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Colorado State University

Agricultural Experiment Station

College of Agricultural Sciences | Department of Soil and Crop Sciences | Plainsman Research Center | Extension

Plainsman Research Center 2015 Research Reports

For a full list of authors for this research report refer to the personnel with projects page

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This Plainsman Research Center booklet is dedicated to:

The Neill Foundation Board:

James Hume, Corwin Brown, Doyle Wilson, Pat Cooper, and Larry Bishop

The Neill Foundation's generous grant will keep Plainsman abreast of technological advancements in agricultural practices. Updating our equipment will make farming at Plainsman more timely, more precise, and more relevant. Thank you.

We think Bernard would be proud of your funding decision. Bernard was, and still is, a huge supporter of Plainsman.

Plainsman Research Center, 2015 Research Reports

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2015 Climatological Summary
Plainsman Research Center

Month	Temperature Max. F	Min. F	Max. Mean F	Min. Mean F	Precip. In.	Greatest Day of Precip-atation	Snow-Fall In.	Greatest Snow Depth In.	Average Soil Temp.
Jan.	69	-2	46.1	19.9	0.85	0.62	3.00	2.50	31.80
Feb.	80	3	48.8	21.1	1.10	0.52	12.70	6.00	35.89
Mar.	85	10	61.4	29.4	0.40	0.28	0.00	0.00	41.87
Apr.	84	25	70.6	37.7	0.77	0.33	0.00	0.00	52.73
May	86	33	71.5	45.6	5.64	1.92	0.00	0.00	56.97
Jun.	102	52	89.3	59.9	1.75	1.11	0.00	0.00	71.16
Jul.	101	53	91.3	63.3	5.54	2.03	0.00	0.00	77.16
Aug.	99	51	90.1	61.5	2.68	1.46	0.00	0.00	73.94
Sept.	101	45	88.3	56.7	1.05	0.52	0.00	0.00	71.87
Oct.	92	33	71.9	45.0	2.93	1.91	0.00	0.00	58.68
Nov.	81	14	54.3	27.9	1.55	0.75	7.00	5.00	41.87
Dec.	70	8	43.5	22.7	0.92	0.67	5.90	3.50	32.87
Total Annual			**68.9**	**40.88**	**25.18**		**28.60**		

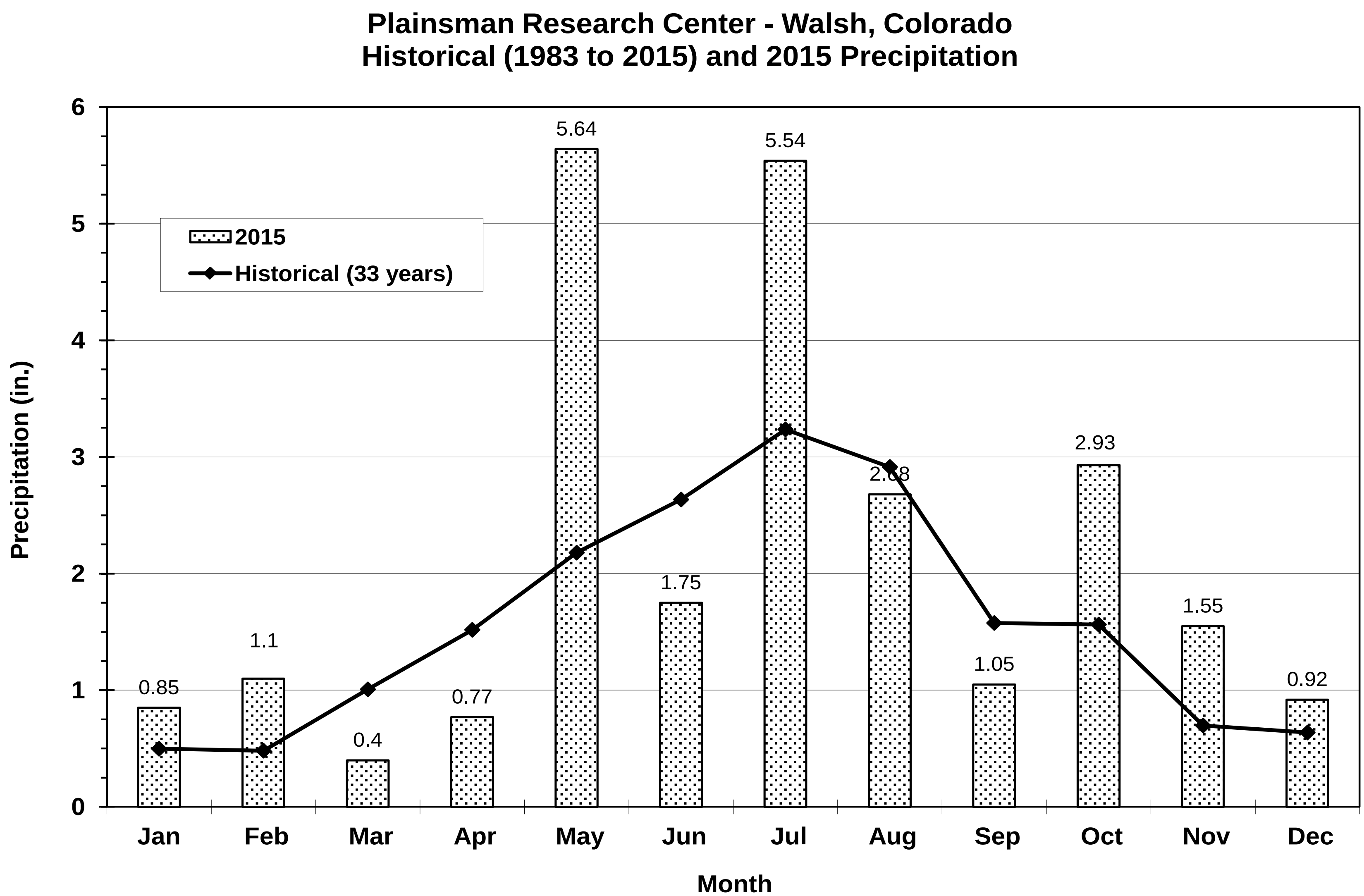
*** NOTE: Evaporation read April 15 through October 15th.
Wind velocity is recorded at two feet above ground level.
Total evaporation from a four foot diameter pan for the period indicated.

	2015	2014
Highest Temperature:	102 F on June 22	107 F on July 26
Lowest Temperature:	-2 F on January 1	-10 F on January 6
Last freeze in spring:	30 F on April 27	32 F on May 14
First freeze in fall:	31 F on Nov. 6	32 F on Oct. 29
Frost free season:	193 frost free days	168 frost free days

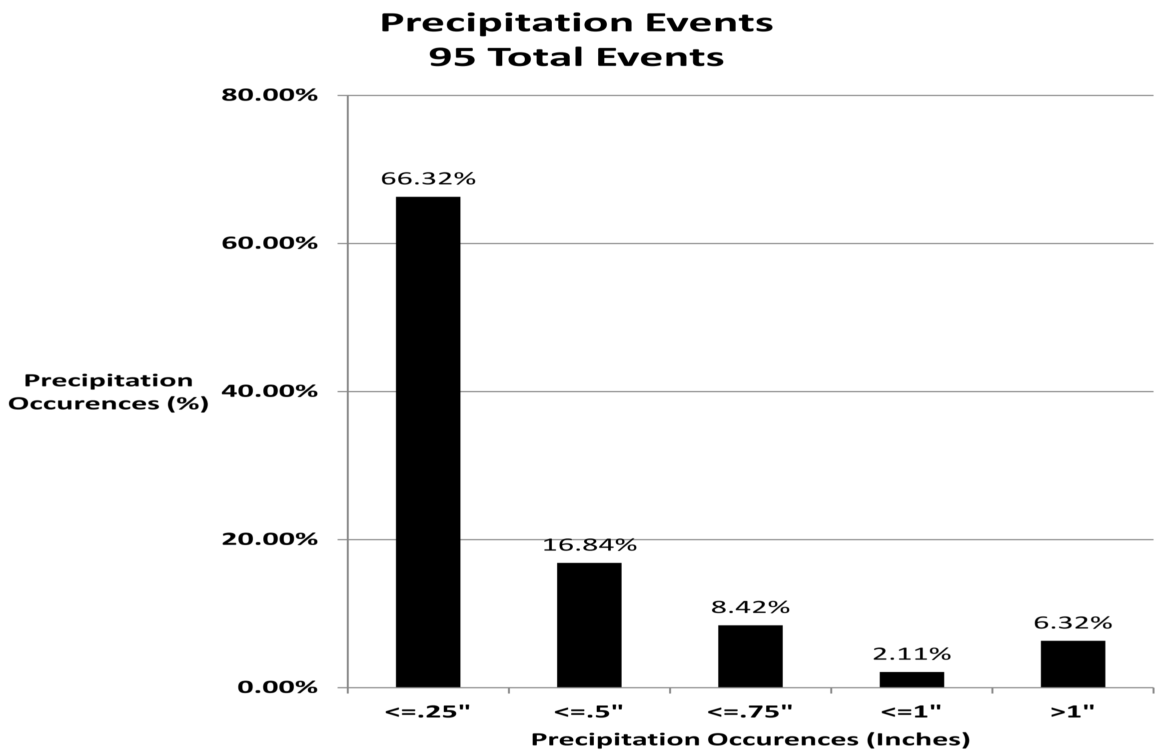
Avg. Precip for 33 years: 18.77 in.

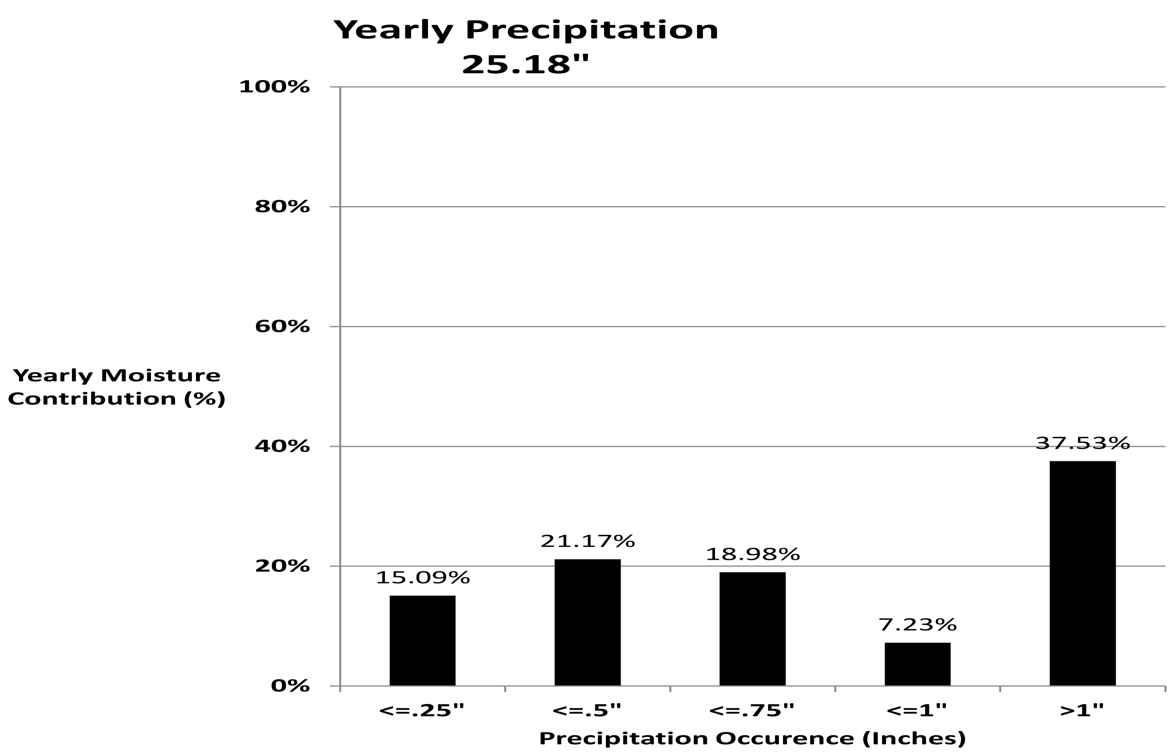
Maximum Wind:

