Agronomics of Oilseed Crops for Central Utah Biodiesel Production

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Abstract

Global energy demand, civil unrest, climate change, and an emphasis on sustainable systems have recently renewed interest in agriculturally produced biofuels. Biologically derived diesel fuel is an attractive energy source for agricultural producers because diesel is a primary fuel source, there are a variety of available oil seed crops, and processing of oil seed to biodiesel can be done easily, economically, and on a small scale. Four oil seed crops Camelina (Camelina sativa), spring planted Canola (Brassica napus), Safflower (Carthamus tinctorius), and Sunflower (Helianthus annuus) were evaluated for agronomics, seed yield, and oil yield in 5 central Utah locations during 2006. Research and demonstration plots were seeded in a Randomized Complete Block Design (RCBD) with split plot overlays of preemergent herbicides, trifluralin and ethalfluralin. Canola entries were glyphosate resistant and were evaluated with and without the use of glyphosate herbicide. Preemergent herbicide treatment produced lower weed populations with no apparent crop injury in all species. Ethalfuralin provided better weed control than trifluralin at some locations. Preemergent weed control was not sufficient in some locations depending on weed species. Preemergent combined with glyphosate treatments provided superior weed control with no apparent crop injury in canola plots. Oil seed yield was greatest with sunflower followed by safflower, canola, and camelina in descending order. Oil seed average yields varied from 474 kg/ha to 3169 kg/ha. Seed yields and corresponding oil or biodiesel yields were sufficient for sustainable farm fuel needs but were not economically competitive with other irrigated cash crops in the region, hay and corn silage. Oil seed crops for biodiesel production in Central Utah will probably be used in crop rotations but are not likely to displace commonly grown crops at current energy prices.

Introduction

In the fall of 2005 several Extension stakeholders composed of farmers, Snow College educators, County Commissioners, County Economic Development Directors, and forward thinking citizens approached USU Extension about the feasibility of producing local biodiesel fuel to provide the opportunity for farmers and rural citizens to become diesel fuel self-sufficient. Limited information was available about the agronomics of growing various oil seed crops to produce biodiesel. Crop research and demonstration plots were established in seven Utah counities, See Figure 1.

Figure 1. Map of USU Extension oil-seed research and demonstration trials for 2006-07 and cooperating farmers that have planted oil-seed for on-farm biodiesel production.

Materials and Methods

Seeding – Direct Seeded March – May
Seeding Rates – Camelina – 3 & 6 lbs/ac Spring and Fall Canola 5 lbs/ac
Safflower 25 lbs/ac & Sunflower 5lbs/ac
Experimental Design – Randomized Complete Block Design with 4 replications
Herbicide Treatments – Postemergents - glyphosate (Roundup®) 32oz/ac
Preemergents - ethalfuralin (Sonolan®) & trifluralin (Treflan®) 2pts/ac tillage incorporated
Irrigation – Sprinkler
Fertilization – Nitrogen - 50 lbs N/ac as Ammonium Sulfate
Phosphorus and Potassium – as needed

Crops and Number of Entries Planted 2006–07
Camelina (*Camelina sativa)* (1) Cultivar "Ligena"
Fall Canola (*Brassica rapas*) (17) Cultivars and Experimental Lines
Spring Canola (*Brassica rapas)* (4) Cultivars
Safflower (*Carthamus tinctorius)* (5) Cultivars
Sunflower (*Helianthus annuus)* (4) Hybrids
Harvest- Direct Combine Camelina and Canola – August
Safflower and Sunflower – October and November

Figure 2. Utah State University Extension Research and Demonstration Field Day in Ephraim, UT. Crops (top left to right) are Safflower, Canola, Camelina, and Sunflower.

Figure 3. Experimental combine and crops at a research and demonstration plot in Circleville, UT.

Figure 4. Spring canola with a glyphosate treatment plot in the front and a preemergent treatment plot with a severe sowthistle infestation (back).

Results and Discussion

Considerable variation was observed over location, species, seeding rate, culitvar/hybrid or line, and herbicide treatments. Camelina was shown to have increased yield at the 6 lb/ac seeding rate. Herbicide treatments also varied in efficacy by location and weed species present. One location with other weeds from the Asteraceae family was especially problematic in plots, as preemergent herbicides had no control on these weeds. In this location and others the glyphosate treatments resulted in the best weed control with glyphosate resistant entries (Figure 4.). Ethalfuralin provided better weed control than trifluralin at some locations with no detectable crop injury observed with the both preplant incorporated herbicides.

Seed yield ranges are presented in Table 1 with oil content estimated from typical values published for those crops. Gallons of oil per acre are estimated by using the expected oil content and assuming a gallon oil weight of 7.7lbs. Using an oil seed commodity price of $0.15/lb the gross income from the oil seed crops grown would need to achieve yields near 4000 lbs/ac to complete with corn silage and alfalfa hay that averages $600 gross income per acre in Utah. Oil seed crops are likely to be used only as rotations in these cropping systems.

Table 1. Yields, expected percent oil content, and estimated gallons of oil for various oil seed crops grown in Central Utah during 2006 in pounds per acre (Lbs/Acre). Variation in seed yield varied by location, growing conditions, herbicide treatment, and variety.

Crop	Seed Yield Range	Expected % oil	Estimated gallons oil/acre
Camelina	127-720 Lbs/Acre	40	7-37
Spring Canola	345-1356 Lbs/Acre	36	16-63
Safflower	340-2978 Lbs/Acre	37	16-143
Sunflower	1670-3989 Lbs/Acre	33	72-171

Agronomic evaluation of oil seed crops in Utah is part of a multi-disciplinary team of educators that are promoting diesel fuel self-sufficiency as a risk and energy hedge strategy for agricultural producers. With grant funds from Utah Department of Agriculture and Food a mobile oil-seed press and biodiesel processing facility has been purchased for on-farm demonstration and use (Figure 5.)

Figure 5. Central Utah Biodiesel Project mobile oil-seed and biodiesel research and demonstration processing trailer. Biodiesel reactor in the foreground and screw-type oilseed press (back).

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