

Drip Irrigation of Berries

Presented by

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with information from

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Drip Irrigation Advantages

- Reduced water use
- Can decrease weed and disease pressure
- Lower pressure than sprinklers
- More opportunities for field operations
- Fertilizer application with irrigation
- Field adaptability – shape, size, and topography

Drip Irrigation Considerations

- Generally smaller wetted soil volume (more frequent irrigations)
- Costs (more or less)
- Clean water (filtration)
- Leaks (all irrigation systems, but drip may not be noticed)
- System life: drip tape (6-15 mil) drip tube (45-70 mil)
- Labor cost (more or less), generally less after installation

Drip System Components

- Water source (potable or irrigation)
- Pressure (pumping or gravity)
- Backflow prevention
- Filtration



Drip System Components

- Chemigation (very simple or complicated)
- Distribution System
 - Pressure control
 - Mainlines
 - Lateral
 - Manifold
- Drip tape or tube
 - Rate (in./hr.) = 1.6 times emitter discharge rate (gph) divided by emitter coverage area (ft²)

Note: emitter coverage area is calculated as the emitter spacing times the line spacing).

Example: $1.6 \times 0.5 \text{ gph} / (1 \text{ ft} \times 6 \text{ ft}) = 0.13 \text{ in./hr.}$

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Drip tape label

60-inch row and drip tape spacing

App Rate = $1.6 * .13 \text{ gph} / (5 * 1)$

App. Rate = .0416 in./hour or 1 inch per day

Drip tape lengths are generally between 400 to 600 feet, but can be over 1,000 feet with low flow rates and pressure compensating emitters and proper drip tape diameter.



Typical of small plots and gardens (large fields can use different drip systems)

Irrigation Application Rates and Time		Drip Tubing/Tape Emitter Flow Rate (gallon per hour per foot)					
		0.2	0.5	0.6	0.9	1	
		Application Rate (Inches/hour)					
Drip Tubing Row Spacing (inches)	12	0.32	0.80	0.96	1.44	1.60	
	18	0.21	0.53	0.64	0.96	1.07	
	24	0.16	0.40	0.48	0.72	0.80	
	30	0.13	0.32	0.38	0.58	0.64	
	36	0.11	0.27	0.32	0.48	0.53	
			Minutes to Apply One Inch				
	12	187	75	62	42	37	
	18	281	112	94	62	56	
	24	374	150	125	83	75	
	30	468	187	156	104	94	
36	561	224	187	125	112		

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Maintenance

- Clean water
- Maintain filtering system
- Fix leaks
- Flush drip lines
- Chlorinate lines (biological films) and sulfuric or phosphoric acid (hard water deposits) if needed (depends on water quality)
- Carefully follow all safety precautions when using chemical injects to prevent human, equipment, or crop harm. Chlorine gas is harmful and can react with other chemicals.

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Irrigation Application Rates

- Drip Irrigation (flow per emitter is usually in gallons per hour)

In./hr.=1.6 *gallons per hour(gph)/emitter spacing (ft²)

Example: 1.6*.5 gph / (1 ft * 2.5 ft) = 0.32 in/hr.

One gallon in one square foot would be 1.6 inches deep

Conversions

1 cfs = 448.8 gpm

1 gpm = 60 gph

1 acre = 43,560 feet²

- Surface Irrigation (flow usually in cubic feet per second)

In./hr. = cubic feet per second (cfs) / acres

Example: 4 cfs / 5 acres = 0.8 in/hr.

- Sprinkler Irrigation (flow is usually in gallons per minute)

In./hr.=96.24 *gallons per minute(gpm)/area (ft²)

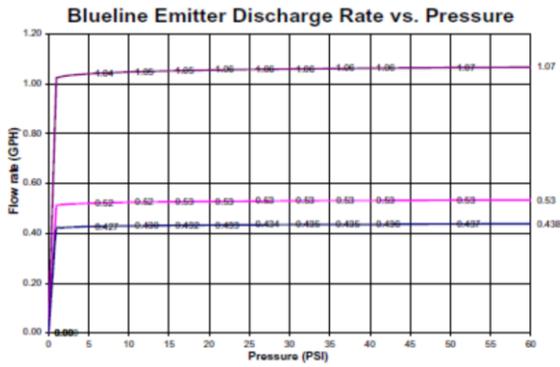
Example: 96.24*7 gpm / (40 ft*60 ft) = 0.28 in/hr.

