

Irrigation Management of Oilseeds in Eastern Washington

Water Use by Canola, Camelina and Safflower

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Reardan, WA



Columbia Basin Soils Developed: Arid environment

Annual Precip. 6-8" (winter)

MAT 52 °F

Temp Range <32 - 110 °F

Sands - silt loam soils

Native Vegetation: Shrub-steppe

- big sagebrush (others)
- antelope bitterbrush
- rabbit brush
- bluebunch wheatgrass
- Idaho Fescue
- Sandberg's bluegrass
- needle grass

1-3% OM

Annual Residue Input

Shrub-steppe 1,100 lb ac⁻¹

Cultivated 3,000 – 12,000 lb ac⁻¹

General Irrigation Guidelines: Oilseeds

- ✓ **Soil type, seasonal temperatures, previous cropping, irrigation, soil water storage, etc. affect oilseed yield.**
- ✓ **Soil moisture should be maintained above 50% available moisture in the active root zone (4 ft).**
- ✓ **After planting avoid soil crusting with light frequent applications until the crop has fully emerged.**
- ✓ **Once the crop reaches the vegetative state irrigate to replace ET losses. Canola uses on average 19 in of water a season and over 0.3 in/day during peak periods.**
- ✓ **Most critical times for irrigation are during late vegetative, spiking and throughout the flowering period. Keep irrigating until flowering stops.**
- ✓ **Irrigation should end by pod and seed-fill or when leaves drop, typically a month before harvest.**

Oilseed Irrigation Trials: Water Use

- **Canola Variety Trials (Prosser, Othello)**
 - 2006-2009 CY
- **Safflower Variety Trials (Paterson)**
 - 2008-2010 CY
- **Camelina Variety Trials (Paterson)**
 - 2010-2012 CY



Fig. 1. Winter canola in mid-March under center pivot irrigation near Othello, Washington (*photo by Becky Lyle*).

Oilseed Irrigation Trials: Water Use

• Canola Variety Trials (Othello)

Varieties – Athena, Erica, Inca, Rapier

Seeding rate – 8 lbs/acre

Row spacing – 9 inches

Seeding depth – 3/4 inch

Date of seeding – Late August – mid September

Fertilizer rate – 100 lbs/acre

Irrigation water – 1 to 24 inches/acre - solid set



Figure 2. Irrigated winter canola at mid-bloom (*Karen Sowers*).

