist but not waterlogged. Most soils need water every 5 to 7 days during establishment. Do not add fertilizer when planting, as excess fertilization damages the roots or can stimulate excessive top growth before the roots develop. Control weeds since they will compete for water and nutrients, and can harbor pests. Planting grass alleyways or mulching between rows can help control annual weed problems. Avoid excessive cultivation around young plants to protect developing roots. Herbicides can help control weeds, but take extreme care when using systemic herbicides, as raspberries are very sensitive and can easily be damaged by unintended drift. Pre-emergent herbicides applied in the spring will significantly reduce annual weed germination.

Fertilization: Nitrogen is the most critical nutrient for raspberries. Sandy soil needs more nitrogen than clay soil. Plants with sufficient nitrogen will produce longer, stronger canes. A general recommendation for an established planting is to apply 3 to 5 pounds of urea (45-0-0) or ammonium sulfate (21-0-0), per 100 row feet (150-275 pounds of fertilizer per acre). Apply fertilizer in the early spring. Add other nutrients if soil tests indicate a need, or if deficiency symptoms become visible.

Iron Chlorosis: Iron chlorosis is a symptom of iron deficiency. It is common in many Utah berry crops and is characterized by inter-veinal yellowing (Figure 7). Iron chlorosis can be easily recognized by the yellowing of the younger leaves while the veins remain a darker green color. In severe cases, the entire leaf can turn a yellow-white color and then begin browning on the edges. Although Utah soils contain iron, the high pH makes the iron unavailable to plants. Successive years of iron chlorosis will result in weakened plants that will be more susceptible to diseases and insects.

Figure 7. Healthy (left) and chlorotic (right) raspberry leaves. Note yellow leaf with green veins.

To minimize iron chlorosis occurrence, it is important to use proper management techniques. Avoid over-fertilizing with nitrogen. Large amounts of nitrogen will stimulate excessive vegetative growth, and the plant cannot take up enough iron to meet the need by the new growth. Over-irrigation, especially in the early spring, also induces iron deficiency. Cold, waterlogged roots are not effective in iron uptake. Wait to begin irrigation until the top foot of soil is dry. Adding a chelated iron amendment to the soil or directly to the leaves of the plants can help, but is relatively expensive. Foliar application

of chelates provides a very short term but rapid response. Best results will be obtained by soil-applied chelated iron twice in the growing season, once in May and again in September. More information on iron chlorosis in berry crops is available at http://fruit.usu.edu.

Irrigation: Watering too early in the season cools the soil, slows root growth, causes poor aeration, and induces iron chlorosis. Once irrigation is needed, apply 1 to 2 inches of water per week. During fruiting, plants may need additional water to promote larger berries. Actively growing raspberry roots will die if submerged in water or subjected to water-logged soils for 24 hours or more. Raspberries are shallow rooted and regular watering is critical to prevent soil drying. During the hottest part of the summer, twice-weekly irrigation may be needed. Soil moisture can be monitored with a tensiometer or electrical resistance block, although for the home gardener these systems may be excessive. For additional irrigation information see USU fact sheet Horticulture_Fruit_2008-04pr.

Figure 8. Raspberry T-trellis in planting with grass alleyway.

Mulches: Apply organic mulch after the soil has warmed in the spring to conserve moisture, reduce weed growth and improve the soil. Common mulches include straw, sawdust, bark chips, shredded paper and compost. For raspberry production, plastic mulches or weed barrier fabrics are not recommended because they prevent primocane emergence from the roots.

Trellising: Trellising is required to reduce cane breakage, to keep fruit off the ground and make harvesting easier. Raspberries can be trellised in many different ways, so it is important to build trellises to fit your situation and your budget. A simple T-trellis system, as pictured in Figure 8, works well for summer bearing raspberries.

Pruning Summer-Bearing Red Raspberries: Summer-bearing red raspberries can be pruned in the fall after most of the floricane leaves have dropped, or in the early spring before they start growing. Some growers prune in the fall as they believe that this reduces winter injury to the remaining canes. Pruning involves four steps: (1) Remove all spent floricanes at ground level. (2) Narrow the rows by cultivation. (3) Thin the remaining canes removing weak and damaged or broken canes, leaving no more than 4 to 6 canes per foot of row. (4) Topping or cutting back the remaining canes. Topping the canes reduces the total amount of fruit that will be produced, but the remaining fruit will be larger. If the primary interest is in processing the fruit into jams and jellies, then leaving the canes untopped will produce the greatest amount of fruit, but fruit size will tend to be smaller. Commercial producers that want large fruit for fresh market sales will cut the canes back leaving only 3 to 5 feet of cane, depending on cultivar and plant vigor.

Figure 8. Characteristic tip wilting from presence of the cane boring insect Raspberry Horntail.

Pruning Fall-bearing Raspberries: Fall-bearing (primocane-fruiting) raspberries have two acceptable pruning methods. If you are only interested in a fall crop, the canes can be cut off at the ground each year during the dormant season. Rows should also be narrowed to 2 to 3 feet by cultivation, although rows for fall bearers are typically left wider than for summer-bearing types. If both a summer and a fall crop is desired, then prune as recommended for summer bearers (remove spent canes and thin remaining canes). Canes should be topped just below the lowest flower cluster from the previous year, see Figure 3. Typically, double cropping results in a smaller fall crop than would result if the canes were cut to the ground each year.

Pests: Insect: A healthy planting of raspberries is less likely to be attacked and can withstand some insect damage better than an unhealthy one. Properly managing irrigation, fertilization and selecting cultivars well suited for Utah can be a great pest defense. Keeping weed populations low and removing pruning from the site will also help to combat insect occurrence.

One of the most important parts of managing insect pests is to carefully monitor raspberry plantings. Early detection can help limit damage. After detecting a pest presence, correctly identifying the pest is critical. For identification assistance, contact your local county Extension agent or submit a sample to the Utah Plant Pest Diagnostic Lab (utahpests.usu.edu/). Table 3 lists common raspberry pests in Utah and control options.

Figure 9. Two spotted spider mite and eggs on leaf.

Table 3. Common raspberry insect pests in Utah.

Pest	Description	Damage	Control
Larger Raspberry Aphid	Soft-bodied, fluid sucking insect. Overwinters as eggs on canes and has many generations per year.	Suck plant sap, stunting vegetative and fruit growth and can spread diseases.	Monitor closely, checking under leaves. Encourage beneficial insects (such as lady beetles) and avoid applying pesticides that will damage them. Insecticidal soaps or oils should be used if plant health declines.
Raspberry Crown Borer	Clear-wing moth that looks like a yellow-jacket. White larvae with brown head. Has a 2-year life cycle.	Canes weaken and often break off. Cane ends look like a shepherd's crook and eventually the entire cane dies back.	Dig out and destroy affected canes and roots. Drench soil and crown with bifenthrin, diazinon, or imidacloprid in early fall.
Raspberry Horntail (Cane Borer) (Fig. 8)	Adult is a black wasp about 1" long. White larvae grows to 1" and has a brown head.	Bores in the canes, causing cane dieback from tip down. Cane dieback occurs from June to August.	Spray with registered insecticide (Rotenone+Pyrethrin, Carbaryl, diazinon, malathion) at bud break and 14 days later. Cut below affected part of cane and destroy.
Root Weevils	Small black night-feeding beetle.	Reduced fruit yields and even cane death.	Apply baits, use traps or parasitic nematodes. Apply registered insecticides if damage is severe.
Rose Stem Girdler (Cane Girdler)	Beetles less than 0.25" long with dark copper to greenish copper color. White, flat larva 0.5" long	Larvae feed inside primocanes, girdling them and causing swollen stem galls.	Prune and destroy infested canes. Spray entire cane before bloom with registered insecticides (Carbaryl, pyrethrin, malathion, befenthrin).
Two-spotted Spider Mite (Fig. 9)	Very small, 0.02" yellow mite with two dark spots on back forms colonies and webbing on undersides of leaves. 10 to 14 day life cycle.	Suck plant sap, leaving fine, gray stippling on leaves, starting on lower leaves and moving up. Large infestations form visible webbing. Reduces cane vigor and yield. Heavy feeding leads to death of leaves.	Mites favor hot, dry conditions. Minimize dust and control weeds, particularly broadleaf, around the field. Keep plants well watered to avoid stress. Promote predatory mites and other predators. Avoid insecticides that will harm beneficial insects.

Disease: Diseases typically cause more serious damage than insect pests and control is more difficult. Depending on the disease, it is sometimes necessary to remove the planting and start over. Therefore, prevention is the best control option. Planting cultivars that have a natural resistance to the disease is very effective, however, not always possible. Keeping the plants healthy and avoiding conditions that favor infection is key. Table 4 lists common diseases in Utah.

Figure 10. Healthy raspberry cane (left) compared to a virus-infected one (right). Note stunted leaf growth and cupping.

Virus: Viruses are systemic, meaning they travel throughout the entire plant and affect every part of it. Once a plant in the field is infected, it is not possible to eliminate the virus. The only control method is to remove and destroy the infected plant and isolate the surrounding healthy plants from sources of infection. The most serious Figure 10. Healthy raspberry cane (left) compared to a virus-infected one (right). Note stunted leaf growth and cupping. viruses in our area are Bushy Dwarf and Mosaic (see Table 5).

Crumbly fruit is a result of poor or incomplete pollination leading to reduced numbers of drupelets. There are several factors that can prevent adequate drupelet formation and cause fruit to crumble. A virus can be the cause of this crumbling, but is not the only possibility. If your planting has crumbly fruit, be sure to check for other symptoms before deciding it is a virus and taking control measures. Weakened plants become targets for raspberry viruses and they fail to harden adequately, resulting in winter injury.

Table 4. Common raspberry diseases in Utah.

Disease	Symptoms	Control
Crown and Root Gall	Bacteria in the soil invades the plants and cause development of tumor like masses on roots and crowns. Results in weak growth and reduced production.	Plant disease-free stock and do not plant into infected soil. No effective eradication method.
Gray Mold (*Botrytis*)	Spores are almost always present and will infect ripe fruit and blossoms when moisture and temperature conditions are right. Infected fruit rapidly becomes watery and soft, tiny, black or gray spores develop on surface of fruit.	If using sprinkler irrigation, water in the morning to allow time for plants to dry during the day. Trellis plants to have an open canopy with good air movement. Cool fruit immediately after harvest. If conditions are favorable for development, apply registered fungicidal spray.
Phytophthora Root Rot	Wilting and dieback of top of canes. Increases in severity until plants die. Dark, water-soaked region at base and roots. Crown are reddish-brown when scraped.	Plant resistant cultivars. Plant into uncontaminated soil. Avoid heavy wet soils or plant into raised beds.
Powdery Mildew	Tops of leaves turn blotchy yellow and underside is covered with white powdery fungal growth. Develops in warm, dry weather.	Plant resistant cultivars. Mild infections do not warrant chemical control. Remove infected shoots during late summer to reduce further infection.

Table 5. Common raspberry viruses in Utah.

Virus	Transmission	Symptoms	Control
Mosaic	*Amphoraphora agathonica* aphid	Delayed leafing out. Small, misshapen leaves, mottling or large green blisters.	Plant aphid resistant cultivars. Control aphid populations in the planting.
Raspberry Bushy Dwarf	Pollen	Crumbly fruit, yellow, irregular, misshapen leaves.	Plant virus free, resistant cultivars.
Leaf Curl	*Aphis rubicola*	Small leaves, tips and margins turn downward. Fruiting laterals shortened.	Plant virus free, resistant cultivars.
Tomato Ringspot	*Xiphinema americanum* Nematode	Crumbly fruit, pale ringspots on leaves in spring, followed by yellowing of leaves and overall stunted growth.	Plant virus free, resistant cultivars. Rotate to non-host species.

HARVEST, STORAGE AND USE

Raspberries are harvested over a 2 to 4 week period, depending on the cultivar. Unfortunately, berry quality can quickly decline once harvested. It is best to pick in the early morning before the afternoon heat. Cool berries as soon as possible after harvesting by placing them in a refrigerator or other cool place, this will extend their shelf life. During peak production, raspberries need to be harvested once every 2 days. Typical yields for raspberry plantings in Utah are approximately 1 pound per linear foot of row each season. Handle fruit carefully to avoid bruising. Fruit can be stored for up to 5 days if properly handled. Raspberries can be eaten fresh, preserved as jam or jelly or used in baking.

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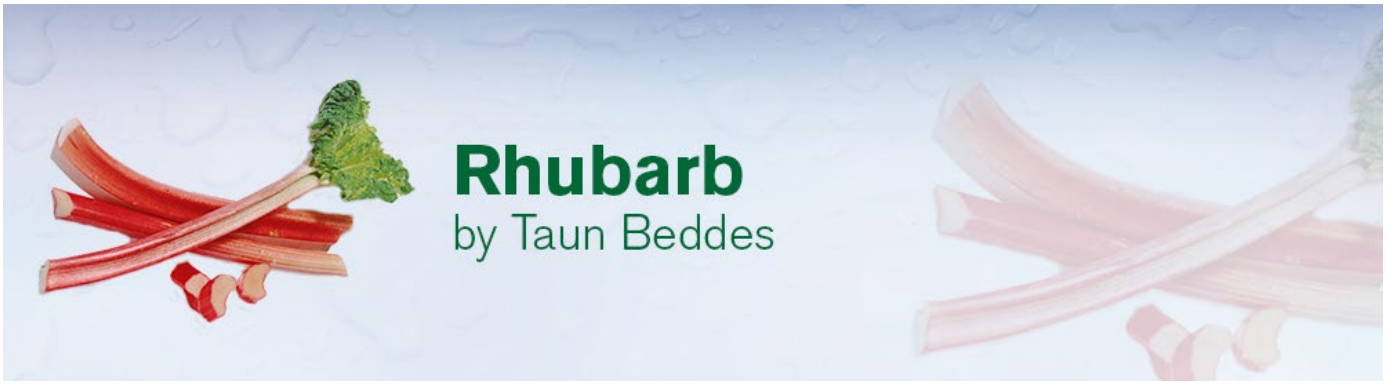
Notes



Rhubarb

by Taun Beddes

SUMMARY

Rhubarb prefers organic, rich, well drained soils, but grows in most Utah soils. Stalk color ranges from green to red and is variety dependent.