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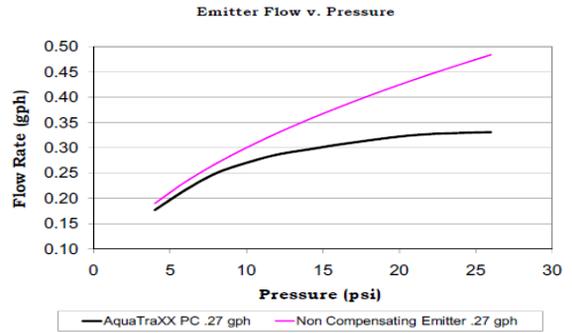
Pressure Compensating Emitters

In./hr.=1.6 *gallons per hour(gph)/emitter spacing (ft^2)
spacing is row spacing time emitter spacing

Drip tubing



Drip tape



Examples from Toro Irrigation literature

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How many feet of tubing can I operate with my water supply? Can be designed to accommodate water supply. Pressure compensating emitters best for long lines. A typical outdoor faucet can provide about 5 - 7 gallons per minute.

Drip Tubing/Tape for various water supplies (feet)		Drip Tubing/Line/Tape (gallon per minute per 100 feet)							
		0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33
		Drip Tubing/Line/Tape (gallon per hour per 100 feet)							
		10	20	30	40	50	60	70	80
Water Supply Flow (gallons per minute)	5	3000	1500	1000	750	600	500	429	375
	10	6000	3000	2000	1500	1200	1000	857	750
	15	9000	4500	3000	2250	1800	1500	1286	1125
	20	12000	6000	4000	3000	2400	2000	1714	1500
	25	15000	7500	5000	3750	3000	2500	2143	1875
	30	18000	9000	6000	4500	3600	3000	2571	2250
	35	21000	10500	7000	5250	4200	3500	3000	2625
	40	24000	12000	8000	6000	4800	4000	3429	3000

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How much time should I run an irrigation set?
 $\text{In./hr.} = 1.6 \times \text{gallons per hour (gph) / emitter spacing (ft}^2\text{)}$
 Efficiencies are 85 to 95 percent

		Drip Tubing/Line/Tape (gallon per minute per 100 feet)							
		0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33
		Drip Tubing/Line/Tape (gallon per hour per 100 feet)							
		10	20	30	40	50	60	70	80
Line Spacing (inches)	6	0.32 in/hr.	0.64	0.96	1.28	1.60	1.92	2.25	2.57 in/hr
	12	0.16	0.32	0.48	0.64	0.80	0.96	1.12	1.28
	18	0.11	0.21	0.32	0.43	0.53	0.64	0.75	0.86
	24	0.08	0.16	0.24	0.32	0.40	0.48	0.56	0.64
	30	0.06	0.13	0.19	0.26	0.32	0.38	0.45	0.51
	36	0.05	0.11	0.16	0.21	0.27	0.32	0.37	0.43
	42	0.05	0.09	0.14	0.18	0.23	0.27	0.32	0.37
	48	0.04	0.08	0.12	0.16	0.20	0.24	0.28	0.32
	60	0.03	0.06	0.10	0.13	0.16	0.19	0.22	0.26
	66	0.03 in/hr	0.06	0.09	0.12	0.15	0.17	0.20	0.23 in/hr