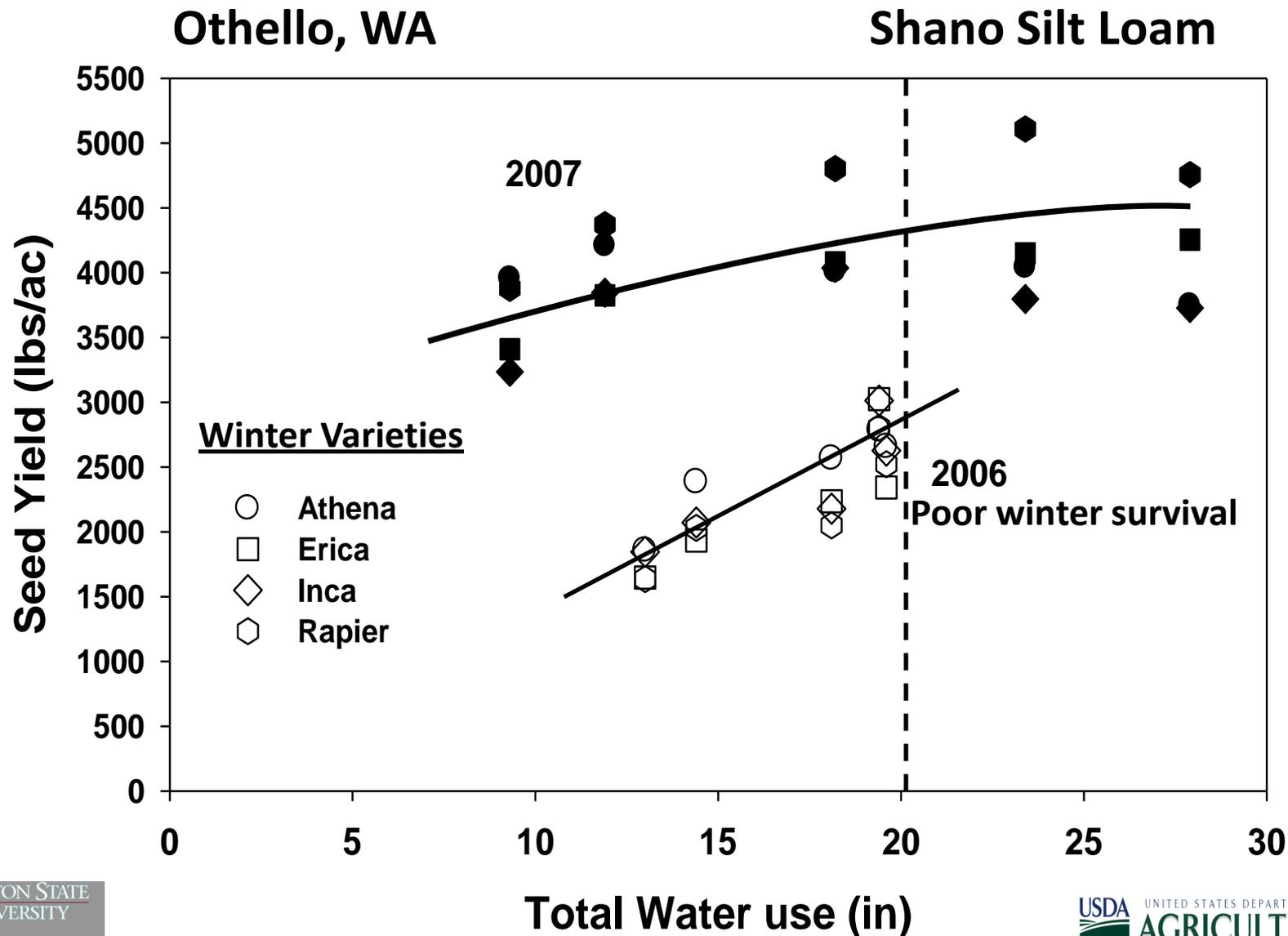


Figure 3. Spring-flowering canola under critically-timed center pivot irrigation near Othello, Washington (*photo by Becky Lyle*).



Figure 4. Ripe canola pods (*photo by Karen Sowers*).

Canola Variety Trials: Water Use



Canola Variety Trials: Water Use ¹⁹ ¹⁸¹

Table 1. Yield of winter canola and water use at the WSU Field Station at Othello, WA.

Year	2006				2007			
Irrigation	Full		Deficit		Full		Deficit	
Yield	lb/ac/in		lb/ac/in		lb/ac/in		lb/ac/in	
	lb/ac	Water	lb/ac	Water	lb/ac	Water	lb/ac	Water
Athena	2875	148	2567	142	3750	135	4040	173
Erica	3024	156	2236	124	4225	153	4149	177
Inca	3013	155	2178	120	3727	135	3796	162
Rapier	<u>2804</u>	<u>145</u>	<u>2050</u>	<u>113</u>	<u>4757</u>	<u>172</u>	<u>5109</u>	<u>218</u>
Average	2929	151	2258	125	4115	150	4274	183

- Deficit irrigation was 80% of full irrigation.
- Irrigation water savings: 2-4 in/acre.
- Stand difference between years was due to winter survival.
- No statistical difference in yield between irrigation levels.
- Yield per water used is based on soil storage, precipitation and irrigation applied.
- Greater yield per inch of water applied under deficit irrigation

Canola Variety Trials: Water Use

Table 2. Average available soil water and water use by canola at the WSU Field Station Othello, WA.