Starts (cuttings) are available in early spring as cut pieces of a crown. Purchase cuttings with a large leaf bud on the top surface and undamaged root(s) underneath. Plant so that the leaf bud is 1 inch beneath the soil. Space plants 3 feet apart.

Rhubarb requires regular irrigation. Leaf stalks (petiole) should not be harvested for 2 years after planting.

A plant yields 4 to 12 pounds of stalks annually depending on age, variety and growing conditions. Rhubarb can be preserved by freezing or canning.

Rhubarb leaves just emerging from the soil in the spring. When first planting new starts, be sure to not cover them with more than 1 inch of soil[1]

INTRODUCTION

Rhubarb (*Rheum rhabarbarum L.*) has been cultivated for thousands of years and was introduced to North America in the seventeenth century. Rhubarb is an easy to grow, nutritious vegetable that can live in the garden for 10 to 15 years, and deserves more attention.

HOW TO GROW

Soils: Rhubarb prefers organic, rich, well drained soil for best growth. However, most soils are adequate as long as they are well drained. An inexpensive soil test can reveal potential soil problems as well as soil nutrient levels. Visit the USU analytical lab website at www.usual.usu.edu for further information about soil testing.

Soil Preparation: Before planting, control all perennial weeds and incorporate 2 to 4 inches of well composted organic matter 6 inches deep into the soil where rhubarb is to be planted.

Plants: Rhubarb is almost always purchased as starts (cuttings). Cuttings are taken from healthy crowns and should have at least one leaf bud on top and healthy roots (that may have been trimmed) on the bottom. Cuttings can be purchased online, via mail order or from local garden centers in late winter or early spring. Containerized, established plants are often available from local garden centers in late spring and early summer.

Planting and Spacing: Mature rhubarb plants grow over 3 feet in height and width. Place them where they will not interfere with other crops. In a sunny area, space plants every 3 feet. Plant crowns in early spring (late March to mid-April in Northern Utah). Cover crowns with no more than 1 inch of soil. Firmly press soil above and around crowns and then water well. If more than one row is planted, space rows 4 feet apart. For container grown plants, cover the top of the root-ball with 1 inch of garden soil. Planting crowns or established plants excessively deep delays maturity and can result in plant death.

A newly formed rhubarb flower stalk. The tendency to flower is variety dependent[1].

Watering: How often to irrigate rhubarb depends on soil type, sun exposure and

outdoor temperatures. For the first 2 to 3 years after planting, irrigate one to two times weekly so water penetrates to the bottom of the root-ball (usually 6 inches to a foot deep). Mulch around plants with straw, grass clippings or bark to conserve soil moisture and reduce weed competition.

Reduce irrigation frequency to once every 1 to 2 weeks after year 3, especially when mulch is applied around the plant. Irrigate so that water penetrates the soil 12 to 18 inches deep. Additional water may be needed during harvest in dry years.

RECOMMENDED VARIETIES

Variety	Stalk Color	Comments
Chipman's Canada Red (Canada Red)*	Moderate red	Multiple uses. Color resists fading when processed. High yielding variety.
Crimson Red (Crimson Cherry, Crimson Wine)	Bright Red	Well-balanced, sweet yet tart flavor and stalks are not stringy. Likely to produce flower stalks.
Cherry Wine	Bright red	Moderate vigor. Produces few flower stalks.
Early Sunshine	Intense red	Useful for pie filling. Moderate producer.
MacDonald (MacDonald's Canadian Red, MacDonald Crimson)	Bright pink to bright red	Common, high yielding variety. Useful for pies, freezing and canning.
Valentine	Deep red	Historic variety grown for its classic rhubarb flavor. Color resists fading when processed.
Strawberry	Light red	Moderate vigor. Produces few flower stalks.
Victoria (Large Victoria)	Mostly pink at the bottom that fades to green at the top.	Popular commercial variety due to its sweet taste and excellent yield. Very likely to produce flower stalks that need removal.

* Variety names listed in parentheses are alternate names that the same cultivar may be sold as.

Fertilization: Apply ½ cup of 16-16-16 granular fertilizer around the base of the plant just before leaves begin to emerge in the spring and lightly work into the soil. Do not fertilize during the first year of establishment.

Flowers: Rhubarb occasionally produces flower stalks. Flowering tends to reduce plant vigor and leaf and petiole production. Flower stalks should be removed just as they begin to elongate.

Dividing Plants: Depending on the variety and overall vigor, divide established plants every 5 to 10 years. In early spring, before new growth begins, dig up the entire crown. Divide the crown so that there is one large bud to each section of crown and root. A healthy, mature crown generally produces 5 to 10 new plants. Replant 3 feet apart in a new area of the garden using planting procedures described above. If divided crowns are not immediately replanted, store by covering with moist media such as potting soil, saw dust, peat moss, or vermiculite at temperatures between 32 to 40° F. Replant before or just as crown pieces begin to grow.

PROBLEMS

In Utah, rhubarb is not generally impacted by many pests or diseases, as long as proper plant health is maintained and healthy starts are used. To minimize risk, irrigate and fertilize properly and remove weeds from the growing area. An insect called the rhubarb curculio may cause minor damage by piercing stalks and feeding on plant juices. Rhubarb will get various root-rot diseases if over-irrigated or grown in wet soils. The disease red leaf has been reported in many states. Leaves turn red and localized rot begins in the roots and then spreads throughout the plant. Other diseases are reported but are less common or are not present in Utah due to our dry climate. For assistance identifying and managing plant problems, contact your local USU Extension office.

HARVEST AND STORAGE

Harvesting: Do not harvest any stalks for the first 2 years. In the third year, stalks can be harvested for 3 to 4 weeks. After the fourth year, harvest stalks for 6 to 10 weeks or until plants begin to lose vigor. Stalks are ready for harvest when the petiole is 10 to 15 inches long. To remove, grasp the stalk just below the leaf and pull upwards and to one side.
Leave 1/3 of stalks at any given time to maintain plant health. Only the stalks are edible, so all leaves should be removed and discarded. Never cut stalks from the base of the plant. This leaves plant tissue potentially open as a disease entry point.

Productivity: Depending on the variety and growing conditions, between 4 to 12 lbs of stalks can be harvested annually per plant.

Storage and Processing: Fresh stalks can be refrigerated for 2 to 4 weeks in plastics sacks. Stalks can also be frozen. Blanch stalks in boiling water for 1 minute. Promptly cool blanched stalks in an ice bath to preserve crispness and color. Pack stalks tightly into containers and freeze with or without sugar.

When canning, 7 pounds of rhubarb is needed to fill nine pint bottles. Cut stalks into ½ to 1 inch pieces and place in a large sauce pan. Add ½ cup of sugar per quart of cut stalks. The added sugar draws out plant juices. Allow this mix to stand until juice appears. Heat to boiling and add the mix to clean canning jars, leaving ½ inch of head space. Boil filled jars in a water bath for 20 minutes at elevations of 1,000 to 6,000 feet and 25 minutes at elevations above 6,000 feet.

Nutrition: Rhubarb is rich in vitamin C and calcium. It has some vitamin A, iron, phosphorus and potassium.

FREQUENTLY ASKED QUESTIONS

Why are the stalks on my rhubarb so thin? Stalk (petiole) size is influenced by plant health, age, and variety. Over harvesting, poor nutrition, inadequate water, or other stresses (temperature) all affect stalk size. As plants get older and more crowded, stalk size also decreases. Finally, some varieties produce larger or smaller stalks.

Why do you discard the leaves after harvesting the petioles? Rhubarb leaves contain high concentrations of oxalic acid that can make you quite sick and lead to kidney failure. The stalks on the other hand have almost no oxalic acid. Animals are also susceptible to this poisoning so leaves should not be fed to livestock. Discard the leaves into the compost pile or leave in the garden as a mulch.

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Authors: Taun Beddes, USU Extension Cache County Horticulture Agent

Notes

Rutabagas

by Dan Drost

SUMMARY

Rutabagas and turnips are cool season vegetables that prefer sunny locations and fertile, deep, well-drained soils. Incorporate plenty of organic matter and an all-purpose fertilizer into the area before planting. Plant seeds ¼-½ inch deep. Thin seedlings to 3-6 inches apart in row with rows 18 inches apart. Plant turnips 2-3 weeks before the last frost. Turnips taste best when plants grow rapidly and mature before the heat of summer. Rutabagas should only be grown as a fall crop. Avoid water or fertilizer stress during growth. Irrigation should be frequent and uniform to ensure good growth. Control insect and diseases throughout the year. Harvest when roots reach full size.

VARIETIES

There are many good rutabaga and turnip varieties for sale in local gardening outlets and through seed catalogs. Suitable rutabaga varieties include American Purple Top and Marian. Turnip varieties include Purple Top, White Globe, and Just Right Hybrid. Most varieties grow well in Utah.

HOW TO GROW

Soils: Rutabagas and turnips prefer fertile, well-drained, deep, sandy soils rich in organic matter for best growth. Most light soils in Utah are well suited for production. Heavy clay soils will need to be amended with plenty of compost and should be double dug to allow good root development.

Soil Preparation: Before planting, incorporate up to 15-20 lbs of well composted organic matter and apply 2-4 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Rutabagas and turnips are always grown from seed. Rutabagas should be seeded in the summer and grown as a fall crop as they develop slowly, need time to fill out the root, and do not withstand summer heat as well. Turnips can be sown after soils reach 40ºF. Seeds germinate best at 60-85ºF and require 7-10 days to emerge. Rutabaga root development occurs best when temperatures are less than 75ºF. Turnips grow best when temperatures do not exceed 85ºF. Low temperatures do not seriously damage plants and can enhance root flavor.

Planting and Spacing: Seeds should be planted ¼-½ inch deep and thinned when plants have 3-4 true leaves. Crusting soils will limit seedling emergence and affect plant stands. Seed turnips every 4 weeks for season long production. For fall rutabagas and turnips, select early maturing cultivars and plant 75 days before the anticipated maturity date. The maturity date should be about 2-3 weeks after the first fall frost. High summer temperatures reduce growth, decrease quality, and cause bitter or off flavors to develop if plants are not watered properly. After emergence, thin turnips 3-4 inches between plants in rows 12-18 inches apart. Denser plantings will reduce weed pressure. After emergence, thin rutabagas, spacing them 4-6 inches between plants in rows 18 inches apart. Wider in-row spacings are needed to accommodate the larger root.

Water: Water regularly, applying 1-2 inches per week depending on weather. Water requirements depend on soil type. Use drip irrigation if possible. Mulching around the plants helps to conserve soil moisture. Moisture fluctuations cause root disorders like cracking, woody roots, and pithyness, and contribute to bitter flavors.

Fertilization: Apply ¼ cup per 10 feet of row of a nitrogen-based fertilizer (21-0-0) 6 weeks after emergence to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches: Use fabric covers to protect seedlings from frost (early or late) and insects. Apply organic mulches around the plants during summer when temperatures increase. Mulches will cool the soil and reduce water stress. Organic mulches include grass clippings, leaves, straw, and newspapers also help control weeds.

PEST CONTROL

Weeds: Rutabagas and turnips do not compete well with weeds. Weed control is particularly important during germination and establishment. Thin closely spaced plants to encourage good root size. Avoid deep cultivation around plants as root pruning and damage will affect growth and yield.

Insects and Diseases: Most rutabagas and turnips are moderately fast growing but are susceptible to many of the same production problems as cabbage. Rotate planting locations from year to year to help control diseases.

Insect	Identification	Control
Aphids	Green or black soft-bodies insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit diseases. Insects secrete honeydew, making plants appear shiny, wet, or sticky.	Use soil insecticidal soaps, appropriate chemicals or strong water stream to dislodge insects.
Cabbage Worms	Worms are light to dark green. Adult moths are gray, brown or white. Worms chew holes in leaves and hide in and under leaves.	Control worms with chemical or biological measures like Bt or parasitic wasps.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant vigor or may kill seedlings.	Control with chemicals at seeding or after seedlings have emerged from the soil.
Disease	**Symptom**	**Control**
Alternaria Leaf Spot	Damping off of seedlings. Leaf spots on leaves or heads are a more common symptom. Spots form concentric circles which have a black sooty color.	Avoid overhead irrigation. Practice good sanitation. Rotate crops. Apply appropriate fungicides as a last resort.

HARVEST AND STORAGE

Rutabaga and turnip leaves can be harvested anytime after they reach full size. For greens, pick off the older leaves. Roots are mature 60-80 days from seeding. Use a digging fork to loosen soil and pull up plants by the tops and trim off leaves. Start havesting when rutabaga roots reach 4 inches in diameter and the turnip is greater than 2 inches. Rutabagas and turnips are quite tolerant to light frosts. Many gardeners overwinter some rutabagas and turnips under heavy mulches and soil in the garden. If soils freeze deeply, pull and store indoors. Wash the roots and store in cool moist conditions (35ºF and 95% relative humidity) for 3-4 months.