Jan.	40 mph on 4th	July.	41 mph on 28th
Feb.	36 mph on 1st	Aug.	41 mph on 28th
Mar.	36 mph on 3rd	Sept.	46 mph on 19 & 20th
Apr.	46 mph on 3rd	Oct.	52 mph on 4th
May	42 mph on 16th	Nov.	47 mph on 18th
Jun.	40 mph on 12th	Dec.	46 mph on 27th



Plainsman Research Center - Walsh, Colorado
Historical (1983 to 2015) and 2015 Precipitation
2015
Historical (33 years)
Precipitation (in.)
0
1
2
3
4
5
6
0.85
1.1
0.4
0.77
5.64
1.75
5.54
2.68
1.05
2.93
1.55
0.92
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Precipitation Events
95 Total Events
80.00%
60.00%
40.00%
20.00%
0.00%
Precipitation Occurences (%)
66.32%
16.84%
8.42%
2.11%
6.32%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurences (Inches)


Yearly Precipitation
25.18"
100%
80%
60%
40%
20%
0%
Yearly Moisture Contribution (%)
15.09%
21.17%
18.98%
7.23%
37.53%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurence (Inches)

Variety Performance in the 2015 Eastern Colorado Winter Wheat Trials

Jerry Johnson and Scott Haley

Colorado State University faculty, staff, and students work tirelessly throughout the year to provide current, reliable, and unbiased wheat variety information to Colorado producers. We are fortunate that farmers really support research in Colorado; research support has kept public variety testing alive and well. Farmer support for public variety testing is our hope for the future. Our work in Colorado is possible due to the support and cooperation of the entire Colorado wheat industry, especially support from the Colorado Wheat Administrative Committee (wheat assessment) and the Colorado Wheat Research Foundation (seed royalties). We have to test under a broad range of environmental conditions to best determine expected performance of new varieties. That is why we have 11 dryland variety performance trials, three irrigated variety performance trials, and 30 on-farm variety tests each year.

We have a uniform variety testing program, meaning that all varieties are tested in all test locations. There were 44 varieties and experimental lines in each of the 11 dryland trials. The three irrigated trials each had 32 varieties and the ~30 collaborative on-farm tests (COFT) each had six varieties. The trials included a combination of public and private varieties and experimental lines from Colorado, Texas, Kansas, Oklahoma, Nebraska, Wyoming, and Montana. Seed companies with entries in the variety trials included WestBred (Monsanto), AgriPro (Syngenta), Limagrain Cereal Seeds, AGSECO, Adaptive Genetics, and Watley Seed Company. There were entries from five marketing organizations: PlainsGold (Colorado), Husker Genetics (Nebraska), the Crop Research Foundation of Wyoming, Oklahoma Genetics, and the Kansas Wheat Alliance. All dryland and irrigated trials were planted in a randomized complete block design with three replicates. Plot sizes were approximately 175 ft2 (except the Fort Collins IVPT, which was 80 ft2) and all varieties were planted at 700,000 seeds per acre for dryland trials and 1.2 million seeds per acre for irrigated trials. Plot sizes for the COFT ranged from 0.5 to 1.5 acres per variety for the six varieties for three to nine total acres and seeding rates conform to the wheat seeding rate of the collaborating farmer. Yields were corrected to 12% moisture. Variety trial test weight information was obtained from a Harvest Master weighing system on the plot combine.

General Growing Season Comments

The 2014-2015 growing season can be characterized by two primary factors:

1. Enormous variation in temperatures
2. Rain (Stripe rust!)

The summer of 2014 was relatively cool and wetter than normal, contributing to over-summering of mite and insect pests that caused significant virus problems in many areas (barely yellow dwarf virus and wheat streak mosaic virus). The fall was much warmer than normal and set some records. Planting conditions were good with some exceptions in the Southeast. There was very lush growth in some variety trials due to moisture and favorable temperatures. We had generally high temperatures during the month of October. On November 10, things got cold with record low temps on November 13 (November 12-17 was very cold). Eastern Colorado experienced very cold temps again in late January, down to -20°F. There was widespread snow in early February. Very warm temperatures occurred around February 11 and set some records.

Eastern Colorado experienced a very dry winter in general. On March 16, the temperatures warmed into the low 80s. There was good statewide precipitation around April 16-19, and again from April 25-27. Stripe rust was found at Roggen on April 30. There were widespread cool and cloudy conditions during the week of May 3. It was very cold the night of May 9 and again the night of May 10, which caused extensive freeze damage in some areas north of I-70. On May 20 many locations saw air temperatures in the upper 20s, causing freeze damage to headed wheat plants in some fields. The month of May was really wet, with some areas receiving 12 inches or more of precipitation. We saw high temperatures from mid-June up until harvest.

Significant winter injury was noted at several locations (Burlington, Akron, and Yuma) with lesser winterkill at some other locations (Arapahoe, Julesburg, and Orchard). Winter injury appeared to be associated with drought tolerance, and presumably, root growth. Varying degrees of winterkill occurred from near 100% loss to burned tips of leaves. Many fields suffered winterkill on more than one event. Very high precipitation and cool temperatures in the month of May created very good conditions for the spread of stripe rust and other fungal pathogens that are very atypical for eastern Colorado (i.e., stagnospora glume blotch, and Fusariam head blight).

General Growing Conditions in Southeast Colorado - Wilma Trujillo

For the first time in several years, southeastern Colorado wheat producers planted into adequate moisture. Rains in August restored farmers' hope after continuous losses from drought. This led to an increase in the wheat acreage planted in 2014. While adequate topsoil moisture provided a better seed bed for farmers to drill into, the subsoil moisture profile was still low.

The weather conditions have been the biggest challenge for producers in this area. Although the planting conditions were positive, a successful crop still depends on weather conditions during the entire growing season. The fall months were characterized by wet and warm conditions. Precipitation was slightly above the 30-year normal. October was unusually warmer than it has been in previous years. Precipitation and warm temperatures were beneficial for wheat germination and emergence. Some concerns were expressed regarding warm temperatures leading to advanced growth of early planted wheat and its high water use. November started with frigid weather conditions across Southeastern Colorado. There were some concerns expressed over wheat winterkill. During December and most of the winter months, producers remained concerned about wheat conditions, as a consequence of hard freezes, particularly in areas where advanced growth of the crop was observed. The weather patterns with cold temperatures also brought snow that helped insulate and protect the wheat crop from excessive winterkill.

Wheat began breaking dormancy in early March. As warm temperatures and dry conditions prevailed, moisture stress was observed in several locations across Southeastern Colorado. During April, dry conditions persisted and dry pockets in wheat fields became more pronounced where no replenishing moisture events occurred. As dry conditions prevailed, outbreaks of army cutworms, pale western cutworms, and false wireworms significantly affected a great percentage of wheat fields. Severity of the insect pressure ranged from minor to severe. May was characterized by widespread precipitation events. May 2015 is considered to be the wettest month on record for Southeastern Colorado. Accumulated precipitation ranged from 5.64 inches at Walsh to 9.25 inches at Eads. Also, May was marked by cooler temperatures. The wet and cool conditions were favorable for the development of stripe rust. Damage to wheat from stripe rust ranged from very mild to severe depending on the variety and the amount of inoculum present. June started with strong thunderstorms and localized hail associated with several storm systems. The abundance of heat and moisture generally improved wheat conditions. However, persisting stripe rust and other fungal diseases on wheat were still observed where surplus soil moisture and cool temperatures occurred in greater frequency.

Harvesting activities gradually began in the last week of June. In early July, producers made significant progress in harvesting wheat in the midst of scattered precipitation. In Southeastern Colorado, wheat harvest was wrapped up by the third week of July. Yield ranged from 10 bu/ac to 84 bu/ac throughout Southeastern Colorado. Test weight also varied from 54 lb/bu in poor fields to 62 lb/bu in good fields. Many wheat producers reported higher yields than expected. Yield variability could be attributed to the weather pattern during the growing season, selection of adapted wheat varieties, and pest and disease control timings.

2015 Dryland Winter Wheat Variety Performance Trial at Lamar

Variety	Brand/Source	Yield	Test Weight[a]	Plant Height
		bu/ac	lb/bu	in
CO11D1353	Colorado State Univ. exp.	38.2	56.8	21
CO11D1397	Colorado State Univ. exp.	37.9	59.5	23
CO11D1236	Colorado State Univ. exp.	37.3	57.5	21
CO11D174	Colorado State Univ. exp.	37	58.5	21
CO11D1539	Colorado State Univ. exp.	36.9	54.3	23
Antero	PlainsGold	36.5	57.5	21
CO11D1298	Colorado State Univ. exp.	34.5	57.4	22
CO11D1306W	Colorado State Univ. exp.	34.4	58	21
LCS Mint	Limagrain	34	56.4	22
Byrd	PlainsGold	33.4	60.8	21
LCH13DH-5-59	Limagrain exp.	32.9	56.1	22
CO11D1316W	Colorado State Univ. exp.	31.8	56.9	25
CO11D1767	Colorado State Univ. exp.	31.8	56.2	20
TAM 112	Watley Seed	30.3	60.8	18
Denali	PlainsGold	29.9	56	22
SY Monument	AgriPro Syngenta	29.6	56.8	21
CO11D1174	Colorado State Univ. exp.	29.4	54.1	22
CO11D446	Colorado State Univ. exp.	28.9	58.4	19
TAM 113	AGSECO	28.8	57.8	19
Cowboy	Crop Res. Found. of WY	27.7	57.6	21
Iba	Oklahoma Genetics	27.4	52.5	19
KS11HW39-5-4	Kansas State Univ. exp.	27.4	58.1	20
Snowmass	PlainsGold	27.3	54.4	22
TAM 204	Watley Seed	26.6	-	20
Winterhawk	WestBred Monsanto	26.4	-	22
SY Wolf	AgriPro Syngenta	26.4	52.3	19
Hatcher	PlainsGold	26.3	55.4	19
Akron	Colorado State Univ.	26.3	54.7	18
Settler CL	Husker Genetics	25.7	-	18
Oakley CL	Kansas Wheat Alliance	25.6	50	17
KanMark	Kansas Wheat Alliance	25.3	54.7	17
Bearpaw	Montana State Univ.	24.7	54	21
Prairie Red	PlainsGold	24.6	57.8	17
TAM 114	Adaptive Genetics	24.5	57.2	19
Gallagher	Oklahoma Genetics	24.5	-	19
Above	PlainsGold	23.7	-	20
T158	Limagrain	23.2	56.5	18
Sunshine	PlainsGold	23.2	-	19
Ripper	PlainsGold	22.2	-	17
WB-Grainfield	WestBred Monsanto	22.1	-	19
NE10589	Univ. of Nebraska exp.	21.2	-	19
LCS Pistol	Limagrain	19.6	-	18
MTS1024	Montana State Univ. exp.	18.5	-	22
Brawl CL Plus	PlainsGold	17.8	-	21
	Average	**28.2**	**56.4**	**20**
	[b]LSD ($P<0.30$)	3.3		

[a]Test weight could not be measured in a large number of plots due to insufficient grain.
[b]If the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Site Information

Cooperators:	Jensen and John Stulp
Harvest date:	June 30, 2015
Planting date:	September 15, 2014
Fertilizer:	Starter: N at 8 lb/ac and P at 28 lb/ac; Fall: 8-28-0
Herbicide:	2,4-D and Ally
Pesticide:	Lorsban, dimethoate, and Warrior for control of brown wheat mites and worms.
Stripe Rust:	Present in trial and surrounding field, but not significant. Did not spray.
General Comments:	Good moisture at planting, survived winter well, had significant drought stress symptoms in early April. Cutworms were present.