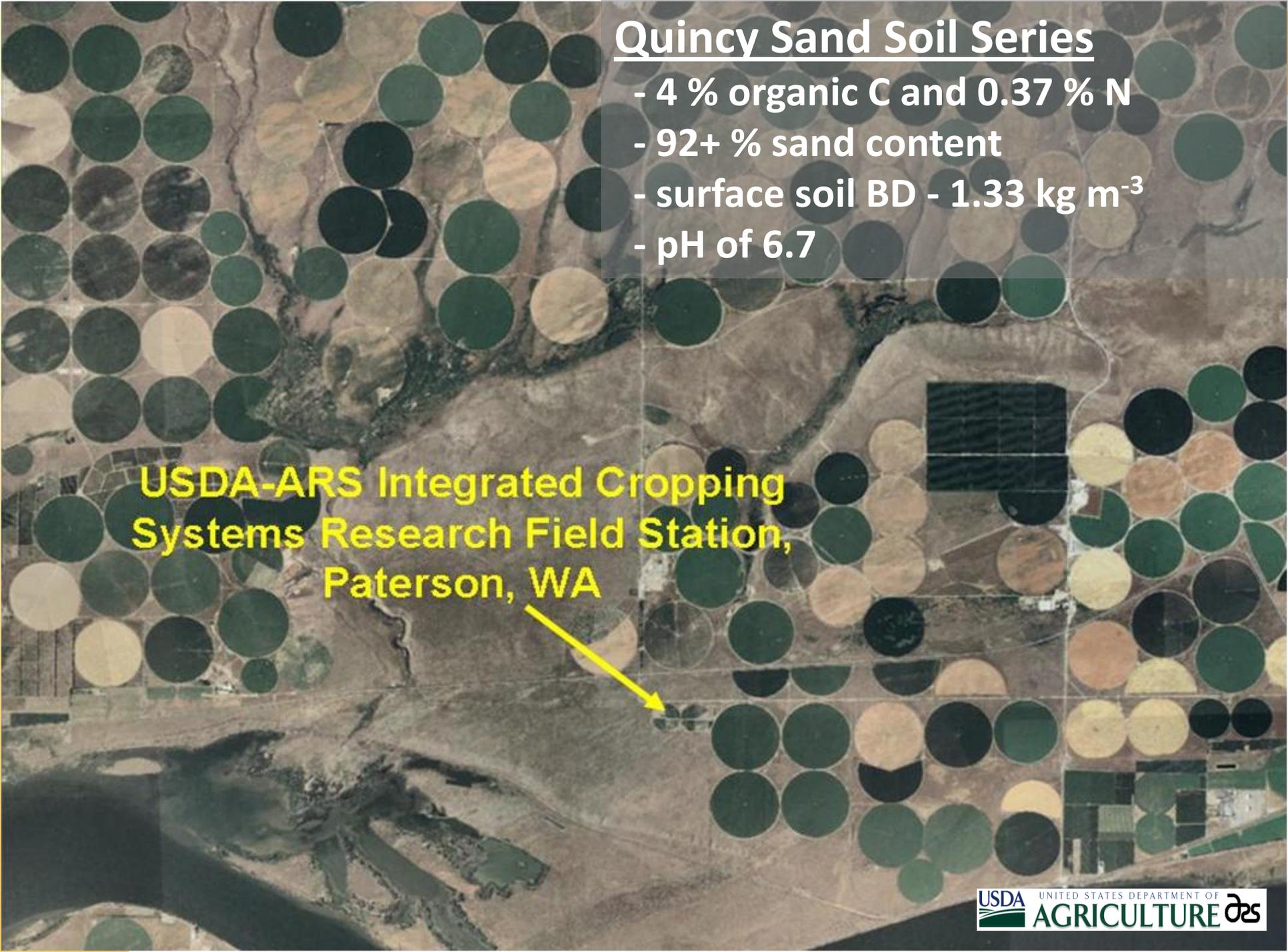
Irrigation	Soil Water Depletion (4 ft profile)	Precipitation Crop Season	Applied Irrigation Water	Total Water Use
2006	-----	inches/acre	-----	
Full	8.6	1.8	9.0	19.4
Deficit	<u>9.5</u>	<u>1.8</u>	<u>6.9</u>	<u>18.2</u>
Difference	+0.9	0	-2.1	-1.2
2007				
Full	3.2	0.5	24.0	27.7
Deficit	<u>3.4</u>	<u>0.5</u>	<u>19.5</u>	<u>23.4</u>
Difference	+0.2	0	-4.5	-4.3