Productivity: Plant 5-10 feet of row per person for fresh use and 5-10 feet for storage. Expect 50-75 pounds of greens or roots per 100 linear feet of row.

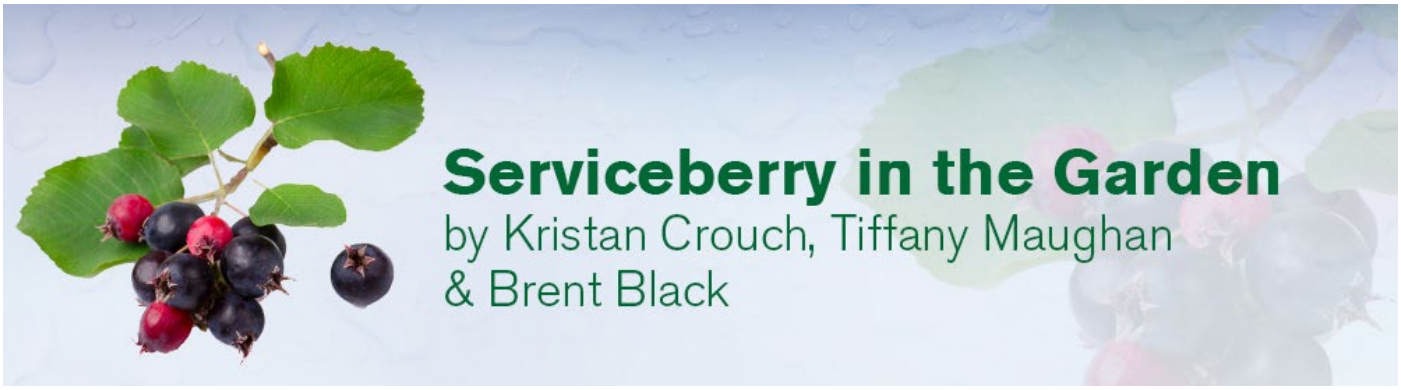
Nutrition: Rutabagas and turnips are low in calories with an abundance of flavor and crunch. A cup serving is very high in vitamin A and C, iron, and fiber. Rutabagas generally have higher amounts of these than turnips.

FREQUENTLY ASKED QUESTIONS

Why are my rutabagas small, tough, and bitter tasting? Rutabagas are best grown as a spring crop in cooler locations of Utah or as a fall crop in hotter areas. When they develop and mature in hot weather, their typical sweetness and flavor is lost. In hot locations, adjust the planting season so root development takes place in the cooler days of fall using the time it takes a particular variety to mature.

Can you use turnips for greens? Turnip tops are nutritious and often eaten as cooked greens. Certain cultivars - such as 'Shogoin' - are grown exclusively for greens. Other cultivars provide both greens and roots, such as 'Purple Top,' 'White Globe,' 'Just Right' and 'Tokyo'.

Authors: Dan Drost, USU Extension Vegetable Specialist, & Wade Bitner, Horticulture Student



Serviceberry in the Garden

by Kristan Crouch, Tiffany Maughan & Brent Black

SUMMARY

Serviceberry (Amelanchier spp,), also known as juneberry, saskatoon or shadbush, is considered a large shrub that can be grown as a small tree. It is native to North America, and is adapted to many areas of Utah. White flowers appear in early spring, with yellow to red foliage in the fall. The fruit is a berry-like pome, and resemble small blueberries. When ripe, they are dark red, purple or almost black in color. They are primarily harvested for juice, jellies, jams and pies, but can also be eaten fresh. Serviceberries are cold hardy to zone 3, adapt to a range of soil types and may have desirable ornamental qualities.

RECOMMENDED VARIETIES

Amelanchier alnifolia var pumila is a naturally occurring dwarf variety that is native to the western United States. It will often stay quite small, only about 3 feet high and wide, and produces small round berries. There are several cultivars that have been selected for fruit production and will do well in the home garden (Table 1). Serviceberry availability at local nurseries can be limited, but many online companies carry serviceberry plants. Care should be taken to only order from reputable nursery companies. Another option is to propagate serviceberries on your own. One of the easiest and most effective methods of propagation is by digging up suckers from a healthy established plant and transplanting them to the desired location. This should be done in the spring before bud break, and the shoots should be pruned back to about 2 inches. Serviceberries seeds will not grow true to parentage, and hardwood and softwood cuttings have only limited success.

HOW TO GROW

Soil: Serviceberry is tolerant of a variety of soil types and pH levels, but prefers well-drained sandy loams and loams. However, it will also do well in silt loam as long as adequate drainage is provided. Clay soil can cause root rot problems, so till organic mulch into the soil before planting and consider raised beds to avoid these issues. Sandy soils need to be properly irrigated to maintain moisture and nutrient uptake.

Soil Preparation: Soil testing can help determine the appropriate amendments to add to the site before planting. Apply any deficient nutrients, as indicated from testing results, to the planting area and till into the soil.

Plants: Serviceberry shrubs range in size from 6 feet tall and wide to 30 feet tall by 20 feet wide, depending on the cultivar. It is important to choose the appropriate cultivar to fit the planting site and the desired fruiting requirements. Serviceberry is self-fruitful and bloom typically occurs between early and late May, depending upon the location and weather. Flowers will appear before or at the same time as leaves. Full sun is required for maximum harvest potential. Serviceberry plants are adaptable to partial shade, but will suffer from reduced yields.

Planting and Spacing: Planting in the spring or fall is ideal for serviceberry, as it allows root systems to establish before summer heat becomes an issue. For most online nursery companies, bare-root plants are more commonly available than containerized plants. Both will establish well, but bare-root plants will need more frequent irrigation for the first 2 weeks. Before planting, prepare a hole twice the width and the same depth as the container or roughly the same depth and somewhat wider than the roots of the bare-root plant. Immediately after planting, water heavily to settle the soil around the roots and to remove air pockets. Applying mulch around the plant will help keep the soil moist between watering and keep weeds down. Spacing should be based

on the cultivar and should leave sufficient room between shrubs to allow sunlight to penetrate the canopies when full growth has been achieved.

Irrigation: During the first season, irrigate at an interval that will keep the soil moist, but not wet. Depending on rainfall and temperature, irrigate about two times per week. For the next few years, maintain a bi-weekly watering program that will apply about 30 inches of water over the season. This can be reduced if there is significant rainfall accumulation. Although established serviceberry plants can survive with little water, to achieve maximum yield and more desirable fruit, irrigation is needed. Additional irrigation may be necessary when hot, dry conditions are prevalent. It is best to water at the base of the shrub, in order to keep the canopy dry and reduce the chance of disease. This may be accomplished with a drip system or deep watering with a hose. It is also advisable to maintain a mulch bed around the base of the shrub instead of sod, as sod has very different watering requirements that conflict with that of serviceberry.

Fertilizer: Applying 4 ounces of an all-purpose fertilizer, such as 16-16-16, in the spring as the plant comes out of dormancy, should supply sufficient nutrients for the growing season and will maximize growth. If phosphorus and potassium are shown to be readily available in a soil test, a nitrogen only fertilizer can be applied instead. Adjustments to a fertilizer program should be determined by plant growth, harvest yield and leaf color.

Table 1. Recommended serviceberry cultivars.

Cultivar	Size at maturity	Comments
'Honeywood'	12' x 9'	Very productive, clusters of medium-large fruit. Minimal suckering. Ripens mid-season.
'Northline'	10' x 6'	Heavy producer, medium sized berries with excellent flavor and few seeds. Can produce many suckers. Ripens early to mid-season.
'Pembina'	12' x 8'	Productive with smaller, very flavorful fruit. Low sucker production but vigorous plant.
'Thiessen'	15' x 12'	.Very high yielding with large fruit. Ripens late-season.
'Regent'	6' x 6'	Smallest of the recommended varieties, little suckering. Small, mild-flavored fruit.
'Martin'	13' x 9'	High-yielding, large fruit. Ripens late-season.
'Parkhill'	12' x 8'	Well-suited for home growers or you-pick operations because the fruit ripen over a long period. Ripens mid-season. High-yielding

Pruning: Pruning is needed to maintain an open canopy, which allows for sufficient light penetration and air movement. The best time to prune is in the late winter or early spring, before new growth appears. Pruning also helps rejuvenate the shrub and promotes higher fruit yields. For the first 3 years, only prune out weak or damaged branches. After 3 years, when the plant is in production, pruning should become more vigorous to encourage new growth and to keep the plant size manageable. Flowers develop on stems that are 2 to 4 years old, and this should be kept in mind while pruning. Removing about one third of old growth from the shrub yearly will help maintain enough young fruiting wood for good fruit production. Similar to apple, serviceberry plants are prone to biennial bearing. This is when a large crop one year is followed by a very small crop load. If careful crop load management is practiced this effect can be minimized.

PROBLEMS

Pests and Diseases: Birds are probably the worst threat to serviceberry crops, as they seem to enjoy the fruit even more than we do. One of the most effective control options is to drape the branches with bird netting in order to protect ripening fruit. Aphids, spider mites and bark beetles can also be a problem. Dormant oil applied in the spring, just before bud break, can help control overwintering pests. Frequent scouting throughout the year should be done to monitor pest occurrence.

Entomosporium leaf and berry spot is one of the most common diseases of serviceberry plants. Symptoms include small, angular brown discolorations on the leaves, often with a yellow ring around the spot. Utah's low humidity helps keep disease occurrence low, but in rainy years or if over-watered, it can still be a problem. Keeping an open canopy through proper pruning, removing leaf litter in the fall and avoiding irrigation techniques that would wet the leaves will help control for Entomosporium leaf and berry spot. Infected fruit will have gray spots and will be disfigured. Prune out diseased wood 12 inches below the infected section and sterilize the shears between each cut. Maintain an open canopy to aid in preventing disease occurrence. Saskatoon-Juniper rust can be another problem for serviceberry production. Yellow spots and swellings first develop on leaves and fruit, followed by characteristic yellow, spiky outgrowths from these locations. As the name implies, the life cycle of the rust includes stages on juniper plants. To avoid the disease, it is best to avoid planting serviceberry next to juniper plants. One chemical control option is a broad-spectrum fungicide (ex. Funginex 190 EC). Powdery mildew will also infect serviceberry shrubs. Look for a white dust on the leaves and stems. Early detection and pruning out of diseased shoots as well as planting resistant cultivars are the best control options.

USU Extension provides guidelines for home orchard pest management, as well as weekly fruit tree pest advisories that can be helpful in disease and pest identification and management and are available at your county agent's office or at http://utahpests.usu.edu/ipm/htm/subscriptions.

Weeds: Keeping weeds clear from around the serviceberry plant is important for achieving maximum yields. Applying a mulch around the base of the shrub can help keep weeds to a minimum. Another option is shallow cultivation to kill weeds, but care should be taken not to till deeper than a few inches in order to avoid damaging the serviceberry roots.

HARVESTING, STORAGE AND USE

The berry-like pomes usually ripen in late June through July. It is best to wait until two-thirds of the fruit is ripe before harvesting. Serviceberries continue to ripen after harvesting and should be refrigerated quickly to avoid spoilage. Early pickings that are somewhat less ripe are higher in acid and the more mature fruit have a higher sugar content. If using the fruit for jellies, jams and pie fillings, wait until fully ripe to ensure peak flavor and sweetness. However, the fruit is softer at this stage and can be damaged easily during harvest. It is best to pick by hand early in the morning, when the fruit is dry and cool. Remove damaged or diseased fruit and wash to clean. Fruit should be dry before refrigerating or freezing.

PRODUCTIVITY

Newly planted serviceberry shrubs will not produce heavily for the first 2 years. They will usually begin to bear fruit when 3 to 5 years old and reach full production at 8 years. Once established, some of the highest yielding cultivars will produce 10 pounds per plant. A well-maintained plant can produce fruit for 20 years.

NUTRITION

Serviceberry fruit are high in fiber, iron, calcium, magnesium and manganese.

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Authors: Kristan Crouch, Student, Tiffany Maughan, Research Associate & Brent Black, Extension Fruit Specialist

Notes

Spinach
by Dan Drost

SUMMARY

Spinach is a cool-season vegetable that prefers sunny locations and fertile, well-drained soil. Plant seeds ½-1 inch deep, 2-3 weeks before the last frost in the spring. Thin seedlings or transplant spinach 3 inches apart in the row with rows 12 inches apart. Spinach tastes best when plants grow rapidly and mature before the heat of summer. Avoid water or fertilizer stress during growth. Control insects and diseases throughout the year. Harvest spinach when the leaves reach full size.

RECOMMENDED VARIETIES

Spinach comes in a variety of leaf types and textures. Planting a range of different types makes salads more interesting. There are many good varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Varieties suited to local conditions include Bloomsdale, Melody, Teton, and Olympia.

HOW TO GROW

Soil: Spinach prefers fertile, well-drained soils rich in organic matter for best growth. Most soils in Utah are well suited for spinach production.

Soil Preparation: Before planting, incorporate 2-4 inches of well-composted organic matter or apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil. Work soils in the fall for very early spring plantings.