2015 Dryland Winter Wheat Variety Performance Trial at Sheridan Lake

Variety	Brand/Source	Yield	Stripe Rust	Plant Height
		bu/ac	score (1-9)[a]	in
KS11HW39-5-4	Kansas State Univ. exp.	86.7	1	35
Oakley CL	Kansas Wheat Alliance	85.6	1	30
CO11D1539	Colorado State Univ. exp.	77.7	3	32
Antero	PlainsGold	74.7	2	31
CO11D446	Colorado State Univ. exp.	74.2	2	31
WB-Grainfield	WestBred Monsanto	74.1	2	30
CO11D1353	Colorado State Univ. exp.	69.5	6	37
CO11D1767	Colorado State Univ. exp.	69.4	1	32
LCS Mint	Limagrain	68.8	4	35
NE10589	Univ. of Nebraska exp.	68.3	3	34
TAM 204	Watley Seed	67.7	3	32
Sunshine	PlainsGold	67.4	4	31
CO11D1236	Colorado State Univ. exp.	66.7	6	36
Iba	Oklahoma Genetics	66.7	4	32
TAM 114	Adaptive Genetics	65.5	2	32
Hatcher	PlainsGold	65.4	4	34
TAM 113	AGSECO	65.3	2	35
LCS Pistol	Limagrain	64.6	5	26
Byrd	PlainsGold	62.3	6	36
CO11D174	Colorado State Univ. exp.	62.1	6	35
Winterhawk	WestBred Monsanto	62.1	3	33
SY Wolf	AgriPro Syngenta	61.4	2	30
T158	Limagrain	61.2	2	30
CO11D1306W	Colorado State Univ. exp.	60.8	5	35
SY Monument	AgriPro Syngenta	60.1	3	32
Brawl CL Plus	PlainsGold	59.5	7	31
Gallagher	Oklahoma Genetics	58.3	1	33
Settler CL	Husker Genetics	58.1	6	32
Snowmass	PlainsGold	58	6	36
KanMark	Kansas Wheat Alliance	57.2	5	26
TAM 112	Watley Seed	56.4	6	33
CO11D1397	Colorado State Univ. exp.	56.3	7	31
Denali	PlainsGold	55.9	7	36
Akron	Colorado State Univ.	52.3	8	37
CO11D1316W	Colorado State Univ. exp.	51.7	8	32
Above	PlainsGold	50.9	7	28
Cowboy	Crop Res. Found. of WY	48.4	7	33
Prairie Red	PlainsGold	46.2	7	31
CO11D1298	Colorado State Univ. exp.	45.9	5	34
CO11D1174	Colorado State Univ. exp.	43.4	8	31
Ripper	PlainsGold	40.6	8	29
LCH13DH-5-59	Limagrain exp.	39.6	6	36
MTS1024	Montana State Univ. exp.	32.6	3	29
Bearpaw	Montana State Univ.	24.1	6	31
	Average	**60.1**	**4**	**32**
	[b]LSD ($P<0.30$)	5.7		

[a]Stripe rust score: 1 equals no stripe rust and 9 equals severe stripe rust infection.
[b]If the difference between two variety yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.
†Test weight could not be measured accurately.

Site Information

Cooperator:	Burl Scherler
Harvest date:	June 30, 2015
Planting date:	September 15, 2014
Fertilizer:	Starter: N at 8 lb/ac and P at 28 lb/ac; Spring: N at 38 lb/ac and S at 7 lb/ac
Herbicide:	2,4-D and Ally
Pesticide:	None
Stripe Rust:	Did not spray. Had low levels of rust initially, then received 3" of rain over 6 day period in May and rust levels increased significantly.
General Comments:	Had good stands in spring, no winter injury. Received good spring moisture, although it came late. Barley Yellow Dwarf Virus was widespread in trial. Brown wheat mite and Army cutworms were present.

Summary of 2-Year (2014-2015) Dryland Variety Performance Results

			2-Year Average[a]			
Variety[b]	Brand/Source	Market Class[c]	Yield	Yield	Test Weight	Plant Height
			bu/ac	% trial average	lb/bu	in
Antero	PlainsGold	HWW	69.5	120%	59.4	30
SY Monument	AgriPro Syngenta	HRW	65.4	113%	59.9	29
Oakley CL	Kansas Wheat Alliance	HRW	65.1	113%	59	28
Denali	PlainsGold	HRW	63.3	110%	60.7	30
CO11D174	Colorado State Univ. exp.	HRW	63	109%	59.7	31
CO11D446	Colorado State Univ. exp.	HRW	62	107%	60.3	27
WB-Grainfield	WestBred Monsanto	HRW	60.6	105%	60.4	30
SY Wolf	AgriPro Syngenta	HRW	60.5	105%	58.3	28
Byrd	PlainsGold	HRW	60.1	104%	60	30
Cowboy	Crop Res. Foundation of WY	HRW	60	104%	59.2	29
Winterhawk	WestBred Monsanto	HRW	60	104%	60.8	30
LCS Mint	Limagrain	HRW	59.9	104%	59.9	30
Sunshine	PlainsGold	HWW	58.8	102%	58.2	28
LCS Pistol	Limagrain	HRW	58.4	101%	59.4	28
Settler CL	Husker Genetics	HRW	58.3	101%	57.7	28
Snowmass	PlainsGold	HWW	57.7	100%	59.2	31
Hatcher	PlainsGold	HRW	57.5	100%	58.4	29
KanMark	Kansas Wheat Alliance	HRW	57.3	99%	60.3	25
T158	Limagrain	HRW	55.6	96%	59.5	27
TAM 113	AGSECO	HRW	55.1	95%	58.6	28
Gallagher	Oklahoma Genetics	HRW	54.6	95%	57	27
Iba	Oklahoma Genetics	HRW	54.3	94%	59.3	27
TAM 112	Watley Seed	HRW	54.1	94%	61.3	28
Brawl CL Plus	PlainsGold	HRW	53.5	93%	59.9	29
Above	PlainsGold	HRW	51.8	90%	58.1	28
Akron	Colorado State Univ.	HRW	51.6	89%	58.5	30
Ripper	PlainsGold	HRW	50.6	88%	57.4	27
Prairie Red	PlainsGold	HRW	50.1	87%	58.1	27
Bearpaw	Montana State Univ.	HRW	46.1	80%	57	28
		Average	**57.8**		**59.2**	**28**

[a]The 2-year average yield and plant heights are based on nine 2015 and nine 2014 trials.
Test weights are based on eight 2015 and eight 2014 trials.
[b]Varieties ranked according to average 2-year yield.
[c]Market class: HRW=hard red winter wheat;HWW=hard white winter wheat.

Summary of 3-Year (2013-2015) Dryland Variety Performance Results

			3-Year Average[a]			
Variety[b]	Brand/Source	Market Class[c]	Yield	Yield	Test Weight	Plant Height
			bu/ac	% trial average	lb/bu	in
Antero	PlainsGold	HWW	57.8	120%	58.6	28
Oakley CL	Kansas Wheat Alliance	HRW	54.1	112%	58.4	26
Denali	PlainsGold	HRW	52.6	109%	59.7	29
Byrd	PlainsGold	HRW	50.8	105%	58.8	28
WB-Grainfield	WestBred Monsanto	HRW	50.7	105%	58.9	28
LCS Mint	Limagrain	HRW	50.6	105%	59.4	29
Winterhawk	WestBred Monsanto	HRW	50.3	104%	59.9	28
SY Wolf	AgriPro Syngenta	HRW	50.2	104%	58	27
Settler CL	Husker Genetics	HRW	49.2	102%	56.9	26
Hatcher	PlainsGold	HRW	47.7	99%	57.8	27
Snowmass	PlainsGold	HWW	47.3	98%	57.8	29
T158	Limagrain	HRW	47	97%	58.3	26
Iba	Oklahoma Genetics	HRW	46.2	96%	58.6	25
TAM 113	AGSECO	HRW	46.2	96%	57.8	27
TAM 112	Watley Seed	HRW	46.1	95%	59.8	27
Gallagher	Oklahoma Genetics	HRW	45.9	95%	56.7	25
Brawl CL Plus	PlainsGold	HRW	45.8	95%	58.9	28
Above	PlainsGold	HRW	44.2	92%	57.2	26
Ripper	PlainsGold	HRW	43.5	90%	56.6	26
Bearpaw	Montana State Univ.	HRW	38.7	80%	56.8	26
		Average	**48.2**		**58.2**	**27**

[a]The 3-year average yield is based on nine 2015, nine 2014, and seven 2013 trials.
Test weights are based on eight 2015, eight 2014, and five 2013 trials.
Plant heights are based on nine 2015, nine 2014, and six 2013 trials.
[b]Varieties ranked according to average 3-year yield.
[c]Market class: HRW=hard red winter wheat;HWW=hard white winter wheat.

Dryland Wheat Strips for Forage and Grain Yield at Walsh, 2015

Kevin Larson, Brett Pettinger, and Deborah Harn

PURPOSE: To determine which wheat varieties are best suited for dual-purpose forage and grain production in Southeastern Colorado.

MATERIALS AND METHODS: Fourteen wheat varieties were planted on October 7, 2014 at 50 lb seed/a in 20 ft. by 800 ft. strips with two replications. We swept on 50 lb N/a of anhydrous N and seedrow applied 5 gal/a of 10-34-0 (20 lb P_2O_5, 6 lb N/a). Ally Extra 0.3 oz/a and dicamba 4oz/a was sprayed for weed control. Two 2 ft. by 2.5 ft. forage samples were taken at jointing (April 1) and at boot (April 28). We measure the forage for fresh weight, oven-dried the samples, and recorded dry weight at 15% moisture content. The site was sprayed with Lambda Cyhalothorin for cutworm control. A late season infestation of Stripe Rust was evident, but no controlling measures were taken. The site was not harvested for grain due to a severe hailstorm on June 11 that completely destroyed the wheat crop.

RESULTS: Antero had the highest forage yield at jointing, but at boot its forage yield was only average. TAM 111 had the second highest forage yield at jointing and the highest forage yield at boot. There was no grain production because it was hailed out.

DISCUSSION: This year we selected TAM 111 as the best forage wheat of the 14 wheat varieties tested. TAM 111 had the highest forage yield at boot and the second highest forage yield at jointing. We ranked Antero as the second highest forage wheat variety because it had the highest jointing forage and average boot forage. Since there was no grain harvest, we cannot select a true dual purpose variety this year.

Table .Dryland Wheat Strips, Forage and Grain Yield at Walsh, 2015.

Variety	Jointing		Boot		Plant	Test	Grain
	Fresh Wt.	Dry Wt.	Fresh Wt.	Dry Wt.	Height	Weight	Yield
	------------------------lb/a		------------------------		in	lb/bu	bu/a
Antero	8665	2296	18471	5434			
TAM 111	8723	2252	18946	6204			
Byrd (untreated)	8705	2200	16846	5247			
Denali	8697	2137	17999	5579			
COW 293	7157	1987	15509	4799			
Byrd	7189	1948	18053	5748			
Hatcher	6984	1913	17751	5961			
Winterhawk	7074	1859	17083	6142			
Snowmass	7063	1816	15932	5049			
Brawl CL+	6506	1772	18867	6115			
Bill Brown	6746	1771	16458	5275			
TAM 113	5786	1674	16208	5633			
Grainfield	5933	1634	12685	4314			
Mint	6222	1521	14969	4505			
Average	7246	1913	16841	5429	0	0	0
LSD 0.20	1624.8	407.8	2151.2	775.5			

Planted: October 7, 2014; 50 lb seed/a; 5 gal/a 10-34-0.
Jointing sample taken April 1, 2015.
Boot sample taken April 28, 2015.
Wet Weight is reported at field moisture.
Dry Weight is adjusted to 15% moisture content.
There was no grain harvest for this trial due to hail damage.

Dryland Hybrid Rye Performance Trial, Walsh, 2015

COOPERATORS: KWS Cereals USA; Kevin Larson, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To evaluate hybrid ryes under dryland conditions in Southeastern Colorado.