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Drip Flow Rates

Flow Rates

Product	Part Number	Individual Emitter Flow Rate GPH@ 10 psi	Spacing inches	Q-100 GPM per 100 ft. @ 10 psi
0.20 GPH @ 10 PSI				
	EAPXxx0667	0.20 gph	6"	0.67
	EAPXxx0850	0.20 gph	8"	0.50
	EAPXxx1234	0.20 gph	12"	0.34
	EAPXxx1625	0.20 gph	16"	0.25
	EAPXxx1822	0.20 gph	18"	0.22
	EAPXxx2417	0.20 gph	24"	0.17
0.27 GPH @ 10 PSI				
	EAPXxx0690	0.27 gph	6"	0.90
	EAPXxx0867	0.27 gph	8"	0.67
	EAPXxx1245	0.27 gph	12"	0.45
	EAPXxx1634	0.27 gph	16"	0.34
	EAPXxx1830	0.27 gph	18"	0.30
	EAPXxx2422	0.27 gph	24"	0.22

Example from Toro Irrigation literature

3 to 5 gpm for 5/8" diameter

drip tape \$0.04 to \$0.12 per foot (8 to 15 mil)

drip tubing \$0.20 to \$0.30 per foot (45 mil)

Rooting Patterns of Caneberries

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 Sharid Kamal, Research Assistant, UCCE Monterey County
 Mark Bolda, Strawberry and Caneberry Advisor, UCCE Santa Cruz County

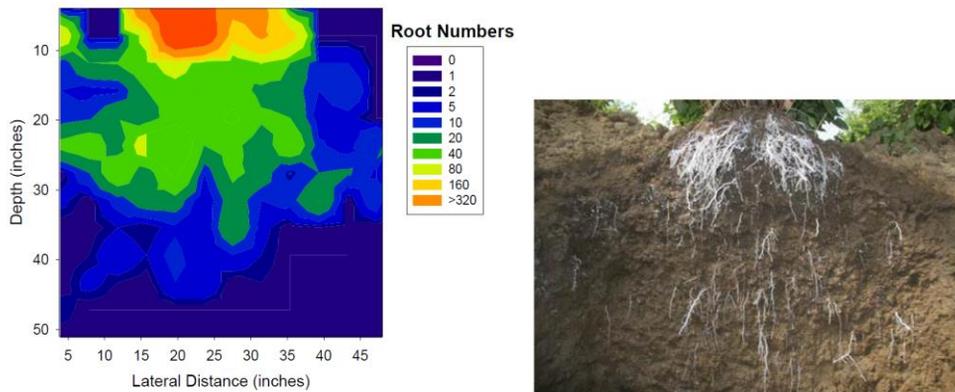
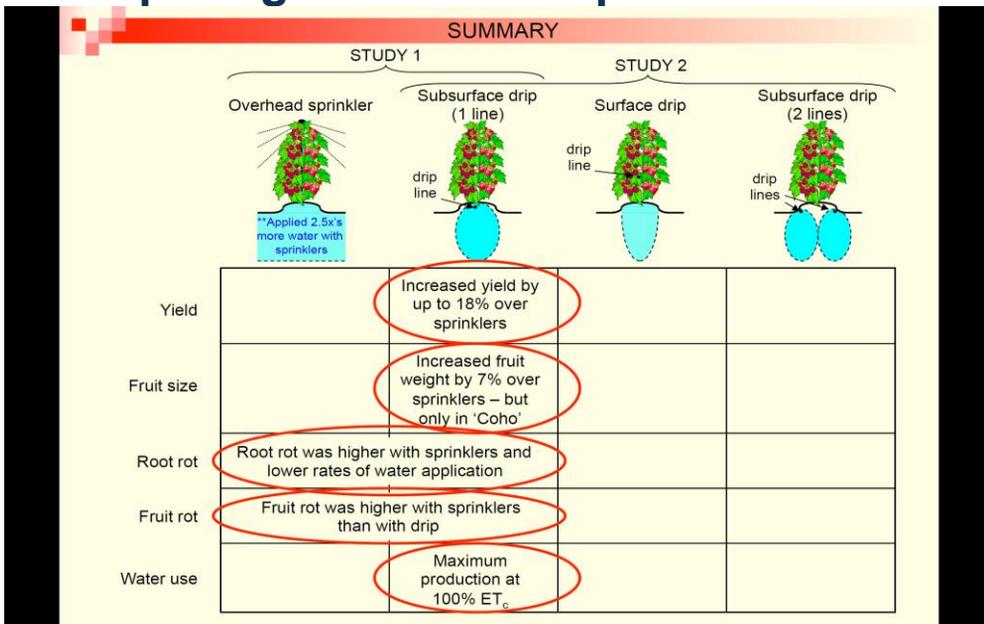


Figure 2. Cross-section of root distribution of 2nd year raspberry on 88-inch spaced rows, drip irrigated. Watsonville CA. May 2007.