Plants: Spinach can be grown from seed or transplants. Spinach seed can be sown after soils reach 40°F. Seeds germinate best at 55-65°F and require 7-10 days to emerge. Temperatures above 80°F reduce seed germination. Seeds should be planted ½-1 inch deep. Thin stands when plants have 3-4 true leaves. Plants removed at thinning can be transplanted to adjacent areas if some roots are maintained. Thinned plants can also be eaten. Transplants provide an earlier harvest. Transplants should have 4-6 mature leaves and a well-developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted spinach should be spaced 3 inches between plants in the row with rows 12 inches apart. Dense plantings will reduce weed pressure. Spinach grows best when temperatures do not exceed 75°F. Temperatures down to 32°F do not seriously damage young plants. Transplants should be planted near the last frost-free date for the growing area. Seeded spinach may be planted 3-4 weeks earlier. High summer temperatures reduce growth, decrease quality, and cause the plants to flower and the leaves to develop bitter or off flavors. For fall spinach, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 1-2 weeks after the anticipated first fall frost for your growing area. Plants can be left in the garden after light frosts. Spinach will easily over-winter for an early spring crop if the plant has 4-5 true leaves formed late in the year. When over-wintering spinach, mulch the plants heavily and remove the mulch after the snow melts in the spring.

Water: Water spinach regularly supplying 1-2 inches per week. Water requirements depend on soil type and temperatures. Mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations will cause leaves to become tough, slow leaf development, and contribute to off flavors

Fertilization: Apply 1/4 cup per 10 foot of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or at thinning to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches and Row Covers: Use fabric covers to protect seedlings and transplants from frost. Organic mulches help cool the soil and reduce water stress. Organic mulches such as grass clippings, straw, and shredded newspapers also help control weeds.

PROBLEMS

Weeds: Spinach does not compete well with weeds. Weed control is particularly important during establishment. Closely spaced plants will help control weeds. Cultivate shallowly and avoid root pruning to ensure uninterrupted growth.

Insects and Diseases: Most spinach is fast growing and is not susceptible to many production problems. Rotating locations from year to year helps control most diseases.

Insects	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Slugs	Soft-bodied or shelled mollusks that chew holes in leaves.	Control with appropriate pesticides or traps. Avoid moist conditions that favor these pests.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

HARVEST AND STORAGE

Individual spinach leaves may be picked anytime before the flower stalk forms. Older leaves are often stripped off the plants first allowing the young leaves to continue to grow. Provided the growing point is not damaged, all leaves can be cut off to within 2 inches of the soil. Spinach can be stored for 1-2 weeks at 32°F and 95% relative humidity.

Productivity: A 10-foot row at 3 inches apart with 12 inches between rows will produce 4-6 pounds of spinach.

Nutrition: Spinach is low in calories and has no fat or cholesterol. Spinach is a very good source of dietary fiber, vitamins A, B6, C, folate, calcium, and iron.

FREQUENTLY ASKED QUESTIONS

How do you keep spinach from developing a bitter flavor? Spinach grown at temperatures above 75°F contributes to bitter flavor.

When is the best time to plant spinach? The best times to plant spinach is as a spring or fall crop. Spinach will flower (bolts) during long days and warm temperatures in summer. Varieties that are "long standing" or slow bolting are better adapted for late spring plantings.

Author: Dan Drost, USU Extension Vegetable Specialist

Strawberries

by Brent Black, Michael Pace & Jerry Goodspeed

SUMMARY

Strawberries are one of the most popular small fruits in the home garden. The attractive plants are relatively easy to grow, require minimal space, and produce the first fruit of the new season. A properly maintained 4 feet by 8 feet bed of strawberries will produce 10 to 15 pounds of berries per year for three to five seasons.

HOW TO GROW

Site Selection: Select a sunny location with well drained soil. Strawberries require at least 8 hours of full sun each day of the growing season to produce at their maximum capability. Strawberries grow best in loamy or sandy soils. Heavy clay soils cause reduced plant growth and vigor and a higher incidence of disease. However, clayey soils will work if they are well drained. Planting in raised beds will improve soil drainage and aeration of heavy soils.

Strawberry blossoms are susceptible to late spring frosts, which can kill the early flowers that produce the largest berries. Situating strawberry beds on a north slope or north side of a fence or building provides late winter shade that will help to delay bloom until spring frosts are less likely. Plantings with a southern exposure may bloom and crop earlier, but are more susceptible to spring frosts. Covering blooming plants with tarps or blankets on cold nights will help protect flowers and developing fruit.

Avoid keeping strawberry beds in the same place for more than 5 years to prevent buildup of soilborne pathogens. Also, avoid planting strawberries in areas where peppers, tomatoes, potatoes, eggplant, or okra, have been grown recently, as these harbor the Verticillium wilt pathogen.

Site Preparation: The soil should be prepared well in advance of planting. Incorporate organic matter (2-3 inches of compost) in the bed to a depth of at least 12 inches. Organic matter will help improve nutrient availability as well as the structure and water-holding capacity of the soil. Also incorporate a balanced fertilizer such as 10-10-10 into the planting bed at the rate of ½ to 1 lb per 100 sq feet. Strawberry plants are highly sensitive to salt. High salt levels (greater than 1.8 ECe dS/m) will cause stunting, marginal leaf scorch, severe yield reduction, and even plant death. Avoid planting in salty soils or apply enough water to ensure that salts are leached below the root zone. Also, be careful not to over fertilize. A soil test will provide information on salinity and initial fertilizer needs. Contact your county agent for information on submitting soil samples for testing, or visit the USU analytical laboratory website for instructions (http://www.usual.usu.edu/).

Strawberries do not compete well with weeds, and perennial weeds are particularly difficult to control. Sites should be free of perennial weeds before planting, and may require pre-plant applications of a non-selective herbicide to reduce perennial weed pressure.

Plant Selection: Strawberry varieties are categorized into three types according to their flowering and fruiting habit. June-bearers initiate flower buds under the short days of autumn, with the flowers opening the following spring, and the subsequent fruit ripening in late May to June. Everbearers initiate flower buds under long days and will generally produce a small crop in the spring and crop again in the fall. Day-neutrals initiate flower buds regardless of day length when temperatures are below about 70°F. In cool climates, day-neutrals can continue to produce a light crop throughout the summer. However, summer temperatures in Utah are generally too warm for season long production. Under most home garden conditions, Everbearers and Day-neutrals behave similarly and many nurseries and gardening books use these terms interchangeably. In fact, many of the newer varieties sold as everbearers are actually day-neutrals. Making general variety recommendations is difficult, as the acceptability of a given

strawberry variety depends upon soil type, local climate, and personal taste. Following are a few varieties that have done well under a wide range of conditions:

Junebearers: Earliglow is among the earliest fruiting varieties and is considered by many to be the gold standard for flavor. Fruit size on secondary blossoms is below average. Chandler is an early mid season variety from California that yields well and has large fruit. The plant is vigorous and adapts well to a range of conditions, but may not be hardy enough for the coldest regions of Utah. The fruit shows some tolerance to gray mold fruit rot. Honeoye is the most popular home variety in the U.S. due to high yields of large fruit that ripen in early mid season. This variety is not well suited to many parts of Utah as it does not do well on heavy soil, and the fruit develops an off flavor when it ripens in hot weather. Allstar is a good choice for mid season fruit as the plants are more tolerant of hot weather and are resistant to root rot, powdery mildew and Verticillium wilt. The fruit are large and sweet. Jewel is a cold hardy variety that produces late season large fruit of excellent quality, and is a consistent producer. However, the plants are susceptible to root rot and some leaf diseases. Sparkle is a long time favorite for home gardens. The medium sized fruit are very flavorful and prized for jams and freezing. The plants are cold hardy, vigorous and show resistance to at least one type of root rot.

Everbearers and Day-neutrals: Ogallala is a cold hardy everbearer that produces medium-sized flavorful dark red fruit. The plants are vigorous, productive and somewhat drought tolerant. **Seascape** is a day neutral from California that has proven to be productive in a wide range of climates. The large flavorful fruit are good for fresh consumption. Plants are resistant to Verticillium wilt.

Tribute is a day neutral from the Eastern U.S. that is a vigorous productive plant resistant to gray mold fruit rot, Verticillium wilt, and red stele root rot. The fruit is medium sized with good flavor. **Evie 2** is a day-neutral recently imported from England that produces medium large fruit. It might be worth a try in a home garden, as it is believed to be higher yielding and more heat tolerant than other day-neutrals. Regardless of the variety you select, start with clean disease- and virus-free plants from a reputable nursery. Resist the temptation to transplant from an existing bed as you will likely be starting off with plants that have plant viruses or root rot diseases that will limit the success of your new planting. A list of strawberry nurseries that sell mail-order plants is frequently published in the Utah Berry Growers Association newsletter. Back issues of the newsletter containing strawberry nursery information are available online (http://extension.usu.edu/publications).

Management Systems: Strawberry plants propagate themselves by sending out runners (stolons) that form daughter plants. The two management systems best suited to home garden production are the Matted Row and the Annual Hill systems, and differ in how they handle runners. The Matted Row system is often easier to manage effectively, but the annual hill system also has advantages in weed and disease management and improved fruit size and quality.

Matted Row: The matted row system is generally used for June-bearers. Bare root dormant plants are transplanted in early spring. Since the plants are dormant, there is no need to wait until after the risk of spring frost has passed. Plants are placed 18 to 24 inches apart within the row, with rows 3 to 4 feet apart. During the first growing season, blossoms and fruit are removed to promote runners and the formation of daughter plants. The soil surface within the row should be kept loose and moist to promote rooting of the daughter plants, which should form a continuous "mat" of plants within the row during the first season.

Cultivation between rows will control weeds and contain the strawberry plants within the row. One problem with the matted row is that too many plants can form that compete with each other, resulting in smaller berries. The easiest way to manage this is by narrowing the rows with cultivation. The optimum row width for yield and fruit size is about 8 to10 inches, but a 12 to 18 inch wide row may be more practical.

In colder regions of the state, strawberries will need the protection of a winter mulch to prevent damage to the crowns and roots. Clean straw or shredded tree leaves should be spread over the bed in late November, to a depth of 3 to 6 inches. Do not use heavy mulches such as grass clippings as these will smother the plants. Remove the mulch in the spring when new growth begins to appear from the crown. This mulch should be left between the rows to reduce weed growth and keep the developing fruit from contacting bare soil. Remember that once the mulch is removed, the emerging flower buds are sensitive to frost. Protect these developing blossoms on frosty nights by covering the rows with a tarp or blanket to hold warm air near the ground.

A matted row planting of June-bearing strawberries will produce the first crop in the spring of the second growing season. To keep the planting productive for multiple seasons, the rows should be "renovated" immediately after harvest is complete. Renovation should include removing weeds, cultivating to narrow rows, and fertilizing and irrigating to promote the formation and rooting of new daughter plants. You may also choose to hand pull the oldest woody multicrowned plants to make room for new daughter plants.

Annual Hill: The hill system is commonly used for everbearing and day-neutral types, but can also be used for June-bearers. Plants are spaced 12 to 15 inches apart in the row, with staggered rows spaced 12 to 15 inches apart and 2 to 4 rows per bed. Runners are removed so that only the mother plants grow and produce fruit. Because there are no daughter plants to root down, a plastic mulch can be used to prevent weeds between the plants and to provide a clean surface for developing fruit. Beds can be raised as shown below, or level with the remaining garden. Drip irrigation or a soaker hose will be needed to supply water under the plastic mulch.

For everbearers and day-neutrals, plant dormant bare-root plants early in the spring. Remove the first flower cluster that emerges to give the plants more time to establish their root system. The plants should then begin fruiting about the time that the June-bearing varieties have finished their season. In many areas of Utah, summer temperatures are too warm for dayneutrals to continue fruiting throughout the summer (>75°F), so typically these plants will produce a late spring crop and then fruit again in the fall. The amount of fruit produced will generally be less than that produced by a June-bearer. Since daughter plants are not allowed to form, the mother plants usually run down after one or two seasons, and are usually replanted after one or two seasons.

The annual hill system can also be used with June-bearing varieties that are planted in mid to late summer and fruited the following spring. These may be grown as an annual, or may be carried over for a second crop. This type of annual hill system will produce the highest yields and largest fruit size, and requires determining the optimum planting time. Allstar and Chandler are two varieties well adapted to this system. For best results, the plants need to be established early enough to allow for the development of multiple crowns per plant (3 to 5), but late enough that runner production is minimized. One challenge of this system is finding a source for plants in mid summer.

Raised beds put the roots at greater risk of winter injury. Raised beds and plastic mulch will also cause the soil to warm earlier in the spring resulting in earlier bloom. Care should be taken to protect the plants with winter straw mulch and the use of tarps or blankets during spring frosts.

Container Gardening: Due to their small root system, strawberry plants do well in containers including planters and barrels. For best results, container gardens should be managed as described for the annual hill system. Irrigate frequently to keep the root system cool and moist, and avoid using dark colored containers that will heat the roots when exposed to summer sunlight.

Planting: Remove dead leaves before planting. Spread the roots out in the planting hole and then firm the soil around the plant. Only the roots and the base of the crown should be covered with soil, leaving as much of the crown above ground as possible. Do not allow the roots to dry out during planting, and water in the new transplants to ensure good root-soil contact.