RESULTS: Of the three hybrid ryes and common rye and winter wheat checks tested, none produced grain yields because a hailstorm on June 11 shattered heads and broke over all tillers. Winter survival rates were 100% for all treatments.

PLOT: Twelve rows with 12 in. row spacing, 35 ft. long with 3 replications. SEEDING DENSITY: 800,000 seeds/a and 1,000,000 seeds/a. PLANTED: September 23, 2014.
HARVESTED: Not harvested because it was destroyed by hail.
SITE PEST CONTROL: Ally Extra 0.4 oz/a, 2,4-D ester 0.38 lb/a, dicamba 1.5 oz/a, Activator 90 4 oz/a. INSECTICIDE: Lambda Cyhalothorin for cutworm control.
FIELD HISTORY: Last Crop: Fallow (Wheat-Fallow rotation).
FIELD PREPARATION: No-till.

COMMENTS: Planted in adequate soil moisture for seed germination and stand establishment. The nine month growing season was wetter than average from October through June, mostly because May was very wet. Plant stands were good and no winterkilling was observed for any of the rye hybrids, nor was there winterkilling in the common rye and wheat checks.

SOIL: Silt loam for 0-8” and Silt loam 8”-24” depths from soil analysis.
FERTILITY: Streamed 28-0-0 at 50 lb/a in the fall and seedrow applied 5 gal/a of 10-34-0 at planting.

Table. Precipitation: October 2014 to June 2015.

	--------------Monthly Total Preciptation (inches)------------									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Total**
Precipitation	1.27	0.51	1.49	0.85	1.1	0.4	0.77	5.64	1.75	**13.78**

Table .Dryland Hybrid Rye Performance Trial, Walsh, 2015.

Entry	Seeding Rate	Grain Yield	Test Weight	Plant Density	Winter Survival	Flowering Date
	seeds/ac (X1000)	bu/ac	lb/bu	plants/ac	%	date
Bono	800	--	--	741	100	8-May
Bono	1000	--	--	958	100	8-May
Brasetto	800	--	--	726	100	7-May
Brasetto	1000	--	--	886	100	7-May
Guittino	800	--	--	668	100	9-May
Guittino	1000	--	--	857	100	9-May
Common Rye	800	--	--	770	100	27-Apr
Wheat (Byrd)	800	--	--	915	100	9-May
Average		0.0	0.0	815	100	7-May
LSD 0.05				53		

Planted: September 23, 2014; not harvested due to hail damage.

Strip Till and No Till Comparison for Dryland Grain Sorghum Production

Kevin Larson and Brett Pettinger

Grower inquiries on the production of strip till compared to no till for dryland grain sorghum were the impetus for this study. In the Southern High Plains, the predominant planting system for irrigated production of row crops is strip till. For dryland row crop production, no till is a far more common practice than strip till. The main advantage of no till is that it causes the least disruption of residue cover, and thereby, conserves more soil and water than strip till or conventional tillage. However, no-till requires liquid fertilizer, the most expensive nitrogen fertilizer; whereas, strip till allows the use of anhydrous N, the least expense nitrogen fertilizer. Another benefit of strip till is the deeper placement of phosphate fertilizer, which makes the immobile phosphate fertilizer more available for root interception throughout the season compared to no till where phosphate fertilizer is applied with the seed at planting.

Materials and Methods

We conducted this dryland grain sorghum study at the Plainsman Research Center on a site in which the previous crop was wheat. For the strip till treatment, we applied anhydrous N at 50 lb N/a and 10-34-0 at 5 gal/a in eight, 30 in. rows to a depth of 6 in. on February 20, 2015. For the no till treatment, we surface applied liquid 28-0-0 in streams 18 in. apart at 50 lb N/a on March 18, 2015 and seedrow applied 10-34-0 at 5 gal/a at planting. We planted Channel 5C35 at 35,000 seeds/a on June 5, 2015 with a John Deere vacuum planter with eight, 30 in. rows. For post emergence weed control, we applied: Huskie at 16 oz/a and atrazine at 1.0 lb/a. We harvested the 20 ft. wide by 1200 ft. long grain sorghum plots on October 20 with a self-propelled combine and weighed them in a digital scale cart. Grain samples were collected for seed moistures and test weights. Grain yields were adjusted to 14% seed moisture content.

Results and Discussion

The no till treatment produced 5.1 bu/a more than the strip till treatment and this yield difference was significant at the 0.10 alpha level. The cost of 50 lb/a of N fertilizer was $10/a cheaper for strip till with anhydrous N than no till with liquid N (anhydrous cost was $630/ton and liquid 28-0-0 cost was $325/ton); however, custom application cost of strip till was $9.25/a more than boom application for no till ($15/a for strip till and $5.75/a for no till). Since the cost of 10-34-0 at 5 gal/a was the same for both treatments and no application cost was charged for the phosphate fertilizer because applications were performed with the anhydrous N during the strip till operation or with the seed at planting for no till, the total variable cost of no till was only $0.75/a more than strip till. The variable net income of no till was $15.83/a more than strip till primarily due to the higher grain yield of no till (5.1 bu/a @ $3.25/bu). The production cost of dryland grain sorghum using typical N fertilizer rates is nearly equivalent for strip till and no till. The yield advantage of no till compared to strip till under our dryland conditions made no till dryland grain sorghum production more profitable than strip till. Nonetheless, strip till would, no doubt, remain the most profitable treatment for irrigated row crop production due to anhydrous N costing so much less than liquid N and the large amount of N required for irrigated crop production.

Table .-No Till and Strip Till Comparison on Dryland Grain Sorghum at Walsh, 2015.

Tillage Treatment	Grain Yield	N Fertilizer	N Fertilizer Cost	Application Cost	Total Variable Treatment Cost	Variable Net Income
	bu/ac	type	$/50 lb N	$/ac	$/ac	$/ac
No Till	54.5	Liquid (28-0-0)	29.00	5.75	34.75	142.38
Strip Till	49.4	Anhydrous (82-0-0)	19.00	15.00	34.00	126.55
Average	52.0		24.00	10.38	34.38	134.47
LSD (0.20)	3.2					

Strip till: anhydrous N applied February 20, 2015 on 30 in. row spacing at a depth of 6 in.
No till: surface applied liquid 28-0-0 March 18, 2015 in streams 18 in. apart.
Liquid 10-34-0 at 5 gal/ac was applied with the anhydrous N for the strip till treatment and with the seed at planting for the no till treatment.
Anhydrous cost: $630/ton; 28-0-0 cost $325/ton.
Grain sorghum price: $3.25/bu.
Planted Channel 5C35 on June 5 and harvested on October 20, 2015.

Dryland Grain Sorghum Seeding Rates, Walsh, 2015
Brett Pettinger and Kevin Larson

Dryland seeding rates in Eastern Colorado vary greatly based on location and hybrid maturity. The goal of this study is to observe general trends in maturation and yield as seeding rate increases. Similar seeding rate trials have been conducted at Walsh and Brandon, Colorado for many years using a non-singulating plot planter. Past studies at Brandon have shown a generalization that from 20,000 to 70,000 seeds per acre planted, each 10,000 seed increment would represent one day shorter maturity. (Larson and Pettinger 2012, 2013) In the interest of making results of this study more relevant to local producers, it was decided that using a vacuum planter would more accurately mirror the current planting practices used by area farmers planting sorghum on 30 inch spacing.

Materials and Methods

Fertilizer inputs were applied with strip till application of 50 pounds nitrogen per acre via anhydrous ammonia and 5 gallons 10-34-0 per acre. Because of an expected snow event, fertilization was performed on two separate dates (February 20th and March 24th). Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The study was planted on June 10, 2015 using an 8R30 John Deere 7300 vacuum planter equipped with Precision Planting sugar beet seed plates. An early maturing hybrid, Mycogen 1G557, was selected and five different seeding rates: 24.6, 29.7, 37.1, 44.4 and 53.7 seeds/a X 1000 were tested. Two randomized block replications were laid out using eight row strips of approximately 1180 feet in length. Replications were separated by strip till application date in order to preserve data integrity. Tractor speed at planting was held to a constant 4.7 MPH. A .002 acre area was used for stand counts which consisted of equal length observations in planter rows 2 and 5 for replication number one and planter rows 4 and 7 for the second replication. A post emergence herbicide application was done using Huskie, 2-4-D and Atrazine.

Results and Discussion

The plot received 13.73 inches of moisture during the growing season. Two significant hail events were observed. The first was observed on June 11th, caused severe soil crusting and hindered stand emergence. The second was observed on August 16th and caused stripping of leaves and damaged some heads. Yields in this study ranged from 43.2 to 52.2 bushels per acre. Figure 1 illustrates grain yield across the five seeding rates. Statistically this test showed a similar trend to the 2014 seeding rate study for increased yield as seeding rate was increased. (Pettinger and Larson, 2014) However, due to the excessive hail damage in 2015, yield variability was much greater (R^2 in 2014 was 0.952, 2015 R^2 was 0.541). In addition to yield variability, the observed emergence percentage was much lower than normal ranging from 52.85% to 70.05%. These observations demonstrate the detrimental effect of soil crusting caused by the June 11th hail event. See figure 2 for stand counts and emergence percent. No flowering dates were recorded due to the impact of hail events.

References Cited

Pettinger B., K. Larson. 2014. “Dryland Grain Sorghum Seeding Rate and Seed Maturation.” Technical Report, TR-15-2. Colorado Agricultural Experiment Station, CSU.

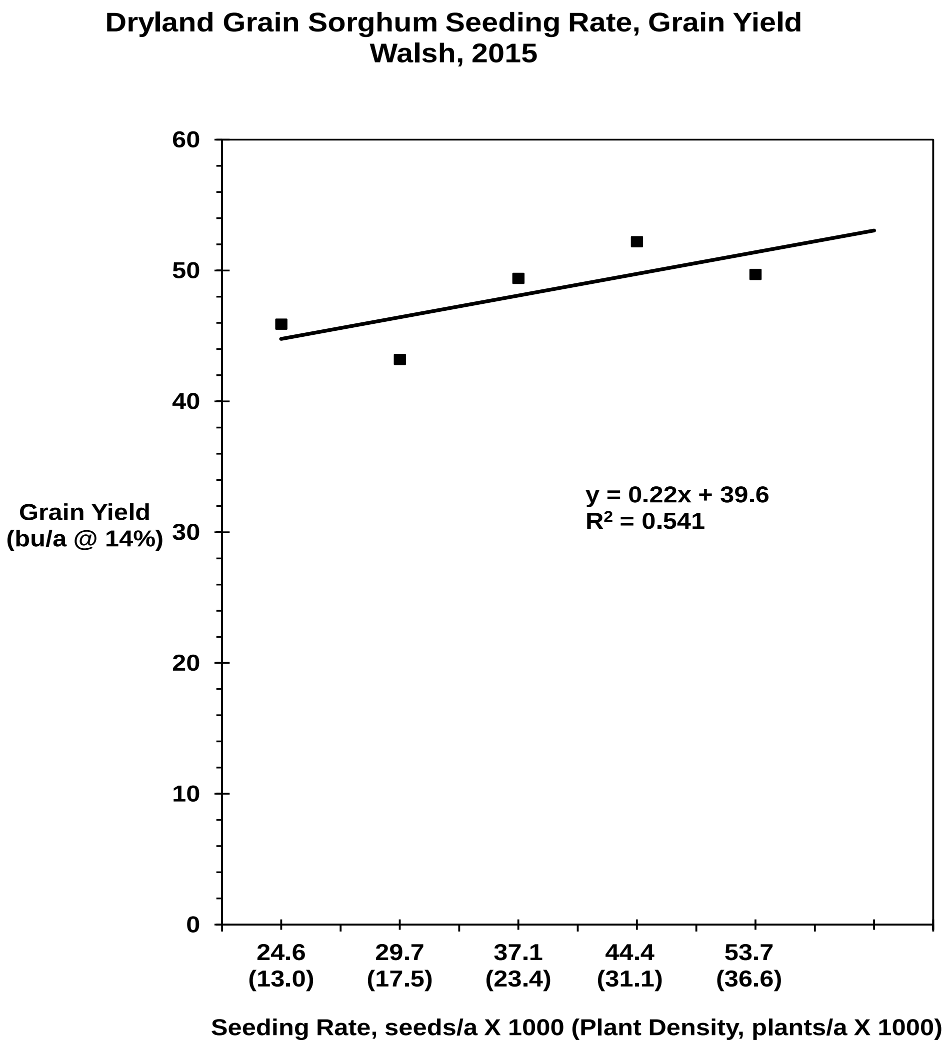


Figure 1-Yield relationship observed in dryland grain sorghum as seeding rate increased. The seeding rates were: 24.6, 29.7, 37.1, 44.4, and 53.7 seeds/acre X 1000. The grain sorghum hybrid was Mycogen 1G557.