- Deficit irrigation was 80% of full irrigation.
- Stored soil water contributed 0.2 – 1.0 inches to the canola crop under deficit irrigation.
- Actual water savings was 1.2 - 4.3 inches/acre.
- We did not measure total crop biomass, only seed yield.

Quincy Sand Soil Series

- 4 % organic C and 0.37 % N
- 92+ % sand content
- surface soil BD - 1.33 kg m^{-3}
- pH of 6.7

**USDA-ARS Integrated Cropping
Systems Research Field Station,
Paterson, WA**

An aerial photograph of a research field station. The image shows a large area of land divided into numerous circular plots, some of which are planted with crops. A yellow arrow points from the text 'USDA-ARS Integrated Cropping Systems Research Field Station, Paterson, WA' to a specific area in the field. The background is a mix of brown and green, indicating different soil types and crop growth.

Oilseed Irrigation Trials: Water Use

• Safflower Variety Trials (Paterson)

Varieties – CW99OL, S345, S334

Seeding rate – 25 lbs/acre

Row spacing – 9 inches (Tye drill)

Seeding depth – 1 inch

Date of seeding – late May – early April

Fertilizer rates – 100 and 150 lbs/acre

Irrigation water - Full (24 in); Deficit (17 in)

30% reduction in irrigation



Figure 1. Irrigation and N fertilizer rate applications delivered through center pivot irrigation.



Safflower Variety Trial: Water Use

Table 1. Yield of safflower and water use at the USDA-ARS Field Station near Paterson, Benton County, WA.

		Full Irrigation				Deficit Irrigation			
N rate (lb/ac)		100		150		100		150	
Yield		lb/ac/in		lb/ac/in		lb/ac/in		lb/ac/in	
		lb/ac	Water	lb/ac	Water	lb/ac	Water	lb/ac	Water
Cw99OL	08'	3103	103	3084	103	3250	135	3026	126
	09'	2547	86	2419	81	2819	113	2212	89
	10'	<u>3040</u>	<u>129</u>	<u>2877</u>	<u>109</u>	<u>2934</u>	<u>118</u>	<u>3105</u>	<u>125</u>
	Average	2897	106	2793	98	3000	122	2781	113
S345	08'	3370	112	3017	101	3557	148	3326	139
	09'	2326	78	2982	100	2793	112	2383	95
	10'	<u>3028</u>	<u>103</u>	<u>3068</u>	<u>104</u>	<u>2871</u>	<u>115</u>	<u>3361</u>	<u>135</u>
	Average	2908	98	3022	102	3074	125	3023	123
S 334	08'	----	----	----	----	----	----	----	----
	09'	----	----	----	----	----	----	----	----
	10'	2936	100	2390	81	2978	120	2822	113

- Full irrigation = 24 in/acre; Deficit irrigation = 17 in/acre
- Irrigation water savings: 7 in/acre.
- No statistical difference in yield between irrigation levels.
- Yield per water used is based on soil storage, precipitation and irrigation applied
- Greater yield per inch of water applied under deficit irrigation.

Safflower Variety Trial: Water Use

Table 2. Average available soil water and water use by safflower at the USDA-ARS Field Station near Paterson, Benton County, WA.