Fertilizing: Strawberries require relatively little fertilizer compared to garden vegetables. In addition to the pre-plant incorporation of a balanced fertilizer, matted row strawberries should be fertilized at renovation and again in late summer. Apply 5 to 8 pounds of 10-10-10 (½ to ¾ pounds of actual nitrogen) per 100 feet of row at renovation. Apply an additional 3 pounds of 10-10-10 in August to ensure good flower bud formation for the following season. Irrigate immediately after fertilizing to wash the fertilizer from the leaves and down into the root zone. The most common nutrient deficiency in Utah strawberries is iron chlorosis, characterized by interveinal yellowing. Apply a chelated iron such as Miller's Ferriplus or Sequestrene 138 in May and again in September at a rate of 0.1 ounce per 100 feet of row.

Irrigation: Strawberry plants have a relatively shallow root system with the majority of the roots in the top 10 to 12 inches. Strawberries also have a relatively high water demand, transpiring up to 2 inches of water per week in hot dry weather. Irrigate thoroughly at 3 to 5 day intervals during the summer heat. Allow the soil to dry somewhat between irrigation cycles to prevent root rot. Drip or trickle irrigation is recommended, as flood or furrow irrigation will spread root rotting pathogens, and frequent sprinkler irrigation will increase gray mold fruit rot. If using sprinklers, only irrigate in the morning to allow fruit and foliage to dry out in the afternoon.

PROBLEMS

Weeds: The most common limiting factor in the life of a strawberry patch is weeds. Strawberries do not compete well with weeds for water and nutrients. Use herbicides and cultivation to prepare a weed free area before planting. Plastic mulch used in the annual hill system is effective for within-row weed control, and straw mulch does provide some weed control in matted row production. Both will also require some hand weeding. Systemic herbicides such as RoundUp® should not be used in or around strawberry beds, particularly in matted rows. The plants in a matted row remain as an interconnected network, and a systemic herbicide that reaches a daughter plant will move back through the network, killing or injuring plants in an extended area.

Diseases: Plant viruses are a common problem in strawberries. These viruses are not harmful to humans and generally do not cause visible symptoms to the strawberry plants other than decreased growth and poor plant vigor. Once plants are infected, there is no treatment or cure. Remove old plantings that no longer show adequate vigor, and always start new beds with disease-free plants.

Root, crown and fruit rots caused by fungal pathogens can be a problem with strawberries. Cultural controls include starting with disease free nursery plants, selecting a site that has not recently had strawberries and that has well drained soil, and careful irrigation management. For chemical control strategies, see the "Utah Home Orchard Pest Management Guide" (online at http://extension.usu.edu/publications).

Pests: Birds pecking ripe fruit are among the most annoying pests, and may require netting to control. Other common strawberry pests include leafrollers, tarnished plant bug, spittlebugs, spider mites and root weevils. Control strategies for these pests are also outlined in the "Utah Home Orchard Pest Management Guide."

HARVEST AND STORAGE

For best quality, fruit should be harvested every other day. Over-ripe fruit may develop off flavors and attract insects and diseases. Pick ripe fruit into shallow containers no more than 3 inches deep to prevent bruising or crushing. To maximize shelf life, pick fruit in the cool morning hours and refrigerate as soon as possible. Store cooled fruit in vented plastic bags or in the crisper as higher humidity will help to maintain fruit firmness. Do not wash fruit at harvest time as this will increase fruit rot. Wash and remove caps just before eating or processing.

Additional Resources

Utah State University Extension publications available at http://extension.usu.edu/publications.

Fruit related resources:
- Iron Chlorosis in Berries
- Utah Home Orchard Pest Management Guide
- Utah Berry Growers Association Newsletter

General resources:
- Preparing Garden Soil
- Soil Testing Guide for Home Gardens
- Salinity and Plant Tolerance
- Using Compost in Utah Gardens

Authors: Brent Black, USU Extension Fruit Specialist, Michael Pace, USU Extension Box Elder County Extension Agent, & Jerry Goodspeed, USU Extension Horticulturist

Summer & Winter Squash

by Rick Hefelbower & Dan Drost

SUMMARY

Squash prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant 4-6 seeds, 1-2 inches deep, in mounds 4 feet apart when soils are 65ºF. Thin the mounds after emergence to two plants. Transplant summer squash 2 feet apart through black plastic for early maturity. Use row covers to protect the plants when planting before the frost-free period. Plant winter squash at same time as pumpkins. After the vines develop runners, side dress with additional nitrogen fertilizer. Irrigation should be deep and infrequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75ºF. Control insect and diseases throughout the year. Harvest summer squash shortly after they flower and winter squash when the skin is hard and not easily broken when pressure is applied with a fingernail. Store in a cool, dry place. Most summer squash varieties perform well in all areas of Utah.

RECOMMENDED VARIETIES

Most varieties of yellow squash, zucchini, crookneck, and patty pan summer squash do well throughout Utah. Pink banana is a large (25-40 lb) fruited pink skinned winter squash. There are numerous varieties of butternut, buttercup, and acorn squash varieties featured at local gardening outlets and through seed catalogs. Most produce smaller (3-10 lb) fruits that vary greatly in rind and flesh color, fruit texture and flavor.

HOW TO GROW

Soils: All squash prefer organic, rich, well-drained, sandy soils for best growth. Most soils in Utah will grow squash provided they are well drained.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter. Apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting.

Plants: Squash are mostly grown from seed though transplanting is possible. Seed should be planted 1-2 inches deep. Transplants should have 2-3 mature leaves and a well developed root system.

Planting and Spacing: Squash should be planted when soils are 65ºF or after frost danger has past. Plant 4-6 seeds in mounds 4 feet apart. After they have two leaves, thin to two plants per mound. Transplants should be planted 2 feet apart in the row with rows 4-6 feet apart. Avoid damaging the roots when planting which slows establishment and growth.

Mulches: Black plastic mulches warm the soil, conserve water, and help control weeds. Plastic mulches allow earlier planting and maturity of seeded or transplanted squash. Lay down the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out 2 weeks before the last frost. Do not apply organic mulches until soils are warmer than 75ºF. Grass clippings, straw, newspapers, etc., also conserve water, control weeds and help keep the squash clean.

Row Covers: Hotcaps, plastic tunnels and fabric covers protect seedlings and transplants from cool air temperatures. Row covers enhance growth and earliness. Covers need to be removed when plants start to flower or when temperatures exceed 90ºF.

Water: Water deeply and infrequently, 1-2 inches per week. Use drip irrigation if possible. Mulch around the plants will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. Reduce watering amounts as the fruits ripen to avoid fruit rots.

Fertilization: After the vines develop runners, side dress with a nitrogen fertilizer (21-0-0), using 1-2 tablespoons per plant or mound. Incorporate the fertilizer at least 6 inches away from the plants.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Hand weeding is often used to control weeds in other areas. Heavy vine growth by squash will also smother weeds.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet, or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Squash Bugs	Adults are gray or brown and 5/8 inch long. Adults and immature forms suck the sap from leaves leaving them speckled before they wither and die.	Trap adults under boards, check each morning and kill pests. Hand pick adults, immatures and eggs off leaves.
Cucumber Beetles	Adults have stripes or spots and feed on leaves and vines which reduces vigor. May transmit bacterial disease. Larvae bore into roots and stems causing plants to wilt and die.	Application of chemicals at first appearance is needed to control this pest.
Disease	**Symptom**	**Control**
Powdery Mildew	White fungal patches start on older leaves. The disease eventually spreads to all plant parts. The foliage dies, exposing fruits to the sun, which causes premature ripening.	Plant resistant varieties.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on stems. Diseases are caused by different pathogens.	Identify causal disease. Treat disease as recommended once identified.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. An aphid transmitted disease.	Control aphids. Destroy severely infected plants.

HARVEST AND STORAGE

Summer squash take 35-45 days to come into flowering. Summer squash are generally harvested immature (3-5 days after the flower opens). If left on the vine longer, the skin begins to toughen and quality decreases. Handle carefully as the fruits bruise easily. Store at 45-55°F for 2-4 days. Winter squash take 45-55 days to mature from flowering. Use the following guide to determine maturity. Squash are mature when fruits are fully colored, when vines begin to die back, and when the rind is hard and impervious to scratching from a fingernail. Mature fruits should be harvested with the stem attached and stored in cool (50-55°F), dry conditions. Check fruits monthly for softening and rots. Buttercup and banana squash store longer than butternut and acorn squash.

Productivity: Plant 1-3 hills per person for fresh use and an additional 1-3 hills for storage, canning and freezing. Expect 100-150 lbs per 100 feet of row.

Nutrition: Winter squash are a good source of complex carbohydrates (sugar and starch), fiber and are rich in potassium, niacin, iron and beta carotene (vitamin A). Because summer squash is eaten immature, they are considerably lower in nutritional value than winter squash. A cup of cooked or raw squash is considered a serving size.

FREQUENTLY ASKED QUESTIONS

Why don't the first flowers that open on my pumpkins form fruits? This condition is natural for cucurbits (cucumbers, melons, pumpkins, and squash). The first flowers are almost always male. Female flowers will have small fruits behind the flowers. By producing male flower first, the likelihood of getting the female flowers pollinated by bees is greatly improved.

I have vine borers in my squash. Can I control them with insecticides? Vine borers cannot be controlled effectively with insecticides. Reduce future damage by disposing of infested plants. You can achieve some control by carefully splitting open the stem and removing the larvae or use a long needle to stab the larvae through the stem.

Authors: Rick Hefelbower, USU Extension Washington County Horticulture Agent, & Dan Drost, USU Extension Vegetable Specialist

Notes

Sweet Corn

by Dan Drost

SUMMARY

Sweet corn prefers full sun and fertile, well drained soil for maximum yield. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. When soils are above 60°F, space rows 24-30 inches apart and plant seeds 1-2 inches deep and 9-12 inches apart in the row. Plant corn in blocks to ensure good pollination and ear development. Sweet corn may be transplanted or seeded under clear plastic for early production. Plant corn every 10-14 days for a continuous crop throughout the season. Sidedress sweet corn with nitrogen fertilizer when plants have 8-10 leaves and again at silking. Corn requires regular watering, so maintain soils near field capacity. Water stress will reduce yield and ear quality. Harvest when ears are plump, silks are dry, and kernels are milky. Use ears immediately for best quality.

RECOMMENDED VARIETIES

There are many different sweet corn varieties for the home vegetable garden. Major differences include maturity dates and sugar content. Sweet corn has a maturity range of 60 to 90 days from planting depending on variety. Early varieties generally produce smaller ears and are less sweet than later maturing types. Early varieties do well where the growing season is short and temperatures are cool. Late maturing varieties are better adapted to long seasons and warm temperatures. Sugar content in the kernels should also be considered. Sweet corn varieties are classified as standard sugary (su), sugary enhanced (se), or super sweet (sh2). Standard types germinate better than the se or sh2 types in cool soils. All types germinate well in warm soils. Eating quality may be adversely affected when su, se and sh2 are planted together and tassel at the same time. If cross pollination occurs, the extra sweetness of the se and sh2 types is lost and they taste more like the standard variety. Time your plantings so they tassel at different times. All sweet corn varieties will grow in Utah, but not all are available. Most garden centers and nurseries carry varieties proven to grow well and produce high quality, flavorful ears. Here is a partial list of varieties proven to grow well in Utah.

Corn Type	Selected Cultivars	Comments
Standard (su) Sweet Corn	Earlivee, Jubilee, Silver Queen, NK199	Lower sugar content than se or sh_2 types. Good cool soil germination.
Sugar Enhanced (se) Sweet Corn	Incredible, Sugar Buns, Miracle, Peaches and Cream	Higher sugar content, maintains quality long after harvest. Better cool germination than sh_2 types.
Super Sweet (sh_2) Sweet Corn	Honey & Pearl, Phenomenal, How Sweet It Is, Supersweet Jubilee	Poor germination in cool soils, extra sweet flavor, isolation needed from su and se types. Maintains quality after harvest.

HOW TO GROW

Soils: Sweet corn will grow in all Utah soil types that are rich in organic matter, well drained, and fertile.

Soil Preparation: Before planting, incorporate 10-15 lbs of well composted organic matter and 3-4 cups of all-purpose fertilizer (16-16-8) per 100 square feet of planting area. Work the compost and fertilizer into the top 6 inches of soil.

Plants: Sweet corn is a warm weather vegetable that requires soil and air temperatures above 60ºF for best germination and plant growth. Plant corn after the last frost-free date for your area. For earlier production, some gardeners grow transplants for planting after the frost-free date. Seeds may be sown 3-4 weeks earlier if planted through or under clear plastic tunnels (see photo).

Planting and Spacing: To plant 100 feet of row, you will need 3-4 ounces of seed. Planting in blocks of three or more rows rather than in a single long row improves pollination and production. Plant corn seeds 1-2 inches deep. Seeds should be spaced 9-12 inches apart in the row with 24-30 inches between rows. For high-density corn, plant in 15 by 15 inch squares. Plant the same variety every 10-14 days until early July for continuous production throughout the season. Corn requires 60-90 days to mature depending on variety. Planting a 65, 70, 75, and 80 day variety of the same type (su, se, or sh2) all at the same time will also ensure production over a longer time period. With a little planning, a continuous supply of fresh sweet corn can be produced.

Water: Sweet corn requires regular watering throughout growth for best production. Soils should be maintained near field capacity. Water needs are critical during tasseling, silking, and ear formation. Drought stress during ear development will decrease yield, lower kernel quality, and affect flavor. Watering amounts depend on soil type.

Fertilization: In addition to the fertilizer used when preparing the site, sweet corn needs additional nitrogen fertilizer to produce optimum yields. Sidedress sweet corn with 1/4 lb of 46-0-0 per 100 square feet when plants have 8-10 leaves and with an additional 1/4 lb when the first silks appear. Place the fertilizer 6 inches to the side of the plant and irrigate it into the soil.