Seeding Density	Plant Stand	Emergence
Seeds/Acre	**Plants/Acre**	**Percent**
24600	13000	52.85%
29700	17500	58.92%
37100	23400	63.07%
44400	31100	70.05%
53700	36600	68.16%

Figure 2- Seeding Density and observed stand counts.

Effects of Planting Speed on Dryland Grain Sorghum Production 2015

Brett Pettinger and Kevin Larson

Purpose: To study the effects of vacuum seed meter performance and yield of John Deere and Precision Planting systems based upon planting speed. There have been many studies of a similar nature performed for corn planting which have developed helpful guidelines for planting speeds. The goal of this study is much the same, we would like to develop guidelines to increase planting efficiency in grain sorghum.

Materials and Methods

John Deere and Precision meters were cleaned and calibrated on a Meter Max test stand using Channel 5C35 hybrid seed (13,000 seeds per pound) to determine optimum vacuum setting for each system. Seed plates for both systems were sprayed with graphite lubricant per manufacturer's recommendations. An 8 row John Deere 7300 planter equipped with Precision Planting 20/20 monitor and "Wave-Vision" sensors was used to plant the trial. The planter's ground drive transmission chart was modified in effort to keep planting population as close as possible between the two planting systems given the difference in number of cells on the plates (45 Deere, 60 Precision). A two replication plot was designed using eight row strips of 1187 feet in length. Speed categories of 4.5, 5, 5.5, 6, 6.5 and 7 mph were set to be tested. Field preparation consisted of strip-till application of 50 pounds nitrogen per acre via anhydrous ammonia and 5 gallons 10-34-0 per acre on February 20, 2015. Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The study was planted on June 5, 2015 using Channel 5C35 grain sorghum hybrid. Standard talc was used for seed lubricant on John Deere vac meters, while an 80/20 Talc-Graphite mix was used for Precision Planting meters per manufacturer's recommendation. Vacuum settings were approximately 11 psi for Precision and 6 psi for Deere systems respectively. Due to differences in meter performance and planter transmission settings, seed populations were slightly different. Precision Planting seeded population averaged 31,159 seeds/acre while John Deere averaged 33,794 seeds/acre. Huskie, 2-4-D and Atrazine were combined for one post emergence application.

Overview and Results

The plot received 13.73 inches of rainfall during the growing season. Two hail events were observed. The first on June 11th, caused major soil crusting and effected plant emergence. The second on August 16th, stripped leaves and damaged some heads. Due to the plant spacing variability caused by the first hail, we did not perform stand counts or more detailed plant spacing measurements. The entire study averaged 48.7 bushels per acre. Statistical analysis for both planting systems produced optimum yields between 5.5 and 6 mph planting speeds (53.6 bushels per acre for John Deere and 51.8 bushels per acre for Precision Planting). This observation matches the optimum speed found in the 2014 planting speed study and suggests, even with less than ideal growing conditions, 5.5 mph planting speed is best for an early maturing hybrid with a similar seeded population. (Pettinger and Larson, 2014) There was no significant difference in yield when comparing meter systems from John Deere and Precision Planting. Yield results for both planting systems at the 7.0 mph speed showed an upward trend that was unexpected. Although this is something to monitor in further tests, supportive data is missing for explanation.

Three data sets were retrieved from the Precision Planting 20/20 monitor. The first is singulation. Seed singulation is defined as the seed meter's ability to release one seed at a time. Seed skips and multiples are tabulated to come up with this percentage. The second data set is seeded population, which is simply the number of seeds counted by the sensors on a per acre basis. The third set is referred to as Seed Release Index (SRI). Seed Release Index is a tool used by Precision Planting that indicates the number of seeds in a normal distribution that are within one standard deviation of the target seed spacing. An example population of 31,000 seeds per acre with a 14 SRI would explain that approximately 68% (21,080 seeds per acre) were placed in the soil within 14% (.94 inches) of the target spacing of 6.74 inches. As SRI increases, consistency and accuracy of seed placement drops.

Singulation on Precision Planting meters ranged from 99.5% to 99.8% with the highest percentage occurring at 5 mph. These meters showed a marked increase in skips between 5.5 and 6 mph (.2% to .4%), while the percentage of multiples (.1%) was held constant across all speeds. Seeded population for Precision Planting meters varied by 145 seeds per acre across all speeds. SRI for Precision Planting meters showed a negative relationship to increased planting speed (11.1 for 4.5 mph to 17.5 for 7 mph). Planter data for John Deere vacuum meters did not include the 7 mph category due to tractor operator error. Singulation results for John Deere meters ranged from 96.8% at 4.5 mph to 97.7% at 6.5 mph. This observation can be explained by the decrease of multiples (3% at 4.5 mph to 2.1% at 6.5 mph) as speed increases. This is believed to be caused by the individual plate cells having less time in the seed pool as the plate turns faster. Seeded population for John Deere meters revealed a difference of 317 seeds per acre from 4.5 mph through 6.5 mph. The majority of this difference is caused by the decrease in multiples at higher speeds (0.9% of 33,601 equals 302 seeds). SRI for John Deere meters showed the same negative relationship to speed ranging from 14.5 at 4.5 mph to 19 at 6.5 mph.

Discussion

For the second consecutive year, we have observed negative impacts on yield at 4.5 and 5 mph planting speeds. Based upon evidence of singulation and Seed Release Index, we can be relatively certain that this is not caused by the seed meter, but possibly the planter row unit. Information collected from the 20/20 monitor revealed excessive down pressure at slower speeds (200 pounds or greater) and became less as planting speed increased. The 8 row John Deere 7300 planter used for this test is not equipped with down pressure adjustment tools but simply has springs. Due to a lack of row unit sensors for data reliability, (currently 2 rows of the 8 contain sensors), we can only speculate that this may be the cause. Installing sensors on more row units for next year's test is the recommendation of our research team. This would bring more statistical accuracy to down pressure readings so that we may draw solid conclusions from this data. Performing farmer cooperative tests of a similar nature using a planter equipped with a down pressure regulation system could also help in assuring the most useful planting speed recommendations for grain sorghum producers.

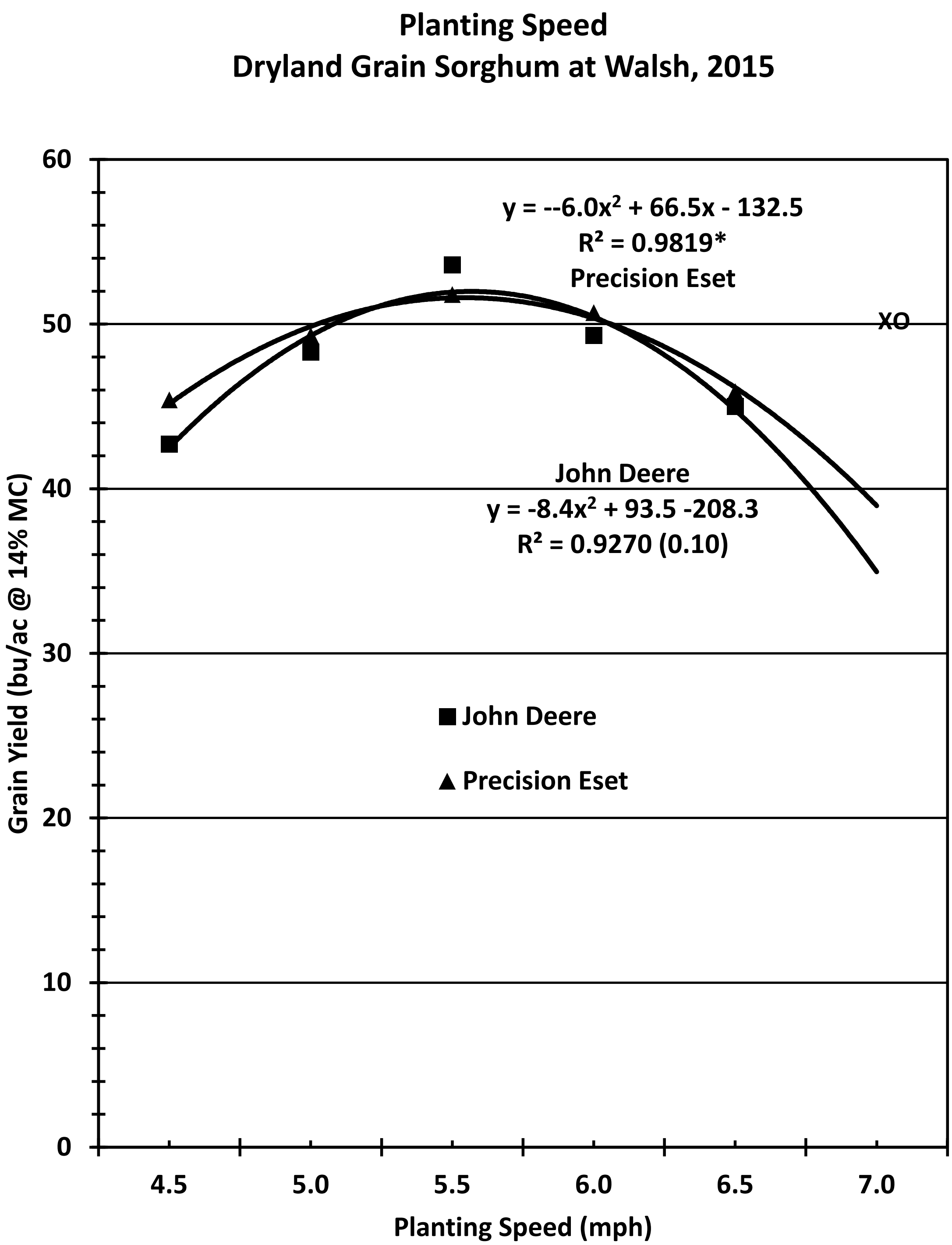
Reference Cited

Pettinger, B., K. Larson. 2014. "Effects of Planting Speed on Dryland Grain Sorghum Production" Technical Report, TR-15-2. Colorado Agricultural Experiment Station, CSU.

SEED METER PERFORMANCE

	Speed	Planted Population	Singulation	Skips	Multiples	SRI
Precision	4.5	31221	99.7	0.2	0.1	11.1
	5	31076	99.8	0.1	0.1	11.8
	5.5	31182	99.7	0.2	0.1	13.2
	6	31176	99.5	0.4	0.1	14.8
	6.5	31158	99.5	0.4	0.1	16.4
	7	31142	99.6	0.4	0.1	17.5
John Deere	4.5	33918	96.8	0.1	3	14.5
	5	33847	97.1	0.2	2.7	14.5
	5.5	33855	97.2	0.1	2.6	15.8
	6	33751	97.6	0.2	2.2	18.4
	6.5	33601	97.7	0.2	2.1	19

Table 1: Seed meter performance retrieved from the planer monitor.



Graph 1: Illustration of grain yield in relation to planting speed for Precision Planting and John Deere vacuum seed meters.