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Drip Irrigation of Raspberries in Heavy Soils

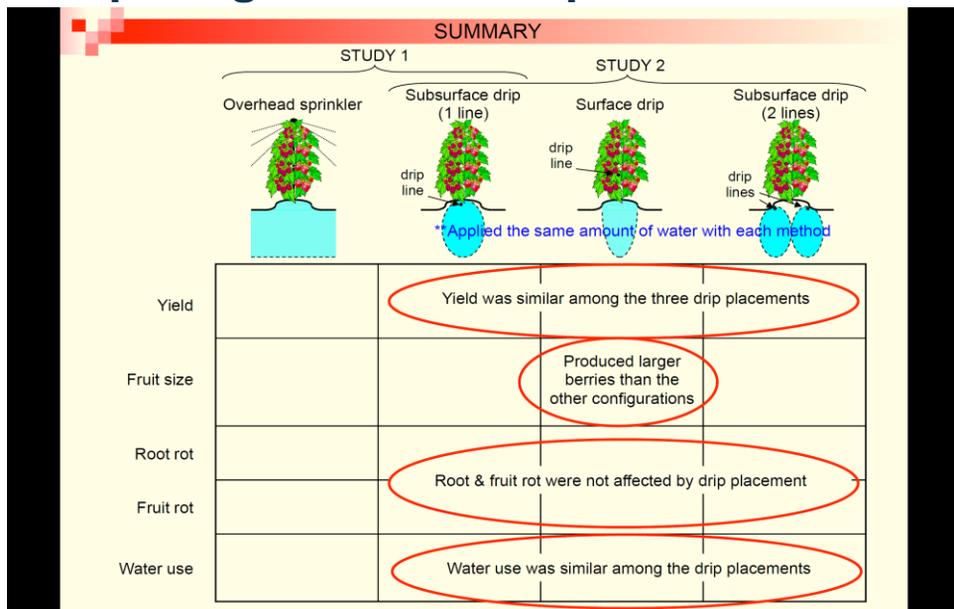


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Drip Irrigation of Raspberries in Heavy Soils



David Bryla
 USDA-ARS Horticultural
 Crops Research Unit
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 (2006-2009)

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Irrigation Scheduling

- By the calendar (example once each week)
- Soil moisture monitoring
- Soil water budget
 - Using ET estimates from weather stations
 - Using soil water monitoring
- Based on crop growth and reproductive stages
- Crop stress (can significantly affect yield)

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Spanish Fork Weather Data (July 2019)

date	eto (in)	etr (in)	airt_max	airt_min	eto_7day	etr_7day	precip_tb
7/1/2019	0.25	0.3	89.2	52.1	1.79	2.35	0
7/2/2019	0.31	0.41	91.6	56.5	1.82	2.38	0
7/3/2019	0.3	0.39	89	55	1.8	2.34	0
7/4/2019	0.24	0.28	85.1	54.2	1.77	2.27	0
7/5/2019	0.22	0.25	84.5	50.8	1.7	2.16	0
7/6/2019	0.27	0.33	91.8	60.3	1.72	2.16	0
7/7/2019	0.27	0.36	87.8	56.4	1.85	2.32	0
7/8/2019	0.25	0.32	85.4	57.7	1.85	2.35	0
7/9/2019	0.24	0.29	89.9	54.2	1.77	2.23	0
7/10/2019	0.26	0.31	94.3	56.3	1.73	2.16	0
7/11/2019	0.25	0.34	95.3	59.6	1.75	2.21	0
.....
7/25/2019	0.22	0.27	90.3	66.6	1.63	1.99	0
7/26/2019	0.18	0.21	86.3	62.6	1.55	1.88	1.04
7/27/2019	0.18	0.21	82.3	60.7	1.49	1.8	0.01
7/28/2019	0.21	0.24	89.6	57.6	1.45	1.74	0
7/29/2019	0.24	0.29	94.6	58.2	1.46	1.76	0
7/30/2019	0.22	0.28	94.6	60.4	1.42	1.7	0
7/31/2019	0.08	0.11	83.8	60.4	1.33	1.6	0.23
Total	7.32	9.11					