Irrigation	Start	End	Soil	Precip.	Applied	Total
	Season	Season	Water	Crop	Irrigation	Water
	Soil Water	Soil Water	Depletion	Season	Water	Use
	----- inches/acre -----					
Full	11.6	8.1	3.5	2.5	23.5	29.5
Deficit	<u>12.5</u>	<u>6.8</u>	<u>5.7</u>	<u>2.5</u>	<u>16.7</u>	<u>24.9</u>
Difference	+0.9	+1.3	+2.2	0	-6.8	-4.6

- Stored soil water contributed 5.7 inches to the safflower crop under deficit irrigation.
- Actual water savings was 4.6 inches/acre.
- We did not measure total crop biomass, only seed yield.

Oilseed Irrigation Trials: Water Use

- **Camelina Variety Trials (Paterson)**

Varieties – Blaine, Calena, Ligena, Sunesen

Seeding rate – 3 lbs/acre

Row spacing – 9 inches

Seeding depth – 1/2 inch

Date of seeding – Late March – Early April

Fertilizer N rates - 50 and 75 lbs/acre

Irrigation water – Full (18 in); Deficit (14 in)
20% reduction in irrigation



Figure 3. Irrigation and N fertilizer rate applications delivered through center pivot irrigation.



Camelina Variety Trial: Water Use

Table 1. 2010 yield trials of camelina and water use at the USDA-ARS Field Station near Paterson, Benton County, WA.

N rate	Full Irrigation				Deficit Irrigation			
	50 (lb/ac)		75 (lb/ac)		50 (lb/ac)		75 (lb/ac)	
	lb/ac/in		lb/ac/in		lb/ac/in		lb/ac/in	
Yield	lb/ac	Water	lb/ac	Water	lb/ac	Water	lb/ac	Water
Blaine	1376	64	1530	70	1260	70	1398	78
Calena	1579	73	1791	83	1396	78	1775	99
Ligena	2223	103	1920	89	1561	87	2087	117
Sunesen	<u>1404</u>	<u>65</u>	<u>1433</u>	<u>65</u>	<u>1316</u>	<u>74</u>	<u>1616</u>	<u>90</u>
Average	1646	76	1669	77	1383	77	1719	96

- Full irrigation = 18 in/acre; Deficit irrigation = 14 in/acre
- Irrigation water savings: 4 in/acre.
- No statistical difference in yield between irrigation levels. STDEV range 200-500 lb/ac.
- Maybe a yield response to fertilization.
- Yield per water used is based on soil storage, precipitation and irrigation applied
- Greater yield per inch of water applied under deficit irrigation.

Camelina Variety Trials: Water Use

Table 2. Average available soil water and water use by camelina at the USDA-ARS Field Station near Paterson, WA.

Irrigation	Soil Water Depletion (4 ft profile)	Precipitation Crop Season	Applied Irrigation Water	Total Water Use
	----- inches/acre -----			
Full	1.8	2.5	17.5	21.9
Deficit	<u>1.5</u>	<u>2.5</u>	<u>13.8</u>	<u>17.9</u>
Difference	-0.3	0	-3.7	-4.0

- Stored soil water contributed 1.5 inches to the camelina crop under deficit irrigation.
- Actual water savings was 4.0 inches/acre.
- We did not measure total crop biomass, only seed yield.

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- ✓ **Soil moisture should be maintained above 50% available moisture in the active root zone (4 ft).**
- ✓ **After planting avoid soil crusting with light frequent applications until the crop has fully emerged.**
- ✓ **Once the crop reaches the vegetative state irrigate to replace ET losses. Canola uses up to 19 in of water a season and over 0.3 in/day during peak periods.**
- ✓ **Most critical times for irrigation are during late vegetative, spiking and throughout the flowering period. Keep irrigating until flowering stops.**
- ✓ **Irrigation should end by pod and seed-fill or when leaves drop, typically a month before harvest.**



Photo B. Hopkins U of Idaho

Questions?