Dryland Grain Sorghum Hybrid Performance Trial at Brandon, 2015

COOPERATOR: Burl Scherler, Sand Creek, Inc., Brandon, Colorado.

PURPOSE: To identify high yielding hybrids under dryland conditions with 2930 sorghum heat units in sandy loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 43,600 seed/a. PLANTED: June 9. HARVESTED: November 3.

PEST CONTROL: Preemergence Herbicides: Valor 3 oz/a, Atrazine 0.9 lb/a, S-Metolachlor 21 oz/a; Post Emergence Herbicides: Ally 0.05 oz/a, 2,4-D amine 0.5 lb/a. Cultivation: None. Insecticides: None.

FIELD HISTORY: Previous Crop: Wheat. FIELD PREPARATION: No-till.

Summary: Growing Season Precipitation and Temperature Chivington, Kiowa County.[a]

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	4.92	509	14	0	21
July	1.28	810	21	8	52
August	1.28	767	23	0	83
September	0.14	638	16	1	113
October	0.03	208	1	0	129
Total	7.65	2932	75	9	129

[a]Growing season from June 9 (planting) to October 16 (first freeze, 25 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture. Weed control was excellent. Precipitation for the growing season was well above the average of the past 29 years. May and June were very wet, but the rest of the monthly precipitation totals for the growing season were below their long term averages. Yields and test weights were excellent.

SOIL: Sandy loam for 0-8” and sandy loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.2	0.3	1.4	2	9.0	363	0.7	8.5
8”-24”				5				
Comment	Alka	VLo	Mod	Lo	Med	VHi	Lo	Lo

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	10	0	2	20
Applied	50	20	0	9

Yield Goal: 40 bu/a.
Actual Yield: 75 bu/a.

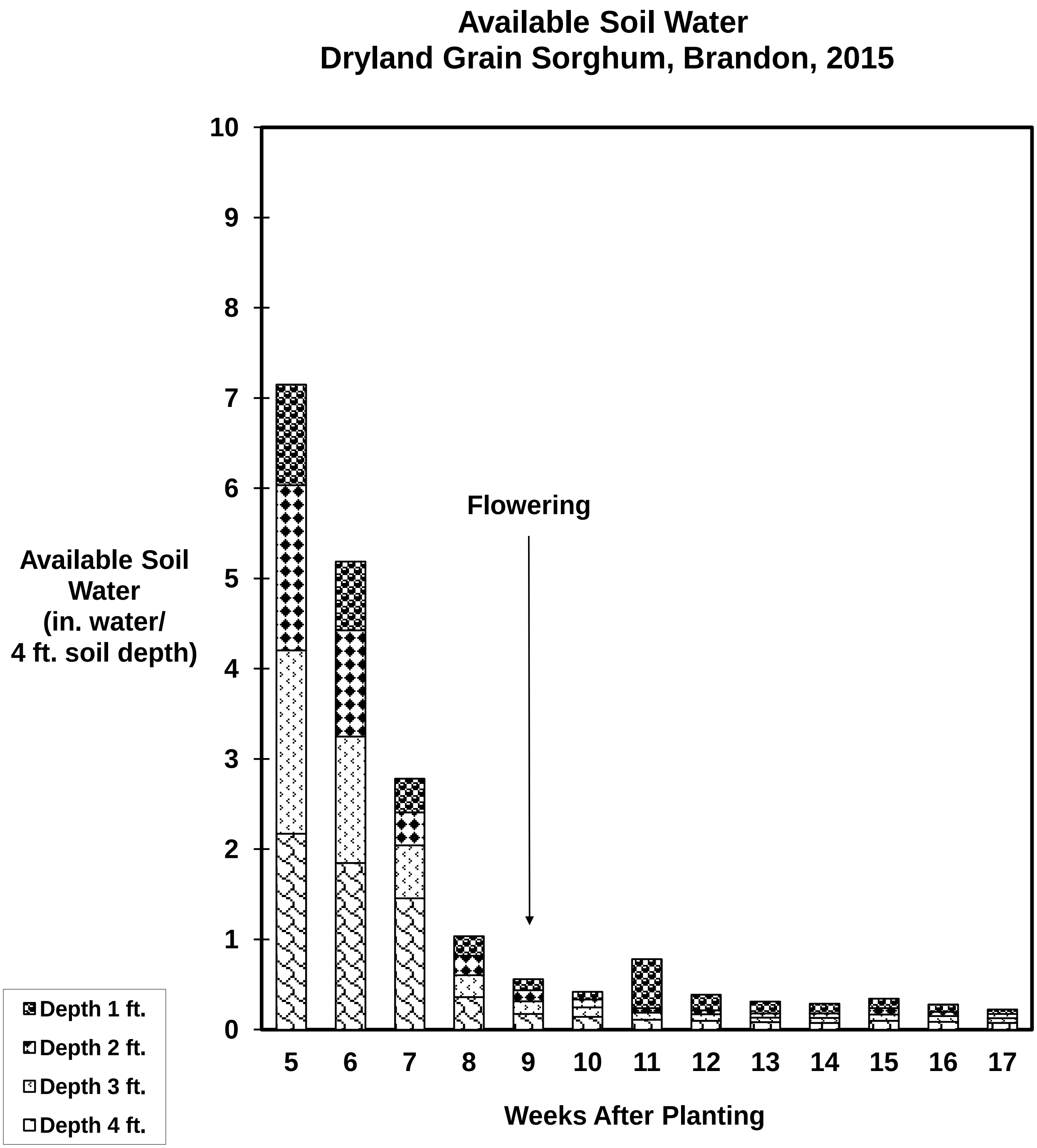


Fig. 1. Available soil water in dryland grain sorghum at Brandon. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Brandon from planting to first freeze was 7.66 in. Any increase in available soil water between weeks is from rain.

2015 Dryland Grain Sorghum Hybrid Performance Trial at Brandon

Brand	Hybrid	Grain Yield[a]	Yield Percent of Trial Average	Test Weight	Lodging	Harvest Plant Population	Plant Height	50% Bloom	GDD[b]	50% Mature	Maturity Group[c]
		bu/ac	percent	lb/bu	percent	plants/ac	in	days after planting		days after planting	
Dekalb	DKS28-05	82.5	111	58.3	4	28,100	43	58	1484	96	E
Mycogen Seeds	1G557	81.8	110	58.0	0	27,700	39	56	1425	95	E
Dekalb	DKS29-28	79.6	107	59.1	0	28,600	38	55	1399	94	E
Alta Seeds	AG1101	77.6	104	58.8	0	26,800	38	54	1373	93	E
Dekalb	DK28E	74.1	100	58.8	0	28,100	38	53	1344	92	E
Gayland Ward Seed	GW-1180	88.4	119	57.9	2	25,800	42	62	1597	103	ME
Heartland Genetics	HG44R	86.9	117	59.3	0	26,300	39	65	1681	106	ME
Alta Seeds	AG1201	85.3	115	58.3	1	27,000	37	62	1597	102	ME
Mycogen Seeds	1G588	77.1	104	57.8	3	25,400	47	63	1621	101	ME
Sorghum Partners	K35Y5	76.1	102	58.7	0	24,200	41	62	1597	100	ME
Heartland Genetics	HG23R	72.1	97	59.0	0	23,700	42	65	1681	105	ME
Alta Seeds	AG1203	71.3	96	60.8	1	22,700	46	66	1709	107	ME
Alta Seeds	AG2105	80.8	109	59.1	2	26,000	46	67	1741	108	M
Alta Seeds	AG2115	76.2	103	59.2	1	26,100	46	67	1741	108	M
Gayland Ward Seed	GW-1160	47.8	64	58.6	0	24,600	49	68	1771	108	M
Heartland Genetics	HG33C	63.3	85	57.2	0	26,700	42	72	1837	115	ML
Gayland Ward Seed	GW-9417	52.5	71	57.6	17	23,900	49	73	1862	116	ML
Average		**74.9**		**58.6**	**2**	**26,000**	**42**	**63**	**1615**	**103**	**ME**
[e]LSD (P<0.20)		8.7			3						

[a]Yields adjusted to 14% moisture and hybrids ranked by yield within maturity group.

[b]GDD: Growing degree-days to 50% bloom date.

[c]Maturity Group: E=early; ME=medium-early; M=medium.

[d]Days after planting or maturation of seed at first freeze.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is an 80% chance the difference is significant.

Table 4. Summary: Dryland Grain Sorghum Hybrid Performance Trials at Brandon, 2013-2015.

			Grain Yield					Yield as % of Test Average				
Brand	Hybrid	Maturity Group[a]	2013	2014	2015	2-Year Avg	3-Year Avg	2013	2014	2015	2-Year Avg	3-Year Avg
Alta Seeds	AG1101	E	17	13	78	46	36	119	71	104	97	100
Alta Seeds	AG1201	E	17	25	85	55	42	114	135	115	117	118
Alta Seeds	AG1203	ME	--	24	71	48	--	--	134	96	101	--
Dekalb	DKS29-28	E	24	13	80	47	39	166	71	107	99	108
Dekalb	DKS28-05	E	12	22	83	53	39	84	123	111	112	108
Mycogen Seeds	1G557	E	18	17	82	50	39	124	93	110	105	108
Mycogen Seeds	1G588	ME	--	24	77	51	--	--	133	104	107	--
Average			**15**	**18**	**75**	**47**	**36**					

[a]Maturity Group: E=early; ME=medium early.
Grain Yields were adjusted to 14.0% seed moisture content.

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2015

COOPERATOR: Plainsman Agri-Search Foundation, Walsh, Colorado.

PURPOSE: To identify high yielding hybrids under dryland conditions with 3300 sorghum heat units in a silt loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 43,600 seed/a. PLANTED: June 8. HARVESTED: November 9.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 21 oz/a, Glyphosate, 32 oz/a; 2,4-D, 0.5 lb/a, Banvel 4 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

FIELD HISTORY: Previous Crop: Wheat. FIELD PREPARATION: Strip-till.

Summary: Growing Season Precipitation and Temperature Walsh, Baca County.[a]

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.23	555	14	1	22
July	5.54	846	20	1	53
August	2.68	803	19	0	84
September	1.05	680	17	1	114
October	2.93	355	1	0	145
November	0.30	69	0	0	152
Total	13.73	3308	71	3	152

[a]Growing season from June 8 (planting) to November 7 (first freeze, 28 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was excellent. No greenbug infestation. The growing season precipitation was above average. May and July were wet. Very long growing season with the first freeze date on November 7. Hybrids at this site had to recover from two hailstorms: one on June 11 reduced plant populations and one on August 18 stripped leaves and damaged stalks and heads. Grain yields and test weights were good despite damage from two hailstorms.

SOIL: Richfield silt loam for 0-8” and silt loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.6	1.2	1.9	46	3.7	420	0.5	16.8
8”-24”				53				
Comment	Alka	Lo	Hi	VHi	Lo	VHi	Lo	Lo

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	20	2	10
Applied	50	20	0	0

Yield Goal: 40 bu/a.
Actual Yield: 39 bu/a.