Example:

The ET is approximately 2.1 inches per week, using ETr and $K_c = 1.0$

Depending on the soil and rooting depth, irrigate twice per week with about 1 inch of water.

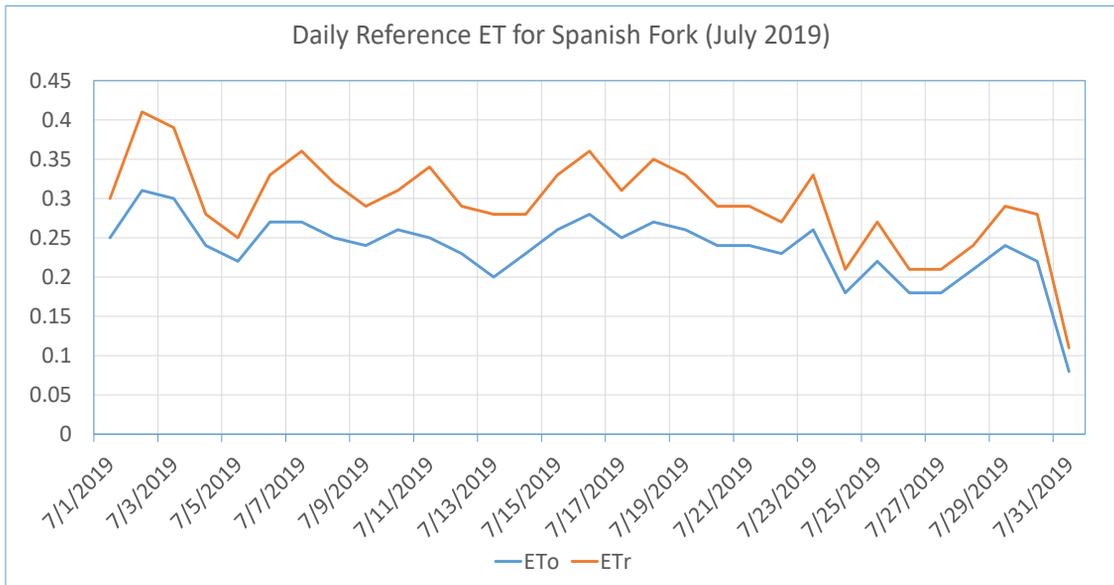
Remember the irrigated soil volume is reduced with drip irrigation.

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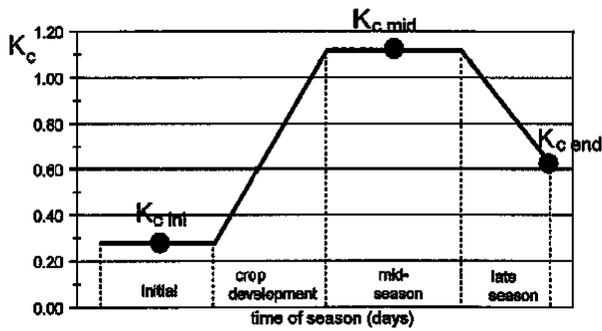
Reference ET



Berry Crop Coefficients

FAO ETo Crop Coefficients for berries

Beginning growth 0.30
 Full production 1.05
 Endo of season 0.50

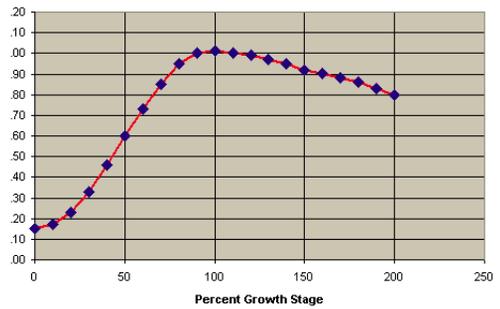


Adjustments

Wind (+0 to 10%)