Mulches and Row Covers: Clear plastic mulches help conserve water, provide some frost protection, and allow earlier planting and maturity, but stimulate weed growth under the plastic. Fabric row covers also protect young plants from frosts. Organic mulches like grass clippings, straw, and shredded newspaper also help control weeds. Mulching the crop during the summer will reduce water loss and improve nutrient availability.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Hand weeding is often used to control weeds in other areas. Heavy vine growth by squash will also smother weeds.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on leaves, tassels and ears. Plants become crinkled, curled, and growth is stunted when plants are small. Honeydew makes plants and ears sticky.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge the insects. Aphids cause cosmetic damage to the ears.
Corn Earworms	Larvae feed on silks and ears of corn. Damage symptoms include holes in ear tips, loss of silks, and damp excrement near silk.	Spray with BT or appropriate insecticides. Regular applications are necessary to protect the plants. Apply mineral oil to silks. Remove damaged part of ear at harvest.
Cutworms or Army Worms	Larvae feed near the soil surface and sever the plants close to the ground. Most damage done at night.	Use barriers or collars around plants. Keep organic mulches way from young plants.

Disease	Symptom	Control
Root Rots and Damping Off	Seedlings darken, wilt and die. Associated with cool, wet conditions in the spring.	Use treated seed. Allow soils to dry before re-watering.
Smut	White fungal galls that form on the tassel, stem, or ear. Early plant infection will stunt growth and deform ears.	Remove and destroy galls and severely infected plants. Plant resistant varieties.
Wilt Diseases	Wilting leaves, streaking and drying of leaves, stalk rotting, and plant lodging may occur. Plants often die.	Remove infected plants. Maintain clean garden practices.

HARVEST AND STORAGE

Sweet corn ears mature in 15-24 days from silk emergence depending on the temperature. Ears are mature when silks are dry and brown. The husks should appear moist and green. Kernels in the tip of the ear should be plump and release milky juice when punctured. Ears can be harvested over a 5-7 day period. For best quality and flavor, harvest and use immediately. To harvest, grasp the ear, snap downward while twisting the ear. Sweet corn can be stored for several days if refrigerated. Do not husk until ready to use.

Productivity: Expect one ear per plant. Plant 10-15 feet of row per person for fresh use and an additional 30-40 feet of row per person for canning or freezing. Expect about 10 dozen ears per 100 feet of row.

Nutrition: Sweet corn is high in fiber, potassium, folic acid, and vitamin A. One ear contains 80 calories and 20 grams of carbohydrates.

FREQUENTLY ASKED QUESTIONS

Often, when I plant corn early in the year, I have poor emergence. How can I get a better stand? It is best not to plant too early in the spring. Wait until the soil is warm, preferably above 60ºF. Try sowing more seed and thin to the correct distance after they emerge. Fungicide seed treatments may also be helpful. The sh2 varieties do not germinate well in cold, wet soil. For early plantings, sow su types or plant through clear plastic.

Sometimes the ears do not fill out at the tips. What's wrong? Poor kernel development at the tip is often caused by: 1) hot, dry weather during silking and pollination; 2) planting seeds too close together; 3) low soil fertility; and 4) poor natural pollination. Be sure to keep soils moist in dry weather; plant at recommended spacing (9 to 12 inches in the row); apply fertilizer according to soil test recommendations; and plant corn in blocks of three or more rows rather than one long row.

I regularly get lots of shoot growth around the base of my corn plants. Are these productive or should they be removed? Extra shoot growth or suckering is common in sweet corn if plants are grown far apart in the rows. Most suckers do not produce usable ears and removal does not increase plant productivity. Plant the seeds closer together to decrease sucker formation and increase ear yield.

How can I keep raccoons out of my sweet corn? It is very hard to keep raccoons and skunks out of sweet corn. If you grow large amounts of corn, an electric fence made with two or three wires helps. Space the wires 4 inches apart starting at 4 inches above ground level. Raccoons prefer sweet corn in the early milk stage so have the fence operating before the corn is ripe. If you have a dog, kennel it close to the corn. The barking may help, but it can also annoy you and your neighbors.

Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Sweet Potatoes

by Jeran Farley & Dan Drost

SUMMARY

Sweet potatoes (*Ipomoea batatas*) are a delicious crop that is high in vitamin content. It is a warm season crop that grows best in long, hot growing seasons. There are many varieties to choose from, with shorter maturity varieties suited to cooler climates. Sweet potatoes are members of the morning glory family, are relatively pest free, and can be stored for a long time after harvest.

RECOMMENDED VARIETIES

Sweet potatoes are classified as soft-fleshed or firm fleshed. The soft-fleshed varieties are sweet and have orange flesh and are often called yams. The firm-fleshed varieties have light orange, yellow, or even white flesh and can be stored for longer periods. Sweet potatoes can have long vines, but many compact bush varieties now exist. Vines can be trimmed on non-bush varieties. Try any of the varieties listed below by matching the maturity period to local growing conditions. Plants generally have to be ordered from seed catalogs or specialty growers if specific varieties are desired. Most varieties perform well in Utah.

Varieties	Days to Maturity	Skin and Flesh Color
Beauregard	105-110	Dark orange flesh, light purple skin
Bush Porto Rico	110	Orange flesh, copper skin
Centennial	90-100	Orange flesh, orange skin
Georgia Jet	90-100	Orange flesh, red or purple skin
Jewel	120-135	Orange flesh, copper skin
Sumor	110-120	Light yellow flesh, tan skin
Vardaman Bush	110	Orange flesh, gold skin
Carolina Bunch	110-120	Deep orange flesh, copper skin

HOW TO GROW

Climate: Sweet potatoes grow best in warm to hot climates. Plants can be damaged by temperatures below 50ºF. The roots mature in 4 to 5 months.

Soil: Sweet potatoes grow best in all soil types provided they are fertile, moist, well drained and nutrient rich. Centennial is a clay tolerant variety.

Soil Preparation: Incorporate 4-6 inches of well composed organic matter and 1-2 lbs of all purpose fertilizer (16-16-8) per 100 square feet. Work complete fertilizer into the soil to a depth of 6-8 inches. Form 8-10 inch tall raised beds to provide good drainage and a place for root development to occur.

Plants: Sweet potatoes are grown from slips, which are plant sprouts from the root. They can also be grown from vine cuttings. If you only need a few plants, grow your own slips from a root suspended in a container of water. To grow more plants, place several sweet potato roots about 1 inch apart in a hotbed and cover with 2 inches of sand or light soil. Add another 1 to 2 inches of sand when the shoots begin to appear. Keep the soil in the bed moist throughout the sprouting period, but never allow it to become

waterlogged. Maintain a soil temperature of 70-80°F. The slips are ready to pull in about 6 weeks (when they are rooted and 6 to 8 inches tall).

Planting and Spacing: Slips are planted in the field after the danger of frost is over. Plant slips in rows 36-48 inches apart, spaced 12 inches apart within the row. A good slip should have 4-5 leaves and a healthy root system. Water regularly after planting to help the plants establish.

Mulches: Use of mulches will conserve moisture and reduce weed problems. For early sweet potatoes, plant through black plastic mulch up to 10 days before planting in uncovered soil. Use floating row covers for additional frost protection.

Water: Sweet potatoes are quite drought tolerant. Provide ample water after planting, and as they are establishing. However, as the plants mature, they should be watered with moderation. Late watering can cause root cracking.

Fertilization: In addition to the fertilizer applied at planting, sweet potatoes should be side dressed with additional nitrogen fertilizer at ½ lb (21-0-0) per 100 square feet in early July for optimum vine growth and tuber sizing.

PROBLEMS

Weeds: Control weeds when the plants are young and getting established. Use a mixture of cultivation and mulches. Once established, the vines will out-compete most weeds. Avoid deep cultivation that can damage the roots and slow vine extension.

Insects and Diseases:

Insect	Identification	Control
Flea Beetles	Small white maggots that feed on and burrow into the developing root.	Use soil applied chemicals at planting or cover young emerging seedlings with fabric row covers to exclude egg-laying adults.
Cutworms	Green, reddish, or black caterpillars up to 2 inches long. Cutworms do most of their feeding near the soil surface and eat through the stems causing the plant to fall over and die.	Control weeds and debris in the garden that provide cover for worms. Use appropriate insecticides if populations are high.
Disease	**Symptom**	**Control**
Scurf	Black fungal spots on infected roots.	Grow resistant varieties, rotate planting areas; don't over water.
Black Rot	Fungal diseases that cause decay and rotting of the root. Causes sunken lesions on young slips and mature roots.	Grow resistant varieties; rotate planting areas; don't over water.

HARVEST AND STORAGE

Sweet potatoes can be harvested when roots are 1½ to 2 inches thick. Some roots may be "harvested," starting in late summer, by digging into the side of the bed and removing some developing roots while leaving the plant in place. Most gardeners wait until the foliage starts to turn yellow or after the first frost damages the leaves, but before the soil freezes. Use a spading fork or shovel and carefully dig up the swollen roots being careful not to bruise, cut or otherwise damage them. The roots store best when cured for 1-2 weeks at 80°F and then stored in a cool, dry location (50-55° F). When properly cured, sweet potatoes can be stored for 3-4 months.

Productivity: Sweet potatoes produce very large roots in a long growing season. Expect 1-2 lbs of roots from every plant. Plant 5-10 slips per person in order to have sufficient for fresh and storage purposes. Productivity depends on variety planted.

Nutrition: Sweet potatoes are an excellent source of vitamin A and vitamin C, carbohydrates, and fiber. They are also supply lots of calcium and iron.

FREQUENTLY ASKED QUESTIONS

Why are the tubers cracked when I dig them up? Heavy rains or over irrigation during the 3 to 4 weeks before harvest will cause the roots to split. Sweet potatoes like a dry period before harvest which helps cure the roots and prepares them for storage.

Are yams and sweet potatoes the same thing? Moist-fleshed varieties of sweet potato are often called "yams." However, sweet potatoes are not true yams, which belong to a different plant family, called Dioscoreaceae. Sweet potatoes belong to the morning glory family (Convolvulaceae) and are related to morning glory and field bind weed. True yams are rarely found in local grocery stores,vary greatly in size, need a very long, warm growing season, and are commonly grown only in the tropics.

Authors: Jeran Farley, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Notes

Swiss Chard

by Dan Drost

SUMMARY

Swiss chard is a cool-season vegetable that prefers sunny locations and fertile, well-drained soil. Plant seeds ½-1 inch deep. Thin seedlings or transplant chard 6 inches apart in the row with rows 12 inches apart. Swiss chard tastes best when plants grow rapidly and mature before the heat of summer. Irrigation should be frequent and uniform to ensure good growth. Control insects and diseases throughout the year. Harvest Swiss chard when the leaves reach full size.

RECOMMENDED VARIETIES

Swiss chard comes in a variety of leaf colors. Planting a range of different types makes salads and meals more interesting. There are many good varieties for sale in local gardening outlets and through seed catalogs. Most grow well in Utah. Suitable varieties include Rhubarb, Bright Lights, Lucullus, and Fordhook Giant.

HOW TO GROW

Soil: Swiss chard prefers fertile, well-drained soils rich in organic matter for best growth. Most soils in Utah are well suited for Swiss chard production.

Soil Preparation: Before planting, incorporate 2-4 inches of well-composted organic matter or apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet. Work this into the top 6 inches of soil.

Plants: Swiss chard can be grown from seed or transplants. Swiss chard can be sown after soils reach 40°F. Seeds germinate best at 55-75°F and require 7-14 days to emerge. Temperatures above 80°F reduce seed germination. Seeds should be planted ½-1 inch deep. Thin stands when plants have 3-4 true leaves. Plants removed at thinning can be used as transplants in adjacent areas if some roots are maintained or they can also be eaten. Transplants are used to provide an earlier harvest. Transplants should have 4-6 mature leaves and a well-developed root system before planting out. Generally 5-6 weeks are required to grow transplants to this size.

Planting and Spacing: Seeded or transplanted Swiss chard should be spaced 6 inches between plants in the row with rows 12 inches apart. Dense plantings will reduce weed pressure. Swiss chard grows best when temperatures do not exceed 75°F. Temperatures down to 32°F do not seriously damage young plants. Transplants should be planted near the last frost-free date for the growing area. Seeded Swiss chard may be planted 3-4 weeks earlier. High summer temperatures reduce growth, decrease quality, and may cause bitter or off-flavors to develop. For fall Swiss chard, select early maturing cultivars and plant 50-75 days before the anticipated maturity date. The maturity date should be about 2-3 weeks before the first fall frost. Plants can be left in the garden after light frosts.

Water: Water chard regularly supplying 1-2 inches per week. Water requirements depend on soil type and temperatures. Mulch around the plant also helps conserve soil moisture and reduce weed growth. Moisture fluctuations will cause leaves to become tough, slow leaf development and contribute to off-flavors.

Fertilization: Apply 1/4 cup per 10 foot of row of a nitrogen-based fertilizer (21-0-0) 4 weeks after transplanting or thinning to encourage rapid plant growth. Place the fertilizer to the side of the plants and irrigate it into the soil.

Mulches and Row Covers: Fabric covers are used to protect seedlings and transplants from frost. Apply organic mulches such as grass clippings, straw, and newspapers to cool the soil when temperatures increase, reduce water stress, and help control weeds.