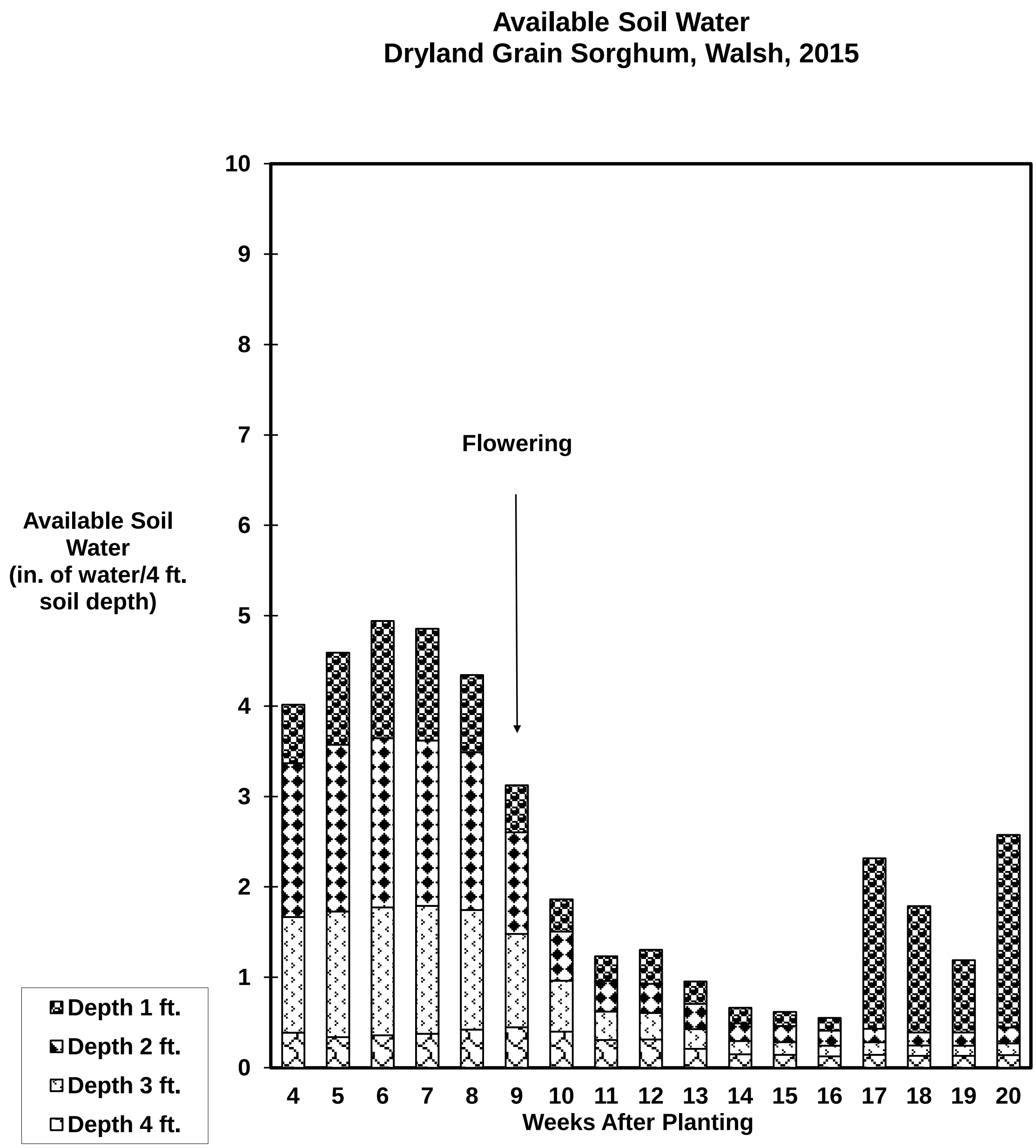


Fig. 2. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.73 in. Any increase in available soil water between weeks is from rain.

2015 Dryland Grain Sorghum Hybrid Performance Trial at Walsh.

Source	Hybrid	Grain Yield[a]	Yield Percent of Trial Average	Test Weight	Lodging	Harvest Plant Population	Plant Height	50% Bloom	GDD[b]	50% Mature	Maturity Group[c]
		bu/ac	percent	lb/bu	percent	plants/ac	in	days after planting		days after planting[d]	
Mycogen Seeds	1G557	48.9	125	57.5	4	20,700	41	60	1596	104	E
Alta Seeds	AG1101	40.6	104	57.2	2	18,400	39	59	1562	103	E
Dekalb	DKS29-28	37.0	95	57.4	4	20,900	36	61	1628	103	E
Dekalb	DKS28-05	34.0	87	57.4	10	18,400	46	61	1628	106	E
Richardson Seeds	Swift	18.7	48	54.3	5	21,300	37	54	1425	98	E
Gayland Ward Seed	GW-1180	54.8	140	57.8	8	17,600	46	66	1763	110	ME
Dekalb	DKS38-88	50.9	130	58.4	7	21,100	48	67	1791	112	ME
Richardson Seeds	RS215	44.5	114	58.4	4	16,800	48	69	1852	113	ME
Alta Seeds	AG1201	43.9	112	57.4	6	16,300	40	64	1710	108	ME
Sharp Brothers	Sprint II	41.7	107	58.4	12	19,400	45	63	1685	108	ME
Alta Seeds	AG1203	38.4	98	59.8	12	18,200	43	69	1852	113	ME
Sorghum Partners	K35Y5	27.7	71	58.8	10	16,700	42	63	1685	107	ME
Alta Seeds	AG2115	41.7	107	58.1	6	16,300	41	71	1904	115	M
Alta Seeds	AG2105	31.7	81	58.0	30	19,400	45	70	1881	114	M
Gayland Ward Seed	GW-1160	30.1	77	58.1	1	20,700	46	71	1904	117	M
Gayland Ward Seed	GW-9417	40.7	104	58.6	8	19,800	51	77	1981	120	ML
Average		**39.1**		**57.9**	**8**	**18,900**	**43**	**65**	**1740**	**109**	**ME**
[e]LSD (P<0.20)		9.5			5						

[a]Yields adjusted to 14% moisture and hybrids ranked by yield within maturity group.

[b]GDD: Growing degree-days to 50% bloom date.

[c]Maturity Group: E=early; ME=medium-early; M=medium; ML=medium late.

[d]Days after planting.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is an 80% chance the difference is significant.

Table 6. Summary: Dryland Grain Sorghum Hybrid Performance Trials at Walsh, 2013-2015.

			Grain Yield					Yield as % of Test Average				
		Maturity				2-Year	3-Year				2-Year	3-Year
Brand	Hybrid	Group[a]	2013	2014	2015	Avg	Avg	2013	2014	2015	Avg	Avg
Alta Seeds	AG1101	E	3	44	41	43	29	71	91	104	97	95
Alta Seeds	AG1201	E	5	55	44	50	35	100	114	112	113	112
Alta Seeds	AG1203	ME	--	54	38	46	--	--	111	98	105	--
Dekalb	DKS38-88	ME	4	68	51	60	41	77	142	130	135	132
Average			**5**	**48**	**39**	**44**	**31**					

[a]Maturity Group: E=early; ME=medium early.
Grain Yields were adjusted to 14.0% seed moisture content.

Dryland Forage Sorghum Performance Trial at Walsh, 2015

COOPERATOR: Plainsman Agri-Search Foundation, Walsh, Colorado.

PURPOSE: To identify high yielding hybrids under dryland conditions with 3100 sorghum heat units in a silt loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 69,700 seed/a. PLANTED: June 8. HARVESTED: October 16.

PEST CONTROL: Preemergence Herbicides: Atrazine 1 lb/a, S-Metolachlor 21 oz/a, Glyphosate 32 oz/a, 2,4-D 0.5 lb/a, Dicamba 4 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

FIELD HISTORY: Previous Crop: Wheat. FIELD PREPARATION: Strip-till.

Summary: Growing Season Precipitation and Temperature Walsh, Baca County.[a]

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.23	555	14	1	22
July	5.54	846	20	1	53
August	2.68	803	19	0	84
September	1.05	680	17	1	114
October	0.12	215	1	0	130
Total	10.62	3099	71	3	130

[a]Growing season from June 8 (planting) to October 16 (harvest).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was excellent. No greenbug infestation. The growing season precipitation was above average. May and July were wet. Hybrids at this site had to recover from two hailstorms: one on June 11 reduced plant populations and one on August 18 stripped leaves and damaged and broke stalks. Forage yields were fair despite damage from two hailstorms.

SOIL: Richfield silt loam for 0-8” and silt loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.7	0.9	2.1	56	4.9	466	0.9	16.2
8”-24”				45				
Comment	Alka	VLo	Hi	VHi	Lo	VHi	Lo	Lo

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	20	2	10
Applied	50	20	0	0

Yield Goal: 8 tons/a.
Actual Yield: 6.4 tons/a.

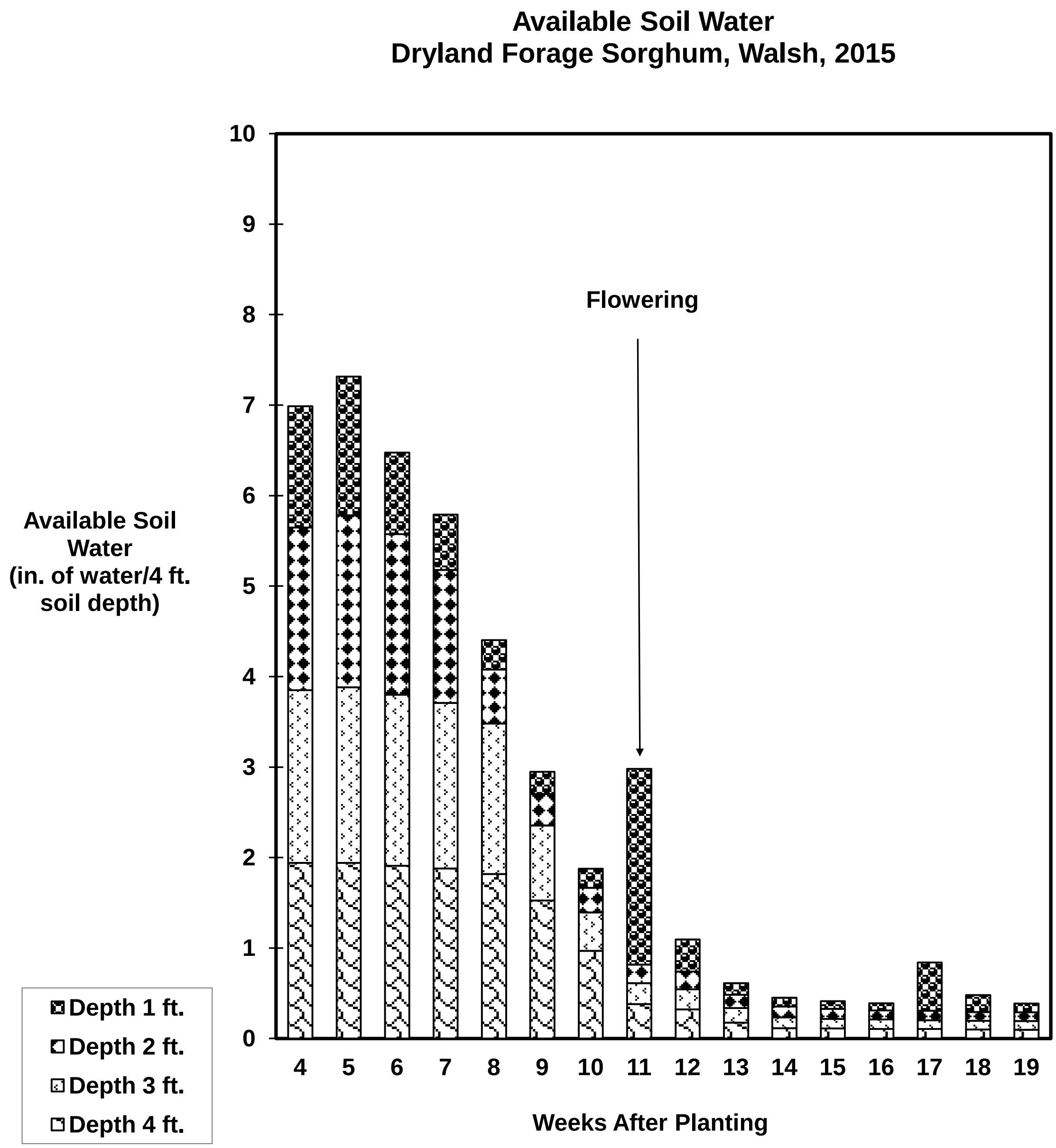


Fig. 3. Available soil water in dryland forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 10.62 in. Any increase in available soil water between weeks is from rain.