Humidity / aridity (up to 10% in our climate)

USBR ETr coefficients



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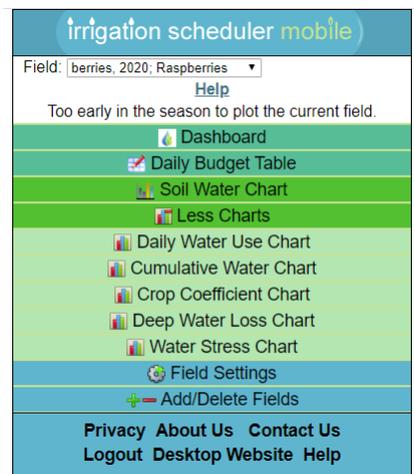
Reference ET to Crop ET

Basics

When canopy is fully developed irrigation about $1.15 * ETo$, this allows for irrigation non-uniformity and leaching.

Can use Washington State University's "Irrigation Scheduler Mobile" application.

Water until end of season (lite frosts), even for summer bearing berries.



#1 – Irrigation scheduling

- WSU Irrigation Scheduler Mobile

irrigation scheduler mobile

Login
Using your AgWeatherNet account.

Username:
xxxxxx

Password:

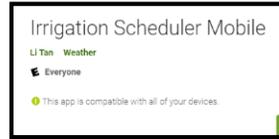
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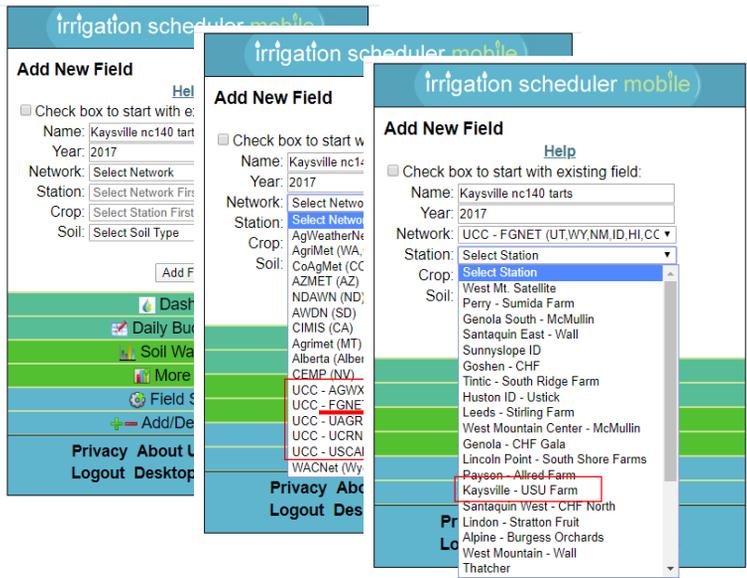
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Register
In order to use the irrigation scheduler, please [register](#) for an AgWeatherNet account which can be used to log in.