PROBLEMS

Weeds: Swiss chard does not compete well with weeds. Weed control is particularly important during establishment. Closely spaced plants will help control weeds. Cultivate shallowly and avoid root pruning to ensure uninterrupted growth.

Insects and Diseases: Most Swiss chard is fast growing and is not susceptible to many disease problems. Rotating locations from year to year helps control most diseases.

Pest	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled.	Use insecticidal soaps, appropriate insecticides, or strong water stream to dislodge insects.
Slugs	Soft-bodied or shelled mollusks that chew holes in leaves.	Control with appropriate pesticides or traps. Avoid moist conditions that favor these pests.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant stands or may kill seedlings.	Control beetles with appropriate insecticides at seeding or after seedlings have emerged from the soil.

HARVEST AND STORAGE

Swiss chard can be harvested when the leaves reach full size or anytime after they form. Older leaves are often stripped off the plants first allowing the young leaves to continue to grow. Provided the growing point is not damaged, all leaves can be cut off to within 2 inches of the soil. Swiss chard can be stored for 1-2 weeks if refrigerated.

Productivity: A 10-foot row of Swiss chard will produce 8-12 pounds.

Nutrition: Swiss chard has no fat, is low in calories and cholesterol, and is a good source of fiber, vitamins A, C, calcium, iron, and folate.

FREQUENTLY ASKED QUESTIONS

Which parts of Swiss chard are edible? The leaves are the main edible part. Stems can also be eaten. Chard may be eaten raw or cooked.

When is the best time to plant Swiss chard? Swiss chard should be planted 2-3 weeks before the anticipated last frost in the spring. Plant 3-4 weeks before the anticipated first frost in the fall for an autumn crop.

Author: Dan Drost, USU Extension Vegetable Specialist

Tomatoes

by Dan Drost

SUMMARY

Tomatoes prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant tomato seeds directly in the garden 10-14 days before the last frost date. Most gardeners transplant tomatoes through black plastic for earlier maturity. Use row covers or hot caps to protect the plants when transplanting before the frost-free period. Side dress with additional nitrogen fertilizer to help grow a large vine. Irrigation should be deep and infrequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75°F. Control insect and diseases throughout the year. Harvest tomatoes when the fruits are fully colored but still firm. At the end of the season, gather all mature green and slightly colored fruits and store at 55°F. Select varieties based on use, fruit size, earliness, soluble solids, growth habit or disease resistance. Many varieties are hybrids but heirloom tomatoes are becoming very popular. Consult with your local nursery or garden center, seed salesman or any seed catalog for detailed information on characteristics of each variety.

RECOMMENDED VARIETIES

Tomatoes can be categorized by maturity class (early, mid-season or late), fruit size (cherry, pear, plum or large), plant size (determinate, semi-determinate or indeterminate), fruit color (red, pink, yellow, orange), or use (fresh, process or dual use). When selecting varieties, consider your growing environment, primary use, and how much space you have available to grow the plants. Most varieties will grow in Utah but all are not available. Most garden centers and nurseries carry varieties that have been proven to grow well and produce high quality, flavorful fruits for local conditions.

HOW TO GROW

Soils: Tomatoes prefer organic, rich, well-drained, sandy soils for best growth. Most soils in Utah will grow tomatoes provided they are well drained.

Soil Preparation: Before planting, incorporate 15-20 lbs of well-composted organic matter or apply 2-3 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting.

Plants: Tomatoes can be grown from seed or transplants. Seed should be planted 2 weeks before the last frost. Transplants should have 5-7 mature leaves and a well developed root system. Transplants mature about 4 weeks before seeded tomatoes and are recommended for most growing areas of Utah. When growing transplants, allow 6-8 weeks to grow the plant. Germinate the seeds at 80F until the seed root emerges from the seedcoat. Then transfer the seeds to sterile seeding mix and grow out at 65-70°F. Adequate light is essential to produce a quality plant. Cool white fluorescent tubes placed 2 to 3 inches above the plants, lit for 14–16 hours per day will ensure plants grow big and healthy. Water regularly and feed weekly with ½ strength soluble complete fertilizer.

Planting and Spacing: Tomatoes should be transplanted when soils are 60°F or after all frost danger has past. Plant 4-6 seeds ½ inches deep, and 18 inches apart in the row. After the seedlings have two leaves, thin to 1-2 plants per clump. Transplants should be planted 2 feet apart in row, with rows 2-3 feet apart. Transplants that are stocky, dark green, have 5-7 leaves and are 6-10 inches tall, grow most rapidly. Plants with flowers or fruits establish slowly and yield poorly. If plants are quite tall, they can be planted deeper as tomatoes form roots from their stems.

Mulches: Black plastic mulch warms the soil, conserves water and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. Lay down the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out several week before the last frost date. Do not apply organic mulches until soils are warmer than 75°F. Grass clippings, straw, newspapers, etc., also conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels, fabric covers, and other devices protect seedlings and transplants from cool air temperatures. Row covers enhance growth and earliness. Plants grown under row covers require ventilation when air temperatures exceed 80°F. Tomato flowers are sensitive to high temperatures during flower development and early fruit growth.

Fertilization: Avoid heavy fertilization of tomato which encourages excessive foliage growth and delays fruit maturity. Side dress with nitrogen (21-0-0) using 1/2 tablespoon per plant at 4 and 8 weeks after transplanting.

Support: Wooden stakes or wire cages are regularly used to support the plants and keep ripening fruits off the ground. Stakes should be driven 18 inches in the soil, 3-4 inches from the stem. Indeterminate varieties require more support and vine pruning to keep plant size manageable. Continue to tie up plants as they grow. Determinate vine types are generally grown on the ground.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Vigorous vine growth by tomatoes will also smother weeds. Cultivate shallowly to avoid root damage.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant vigor or may kill seedlings.	Control beetles with insecticide dust at seeding or transplanting.
Hornworms and Fruit worms	Larvae feed on leaves and fruits causing defoliation and fruit damage. Look for bare areas and black fecal matter.	Hand removal is an easy control method. Use bt or other insecticides for heavy infestations.
Disease	**Symptom**	**Control**
Leaf Blights or Spots	Dark spots on stem, leaves or fruits. The diseases eventually spreads to all plant parts. The foliage eventually dies, exposing fruits to the sun, which causes premature ripening.	Diseases promoted by cool, wet conditions. Don't overhead irrigate late in the day and let soil dry between waterings. Apply appropriate fungicide once disease identified.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on or in stems. Diseases are caused by different pathogens.	Identify causal disease. Plant resistant varieties that have V, F or N designated in their name.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. Viruses can be transmitted by aphids and leaf hoppers, brushing against infected plants, or from tobacco products.	Control aphids. Destroy infected plants, weeds and don't use tobacco products when handling plants.
Fruit Disorders: Blossom-End-Rot, cat-facing, and sunscald	Blossom-end-rot is caused by a localized calcium deficiency brought on by poor water management, excessive nitrogen, root pruning and drought. Catfacing is associated with cold weather during fruit set. Sunscald is caused by fruit exposure to direct sunlight during hot, dry weather.	Better water and nutrient management can reduce all of these disorders. Early plantings often have cat-faced fruits on early trusses. Support structures, moist soils and warm weather help reduce these disorders.

HARVEST AND STORAGE

Tomato fruits requires 25-35 days to mature from flowering depending on the temperature and variety. Pick fruit when they are fully colored but firm, for the best flavor and quality. Pick fruits as they ripen. At the end of the season, harvest all fruits that are mature green or colored slightly. Store at 55°F and use as they ripen. Individual fruits do not need to be wrapped. Ripe tomatoes will store for 1-2 weeks if held at 50-55°F. Fruits are subject to chilling injury so do not store for long periods in the refrigerator.

Productivity: Plant 3-4 tomato plants per person for fresh use and an additional 5-10 plants for juicing, canning or freezing. Expect 100 lbs of fruit per 100 feet of row.

Nutrition: Tomatoes are very nutritious and low in calories. One medium fruit has about 35 calories, is low in fat and is an excellent source of vitamin A and vitamin C.

FREQUENTLY ASKED QUESTIONS

What causes the flowers to drop off my tomato plants? During unfavorable weather (night temperatures lower than 55°F, or day temperatures above 95°F), tomatoes do not set and flowers abort. The problem usually disappears as the weather improves.

What can I do to prevent my tomatoes from cracking? Some varieties are more prone to cracking than others. Many of the newer hybrid varieties are quite resistant. Severe root or vine pruning increases cracking. Keep soil moisture uniform as the tomatoes develop and plant resistant varieties to minimize this problem.

I ***sometimes see small, cloudy white spots just under the skin of my tomatoes. What causes this?*** These spots on green or ripe fruits are caused by the feeding of stink bugs.

Why are the new leaves on my tomato pointed, cupped, twisted, and irregular in shape? It seems likely that your tomatoes have been injured by 2,4-D or a similar growth regulator weed killer. Never use the same sprayer in your vegetable garden that you use for weed control in your lawn. Use caution when applying lawn care chemicals near vegetables or fruit plantings. If applying grass clippings to the garden, make sure the herbicides used are safe for food plants. Consult with your lawn care professional to ensure the chemicals applied to your lawn will not affect your edible garden plants.

On some of my tomato plants, the leaves are turning yellow and the plants are no longer growing. Also, the fruits are ripening prematurely, and are leathery and bitter. What is wrong? Tomatoes with these symptoms are infected with the curly top virus, a disease transmitted by the beet leaf hopper. Once infected there is very little you can do. Since the severity of curly top varies from year to year, planting a few more plants than required will compensate for potential losses. In high risk areas plant Roza, Columbia, Rowpac, or Saladmaster, varieties resistant to curly top.

Author: Dan Drost, USU Extension Vegetable Specialist

Notes

Wasabi

by Andrea Clemenson & Dan Drost

SUMMARY

Wasabia japonica is a challenging plant to grow successfully in Utah due to the hot arid climate combined with freezing winters. It is thought to be one of the rarest and most difficult vegetables to grow in the world. Wasabi requires moist to wet organic rich soils and continuous flowing water. Wasabi grows better in shaded locations and should be supplied regularly with sulfur containing fertilizers. The shaded area should be prepared with a large amount of organic matter. Wasabi grows best when planted in the spring and should be spaced about 12 inches apart. Control weeds and frequently check for slugs and snails. It takes about 2 years before the rhizome matures to full size and flavor.

RECOMMENDED VARIETIES

Wasabi varieties Duruma and Mazuma are main varieties in the marketplace. Mazuma tends to be a hotter variety. Wasabia koreana and Wasabia tetsuigi are other species cultivated for their spicy rhizome.

HOW TO GROW

Soils: Wasabi grows best in loose, very organic-rich, and moist to wet soil amended to a pH of 6-7. Make sure the roots are completely covered and the soil reaches up to the base of the lowest stems.

Soil Preparation: Aerate and till the soil with plenty of organic matter mixed with sulfur-rich fertilizers. If growing in soil, apply 10-12 inches of compost and work this into the soil to a depth of 8-10 inches. Try different types of complete fertilizer with varying amounts of nutrients and evaluate the growth of the plants to find which helps support balanced growth. Wasabi will do best heavily shaded area of the garden or near a pond or artificial stream where fresh water is constantly provided.

Plants: Order wasabi rhizomes online at various websites. When you receive your wasabi plants, keep them moist and in the refrigerator until you are ready to plant, but do not store for more than 30 days. Just before planting, soak roots thoroughly in cool water and remove any damaged leaves.

Planting and Spacing: Plant wasabi in the spring when temperatures stay above 30°F. It is critical to plant wasabi in a shaded area that provides at least 75% shade during the day. A northern exposure out of direct sun is best. The optimal temperature for the whole growing season is 50-60°F. Wasabi is native to areas that have hot, humid summers and dry, cool winters. Wasabi may also be planted in containers that are moved inside or outside depending on weather conditions. If planting in a container, use a 6-inch pot filled with organic rich potting mix and then transplant after 1 year to a 12-inch pot. To increase drainage, put sand underneath the media in the pot. Water thoroughly and frequently, but do not let the plant stand in the drainage water. Wasabi plants will grow 8-18 inches high and should be spaced about 12 inches apart.

Water: Wasabi is a semi-aquatic plant. It grows along streams in heavily wooded areas. For optimal growth, wasabi should be bathed continuously with cool water (45-55° F), year round. Prune back any leaves or stems that remain wilted longer than a few days. Mulch around the plants to help retain soil moisture. One way to achieve this microclimate would be to build a waterfall in a north or northeastern area of the yard. Set it up in such a way that the water, which should be rich with minerals, will continually splash on the plant.

Fertilization: Japanese growers recommend a slow release 12-12-12 fertilizer applied every 3-4 months. Fertilizers high in sulfur will help increase the flavor and spiciness of the wasabi rhizome. Try different fertilizers with varied applications and monitor the growth of the wasabi to identify what works. It is better to under-fertilize than to over-fertilize these plants.

PROBLEMS

Weeds: Keep the area surrounding your wasabi plants weed-free if growing in soil. Clean up any dead leaves to prevent infestation of pests.

Insects and Diseases: Wasabi is vulnerable to various stem and root fungal and bacterial diseases. In the natural running water systems, there are few effective control methods for these diseases.