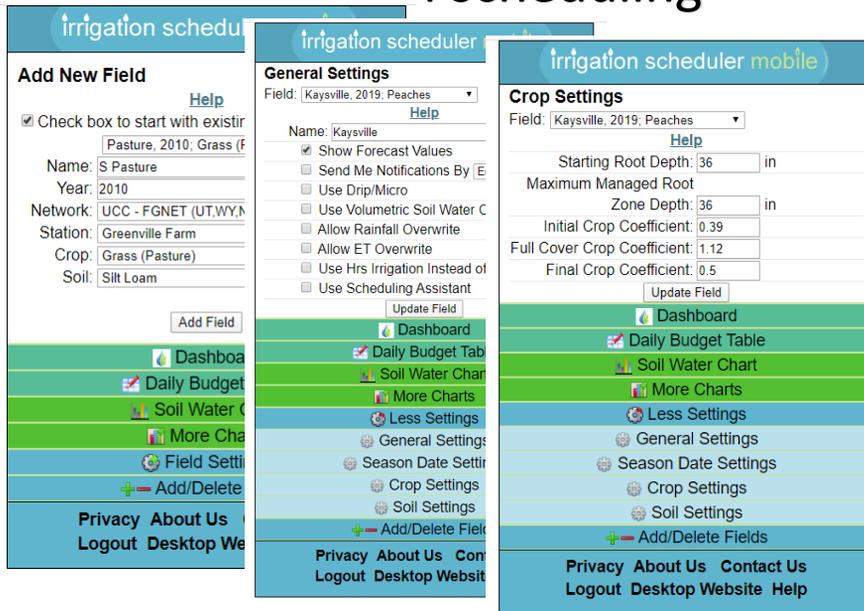
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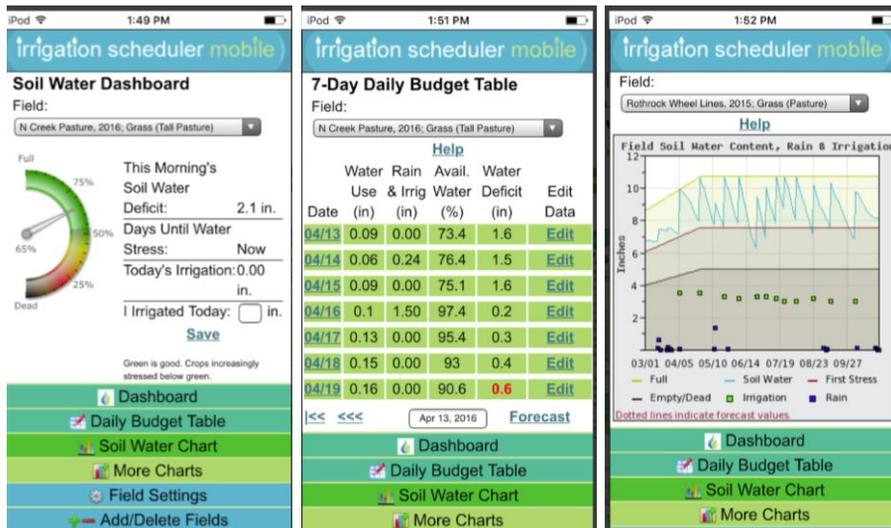
#1 – Irrigation scheduling



#1 – Irrigation scheduling

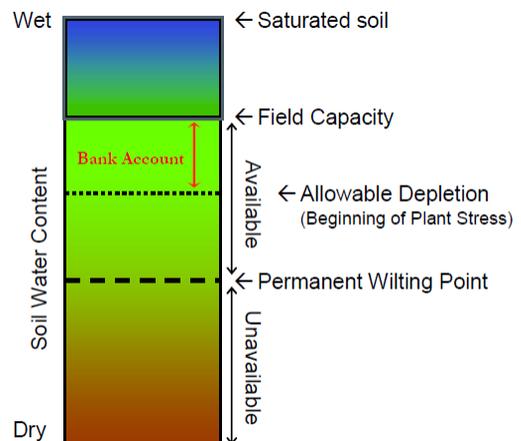


#1 – Irrigation scheduling



Available Soil Water

- Most agricultural soils have about 1 inch of allowable depletion per foot of soil depth.
- Rooting depth can be 3 feet, but most roots are in the top 1.5 feet.
- Roots spread laterally, but with drip the irrigated with ranges from 1 to 2 feet.



Summary

- Drip irrigation is not the only suitable irrigation method.
- Drip irrigation can provide some distinct advantages.
 - Good irrigation uniformity
 - Improves irrigation efficiency
 - Reduces gross irrigation
 - Can increase yield
 - Can be used to uniformly apply fertilizers
- Irrigation Scheduling
 - Approximately 2 inches per week during fruiting and effective cover
 - ET based on climate data
 - Soil water monitoring (not discussed)