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Flea Beetles	Small black beetles that feed on seedlings. Adults chew tiny holes in cotyledons and leaves. Beetles can reduce plant vigor or may kill seedlings.	Control beetles with insecticide dust at seeding or transplanting.
Hornworms and Fruit worms	Larvae feed on leaves and fruits causing defoliation and fruit damage. Look for bare areas and black fecal matter.	Hand removal is an easy control method. Use bt or other insecticides for heavy infestations.
Disease	**Symptom**	**Control**
Leaf Blights or Spots	Dark spots on stem, leaves or fruits. The diseases eventually spreads to all plant parts. The foliage eventually dies, exposing fruits to the sun, which causes premature ripening.	Diseases promoted by cool, wet conditions. Don't overhead irrigate late in the day and let soil dry between waterings. Apply appropriate fungicide once disease identified.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on or in stems. Diseases are caused by different pathogens.	Identify causal disease. Plant resistant varieties that have V, F or N designated in their name.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. Viruses can be transmitted by aphids and leaf hoppers, brushing against infected plants, or from tobacco products.	Control aphids. Destroy infected plants, weeds and don't use tobacco products when handling plants.
Fruit Disorders: Blossom-End-Rot, cat-facing, and sunscald	Blossom-end-rot is caused by a localized calcium deficiency brought on by poor water management, excessive nitrogen, root pruning and drought. Catfacing is associated with cold weather during fruit set. Sunscald is caused by fruit exposure to direct sunlight during hot, dry weather.	Better water and nutrient management can reduce all of these disorders. Early plantings often have cat-faced fruits on early trusses. Support structures, moist soils and warm weather help reduce these disorders.

HARVEST AND STORAGE

Harvest the roots in the spring or autumn when temperatures are cool. It takes about 2 years for the rhizomes to grow to 4-6 inches in length. Pull up the entire plant and remove any side shoots off the rhizome. These shoots are used for replanting the crop. Gently wash off any dirt. Grate the root with a very fine grater and store any unused root in a glass jar in the refrigerator for up to 30 days. Wasabi root may also be dried and ground.

Fall/Winter Plant Care: Wasabi must be protected from cold winter temperatures. In warmer areas of Utah, covering the plants with mulch and/or plastic while continuing the water needs may work. In the colder parts of Utah, move the potted wasabi to a cool, diffuse lit room. Container grown wasabi will be much simpler to move inside for the winter.

Productivity: Expect a 4-6 inch root per plant every 2 years.

FREQUENTLY ASKED QUESTIONS

What is the wasabi I get from the market or sushi bar made from? The wasabi available to most people is made up of horseradish powder, mustard power, cornstarch, and food coloring. Real fresh or dried wasabi is quite expensive and is considered a Japanese delicacy.

What benefits does wasabi offer? Like most other members of the cruciferous (cabbage) family, wasabi has natural cancer fighting isothiocyanates. In Japan, the chemicals in wasabi are thought to prevent food poisoning by killing dangerous microbes commonly found in raw fish.

Authors: Andrea Clemenson, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Notes

Watercress

by Trudy Kendrick & Dan Drost

SUMMARY

Watercress is a sun and water loving perennial that grows naturally along running waterways. Watercress has a preferred pH range of 6.5 to 7.5. The plant does well in varying soil conditions provided the soils stay saturated with water. If you have a waterfeature in the garden, this is a good place to grow watercress. Otherwise, a potted watercress plant can be grown in a bucket to simulate the saturated conditions of a stream. The leaves and shoots are cultivated for their culinary and medicinal uses. The peppery taste of watercress has become very popular, especially in Europe as a salad mix. Flavor is best during the cooler parts of the year and the plant is hardy enough that it can be harvested throughout the winter. After the plant blooms, the flavor of watercress decreases in potency.

RECOMMENDED VARIETIES

Plants commonly called cresses include the fastgrowing annuals Garden Cress, Curly Cress or Peppergrass (*Lepidium sativum*); the biennial Wintercress (*Barbarea vulgaris*) which grows in drier areas and produces a white flower, and the perennial Watercress or Big Leaf Cress (*Nasturtium officinale*). You can purchase watercress seeds or transplants of known varieties from reputable nurseries or seed catalogs.

HOW TO GROW

Soils: Watercress grows best in wet, organically rich soils and tolerates a wide range of pH. If growing in containers use a soilless potting mix containing perlite or vermiculite mixed with peat. When growing in pots, keep the potting mix moist by having the pot sit in a saucer filled with water.

Soil Preparation: Before planting, amend garden soil by incorporating 4 to 6 inches of well composted organic matter into the soil to a depth of 6 to 8 inches.

Plants: Watercress is easily propagated by stem cuttings or from seeds. Seeds should be sown just below the soil surface, about 1/4 inch deep, roughly 3 weeks before the frost-free date for your area. Do not let the soil dry out as watercress requires wet soil for best germination.

Planting and Spacing: Plant watercress in a sunny location. Stem cuttings root quickly in rich soil along stream beds and creeks where the soil stays very wet. Seeds can be germinated indoors or outdoors under cool (50 to 60°F), wet conditions. When transplanting, space plants 8 inches apart and place them outdoors after the last frost. If growing in a container, thoroughly saturate the media prior to seeding or transplanting.

Water: Watercress is an aquatic plant that grows best in submerged or shallow moving water. In the garden, place potted plants in a bucket with 2 to 3 inches of water so the media stays wet and the roots are submerged under water. It is best to change the water once or twice a week. You can also plant watercress by an existing water feature in the yard, locating the plant where the soil stays saturated with water.

Fertilization: Watercress does not have a high nutrient requirement. However, cultivated watercress may show phosphorus, potassium or iron deficiencies. Phosphate deficient plants are stunted and dark colored. Symptoms of potassium deficiency are marginal scorching on older leaves. Iron deficient leaves, common in the winter, are expressed as yellowing between the veins on the newer foliage. Mixing a complete soluble fertilizer with the water at the recommended rates minimizes these problems.

PROBLEMS

Weeds: Keep area around plants free from weeds and mulch lightly to assist in maintaining moist soil conditions.

Diseases: Watercress has no specific disease problems in most production settings. However, white flies, spider mites or snails are some of the more common insect problems. White flies are found underneath the leaves and can be controlled with soapy water or insecticidal soap. Spider mites cause flecking, discoloration and scorching of leaves. Injury can lead to leaf loss and plant death. Natural enemies of these pests include small lady beetles, predatory mites and predatory thrips. Snails can be removed by hand, controlled with a molluscide, or trapped. Always follow labeled directions when using any herbicide, pesticide or fungicide.

HARVEST AND STORAGE

Harvest dime sized dark green leaves at any time during the year. Leaves and young stems taste best if harvested before watercress flowers. The peppery flavor is best when harvested in the cooler spring and fall. The flavor deteriorates as temperatures increase above 85°F. To harvest, cut the plant back to 4 inches tall, then let the plant re-grow for a fall harvest. Gathering watercress from the wild is not recommended as pollutants have been reported to cause illness. Watercress can be harvested year round. Harvest what you can use in one meal. If needed, the leaves can be refrigerated for about a week. Watercress is high in iron, calcium and folic acid and is rich in vitamins A and C.

USES

Harvested leaves are used in salads and soups, potato dishes or chopped to flavor butter blends and fish sauces. Many herbs are used for their claimed health benefits. For more information on herbal medicines, refer to a reliable information source for details on the benefits or hazards to using an herbal medicine. One such source is the National Institutes of Health's herbal medicine website:
http://www.nlm.nih.gov/medlineplus/herbalmedicine.html

ADDITIONAL RESOURCES

Lesley Bremness. 2002. Smithsonian Handbooks: Herbs.
Dorling Kindersley Publishing, 304p.

Authors: Trudy Kendrick, Horticulture Student, & Dan Drost, USU Extension Vegetable Specialist

Watermelons

by Dan Drost & Rick Hefelbower

SUMMARY

Watermelons prefer a sunny location and fertile, well drained soils. Incorporate plenty of organic matter and a complete fertilizer into the area before planting. Plant 4-6 seeds, 1-2 inches deep, in mounds 4 feet apart when soils are 65°F. Thin the mounds after emergence to two plants. Transplant watermelon 2 feet apart through black plastic for early maturity. Use row covers to protect the plants when planting before the frost-free period. After the vines develop runners, side dress with additional nitrogen fertilizer.

Irrigation should be deep and infrequent. Plastic and organic mulches help conserve water and reduce weeding. Do not apply organic mulches until soils have warmed to 75°F. Control insects and diseases throughout the year. Harvest watermelons when the tendril is dry, the ground spot is yellow, and the skin is dull colored.

RECOMMENDED VARIETIES

Crimson Sweet and Mirage Hybrid are large (15-25 lb) red-fleshed melons. Mickylee and Minilee are smaller (10-15 lb) icebox types. Golden Crown and Yellow Baby are yellow-fleshed varieties. There are many other good watermelon varieties for sale at local gardening outlets and through seed catalogs. Most grow well in Utah.

HOW TO GROW

Soils: Watermelons prefer organic, rich, well-drained, sandy soils for best growth. Most soils will grow watermelons provided they are well drained.

Soil Preparation: Before planting, incorporate up to 4 inches of well-composted organic matter. Apply 4-6 cups of all-purpose fertilizer (16-16-8 or 10-10-10) per 100 square feet before planting.

Plants: Watermelons can be grown from seed or transplants. Seed should be planted 1-2 inches deep. Transplants should have 2-3 mature leaves and a well developed root system. Transplants mature about 2 weeks before seeded melons and should be used in short growing areas of Utah.

Planting and Spacing: Plant when soils are 65°F or after frost danger has past. Plant 4-6 seeds in mounds 4 feet apart. After they have two leaves, thin to two plants per mound. Transplants should be planted 2 feet apart in the row with rows 4-6 feet apart. Avoid damaging the roots when planting, which slows establishment and growth.

Mulches: Black plastic mulch warms the soil, conserves water, and helps control weeds. Plastic mulches allow earlier planting and maturity, especially with transplants. Lay the plastic, secure the edges with soil, and cut holes for the seeds or transplants. When using plastic mulches and row covers, seeds or plants can be set out 2-3 weeks before the last frost. Do not apply organic mulches until soils are warmer than 75°F. Grass clippings, straw, newspapers, etc., also conserve water and control weeds.

Row Covers: Hotcaps, plastic tunnels and fabric covers protect seedlings and transplants from cool air temperatures. Row covers enhance growth and earliness. Covers need to be removed when plants start to flower or when temperatures exceed 90°F.

Water: Water deeply and infrequently, 1-2 inches per week. Use drip irrigation if possible. Mulch around the plant will conserve soil moisture and reduce weed growth. Irrigate so that moisture goes deeply into the soil. To improve flavor, reduce watering amounts as the fruits ripen.

Fertilization: After the vines develop runners, side dress with a nitrogen fertilizer (21-0-0) using 1-2 tablespoons per plant or mound. Incorporate the fertilizer at least 6 inches away from the plants.

PROBLEMS

Weeds: Plastic and organic mulches effectively control weeds. Heavy vine growth by watermelon will also smother weeds.

Insects and Diseases:

Insect	Identification	Control
Aphids	Green or black soft-bodied insects that feed on underside of leaves. Leaves become crinkled and curled. May transmit virus diseases. Secreted honeydew makes plants appear shiny, wet, or sticky.	Use insecticidal soaps or strong water stream to dislodge insects.
Cucumber Beetles	Adults have stripes or spots and feed on leaves and vines which reduces vigor. May transmit bacterial disease. Larvae bore into roots and stems causing plants to wilt and die.	Application of chemicals at first appearance is needed to control this pest.
Disease	**Symptom**	**Control**
Powdery Mildew	White fungal patches start on older leaves. The disease eventually spreads to all plant parts. The foliage dies, exposing fruits to the sun, which causes premature ripening.	Plant resistant varieties.
Wilt Diseases	Leaves wilt on one or more vines. Plants often die. Streaking, slime formation, or gummy exudates visible on stems. Diseases are caused by different pathogens.	Identify causal disease. Treat disease as recommended once identified.
Virus	Leaves are light green, mottled, malformed, dwarfed and curled. Early infection affects fruit shape and flavor. An aphid transmitted disease.	Control aphids. Destroy severely infected plants.

HARVEST AND STORAGE

Watermelon fruits take 35-45 days to mature from flowering. Use the following guide to determine maturity. The curly tendril opposite the fruit should be brown and withered; the ground spot under the fruit changes from white to yellow; and the skin color changes from shiny to dull. Pick watermelons as they ripen. Watermelon will store for 1-2 weeks if held at 45-50°F.

Productivity: Plant 3-4 watermelons per person for fresh use and an additional 3-4 plants for juicing or freezing. Expect 40 fruits per 100 feet of row.

Nutrition: Watermelons are mostly water. A 2 cup serving has 80 calories, is low in fat and is an excellent source of vitamin A and vitamin C.

FREQUENTLY ASKED QUESTIONS

My watermelons are not very sweet or flavorful. Is the low sugar content caused by the watermelons crossing with other vine crops in the garden? No. Although watermelon varieties cross with one another, the effect of this cross-pollination is not evident unless the seeds are saved and planted the following year. The poor flavor of your melons may result from wilting vines, high temperatures, or a short growing season in extreme northern areas.

What can I do to prevent my watermelons from developing poorly and rotting on the ends? This condition is similar to blossom end rot of tomatoes and is caused by extremely dry weather when the melons were growing. It may be aggravated by continued deep hoeing, close cultivation or poor irrigation. Mulching the plants with black plastic film helps reduce this problem.

Authors: Rick Hefelbower USU Extension Washington County Agent, & Dan Drost, USU Extension Vegetable Specialist

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