2015 Dryland Hybrid Forage Variety Performance Trial at Walsh

Brand	Hybrid	Forage Yield[a]	Yield	Stem Sugar	Harvest Density	Plant Height	Lodging	Days to Boot	Relative Maturity[b]	Forage Type[c]	Traits
		tons/ac	% of test avg.	%	plants/ac (1000 x)	in	%	days after planting			
Walter Moss Seed Co.	4EVER GREEN	8.8	138	12.1	22.1	75	0	Veg	PS	FS	-
Alta Seeds	AF7202	8.5	134	8.7	21.9	63	8	70	ME	FS	BMR-6, BD
Gayland Ward Seed	Sweet Forever BMR	8.2	129	14.9	24.6	84	0	81	PS	SS	BMR, BD
Walter Moss Seed Co.	MEGA GREEN	7.9	124	12.5	22.5	79	1	93	PS	SS	-
Alta Seeds	AF7401	7.8	122	12.6	25.9	36	0	97	L	FS	BMR-6, BD
Gayland Ward Seed	GW-600 BMR	7.7	121	10.9	26.5	60	7	77	M	FS	BMR-6
Gayland Ward Seed	Super Sugar	7.7	120	18.4	23.4	79	4	62	ME	SS	-
Alta Seeds	AS5201	6.9	108	18.8	22.9	77	15	63	M	SS	-
Gayland Ward Seed	Super Sugar (delayed mat.)	6.9	108	14.2	22.1	66	0	90	L	SS	-
Alta Seeds	AS9302	6.4	101	8.3	22.5	71	1	66	M	S	BMR-6, BD, DS
Alta Seeds	AF7102	6.4	100	8.6	22.3	65	7	65	E	FS	BMR-6, BD
Gayland Ward Seed	GW-2120	6.2	97	11.1	25.0	75	18	64	M	FS	MS
Alta Seeds	AS6402	6.2	97	8.1	20.0	55	0	85	L	SS	BMR-6, BD
Gayland Ward Seed	Silo Pro BMR	6.2	97	19.6	24.8	57	0	78	ML	FS	BMR-6
Alta Seeds	AF7301	5.6	87	6.3	25.0	57	2	73	M	FS	BMR-6, MS
Alta Seeds	AF7101	5.4	85	8.6	25.2	59	8	71	E	FS	BMR-6, DS
Gayland Ward Seed	GW-400 BMR	4.9	76	8.9	25.6	70	9	63	ME	FS	BMR-6, MS
Gayland Ward Seed	Nutra King BMR 6	4.4	69	13.6	25.2	68	18	61	ME	SS	BMR-6
Gayland Ward Seed	Sweet Six BMR (dry stalk)	4.4	69	12.9	25.2	64	5	63	E	SS	BMR, DS
Alta Seeds	AF7201	3.8	59	9.9	20.9	69	10	71	ME	FS	BMR-6, DS
Mycogen	2C799 (corn)	3.7	58	10.9	18.4	66	0	66	M	Corn	-
Average		**6.4**		**11.9**	**23.4**	**66**	**5**	**73**			
[e]LSD (P<0.20)		1.3									

[a]Yields are adjusted to 70% moisture content based on oven-dried samples.

[b]Relative Maturity: E=early; ME=medium-early; M=medium; ML=medium-late; L=late; PS=photoperiod sensitive.

[c]Forage Type: FS=forage sorghum; S=sudangrass; SS=sorghum sudangrass.

[d]Traits: BD=brachytic dwarf; BMR=brown mid-rib; BMR-6=one of the three main brown mid-rib genes; DS=dry stalk; MS=male sterile.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is a 80% chance the difference is significant.

2015 Dryland Hybrid Forage Variety Performance Trial Dry Matter Analysis at Walsh

Brand	Hybrid	Forage Type[a]	RFQ	CP	ADF	NDF	NDFD	IVTDMD	TDN	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				percent						MCal/lb		
Alta Seeds	AF7201	FS	166	12.6	30.2	59.9	72	80.9	68.1	0.72	0.44	0.70
Gayland Ward Seed	Silo Pro BMR	FS	164	17.2	26.2	53.8	71	82.0	72.7	0.78	0.50	0.76
Alta Seeds	AF7101	FS	162	14.3	29.3	58.9	72	81.6	69.1	0.73	0.46	0.72
Alta Seeds	AF7301	FS	161	13.4	29.6	59.0	71	80.4	68.8	0.73	0.45	0.71
Alta Seeds	AF7401	FS	158	9.3	29.5	53.4	71	83.2	68.9	0.73	0.45	0.71
Alta Seeds	AF7202	FS	156	12.1	31.3	60.8	69	78.6	66.9	0.70	0.43	0.69
Alta Seeds	AS6402	SS	152	11.2	31.7	60.1	67	77.2	66.4	0.69	0.42	0.69
Alta Seeds	AF7102	FS	151	15.0	32.2	60.7	71	80.7	65.9	0.68	0.41	0.68
Walter Moss Seed Co.	4EVER GREEN	FS	150	11.2	29.3	56.6	64	76.8	69.2	0.73	0.46	0.72
Gayland Ward Seed	GW-400 BMR	FS	148	18.2	28.5	55.0	72	83.0	70.1	0.74	0.47	0.73
Gayland Ward Seed	Sweet Six BMR (dry stalk)	SS	148	16.4	29.1	60.6	67	78.5	69.4	0.73	0.46	0.72
Gayland Ward Seed	Super Sugar (delayed mat.)	SS	146	9.9	31.6	56.1	64	76.8	66.5	0.69	0.42	0.69
Gayland Ward Seed	GW-600 BMR	FS	146	15.9	28.9	58.5	68	80.0	69.6	0.74	0.46	0.72
Gayland Ward Seed	Nutra King BMR 6	SS	143	15.9	32.2	61.0	68	78.0	65.9	0.68	0.41	0.68
Gayland Ward Seed	GW-2120	FS	142	16.7	31.6	61.4	68	79.1	66.5	0.69	0.42	0.69
Gayland Ward Seed	Sweet Forever BMR	SS	142	11.2	33.5	66.8	65	76.7	64.4	0.66	0.39	0.66
Alta Seeds	AS5201	SS	129	13.2	36.0	66.2	61	72.7	61.6	0.62	0.36	0.63
Gayland Ward Seed	Super Sugar	SS	127	17.0	32.7	60.8	62	75.8	65.3	0.67	0.41	0.67
Walter Moss Seed Co.	MEGA GREEN	SS	126	11.6	33.4	61.0	55	71.2	64.5	0.66	0.40	0.66
Alta Seeds	AS9302	S	125	21.0	29.9	54.8	71	83.7	68.5	0.72	0.45	0.71
Mycogen	2C799 (corn)	Corn	116	16.1	35.0	65.3	58	73.4	62.6	0.63	0.37	0.64
Average			**146**	**14.3**	**31.0**	**59.6**	**67**	**78.6**	**67.2**	**0.70**	**0.43**	**0.69**

[a]Forage Type: FS=forage sorghum; S=sudangrass; SS=sorghum sudangrass.

RFQ= relative feed quality; CP=crude protein; ADF=acid detergent fiber; NDF=neutral detergent fiber; NDFD=neutral detergent fiber digestibility (48 hr); IVTDMD=in vitro total dry matter digestibility (48 hr); TDN=total digestible nutrients; Main.=maintenance; Lact.=lactation.

Sprinkler Irrigation on Corn and Grain Sorghum, Walsh 2015

Kevin Larson and Brett Pettinger

PURPOSE: To identify corn and grain sorghum hybrids that produce highest yields given sprinkler irrigation.

MATERIALS AND METHODS: We tested 14 corn hybrids and 16 grain sorghum hybrids under sprinkler irrigation. We planted the corn study on April 29 at 26,500 seeds/a, and the grain sorghum study on June 1 at 53,700 seeds/a. We fertilized both studies using a strip-till implement with 150 lb N/a to the corn and 100 lb N/a to the grain sorghum with 20 lb P_2O_5/a as 10-34-0, and at planting we seedrow applied an additional 20 lb P_2O_5/a, and 0.38 lb Zn/a. We applied 18 acre-in./a of water to the corn and to the grain sorghum we applied 10 acre-in./a of water using a sprinkler. The plot size was at least four 30 in. rows, 600 ft. long that we harvested with a self-propelled combine and weighed them in a digital weigh cart. Seed moisture was adjusted to 15.5% for corn and 14% for grain sorghum.

RESULTS: Yields and test weights for both corn and grain sorghum were good, despite recovering from hailstorms that occurred on June 11 and August 18. The damage from hail was less severe at this study location than other study sites on the Plainsman farm. The very long growing season (the first freeze was on November 7) and timely rains contributed to high yields and test weights of the grain sorghum study. Corn harvest was only partially completed before the first snowstorm, which caused large snowdrifts on the northwest side of the corn study. One corn hybrid, LG2636VT3RIB, had extensive ear drop caused by the snowdrifts.

DISCUSSION: Severe weather had impacts on the corn study. A hailstorm on June 11 caused an average plant density loss of 3000 plants/a in the corn study. The second hailstorm on August 18 stripped leaves and broke some stalks (fortunately most stalks broke above the ear). The damage of the second hailstorm, although it looked quite bad, probably only caused minimal yield reduction. We had finished one replication and some of the second replication of the corn trial before a wind-driven snowstorm hit on November 17. Only one hybrid, LG2636VT3RIB, exhibited severe ear drop from the snowdrifts. LG2636VT3RIB produced 165 bu/a before the snowstorm and only 104 bu/a after the snowstorm. Corn hybrids on either side of this hybrid did not drop ears, though the snowdrift was just as deep on them.

The production of the grain sorghum irrigated study was very good; it averaged 100 bu/a. We typically do not produce 100 bu/a for irrigated grain sorghum when applying 10 in./a of irrigation. There was a trend for later maturing hybrids to produce higher yield than the earlier maturing hybrids. In part, this trend of higher production from the later maturing hybrids is, no doubt, due to the long growing season of this year. Overall rainfall for the season was above average. July was wet, but rainfall was slightly below average for June and September. Generally, the rain events were well timed, which contributed to the high yields.

Sprinkler Irrigated Grain Sorghum Study at Walsh, 2015

COOPERATORS: Plainsman Agri-Search Foundation; K. Larson, B. Pettinger, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To identify grain sorghum hybrids that produce highest yields given sprinkler irrigation.

RESULTS: The 16 grain sorghum hybrids tested averaged 100 bu/a. The yield ranged from 82 bu/a for Mycogen Seeds 627 to 117 bu/a for Alta AG3103. There was a trend for later maturing hybrids to produce higher yields than earlier maturing hybrids.

PLOT: Four rows with 30 in. row spacing, at least 600 ft. long. SEEDING DENSITY: 53,700 seeds/a. PLANTED: June 1. HARVESTED: October 28.

IRRIGATION: Sprinkler applied 10 acre-in/a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Huskie 16 oz/a; Atrazine 0.75 lb/a. CULTIVATION: None.

Summary: Growing Season Precipitation and Temperature \1
Walsh, Baca County.

Month	Rainfall	Irrigation \2	GDD \3	>90 F	>100 F	DAP \4
	in	in	--------no. of days--------			
June	1.75	2.00	738	16	1	30
July	5.54	2.00	846	20	1	61
August	2.68	4.00	803	19	0	92
September	1.05	2.00	680	17	1	122
October	2.93	0.00	355	1	0	153
November	0.30	0.00	69	0	0	160
Total	14.25	10.00	3491	73	3	160

\1 Growing season from June 1 (planting) to November 7 (freeze, 28F).
\2 Total in-season water from irrigation and precipitation was 24.25 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

FIELD HISTORY: Previous Crop: Corn. FIELD PREPARATION: Disked and strip-tilled.

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was good. The growing season precipitation was above average. May and July were wet. A June 11 hailstorm reduced plant population and an August 18 hailstorm stripped leaves and caused stalk lodging. Yields and test weights were very good due to abundant rainfall and a long growing season.

SOIL: Silt loam for 0-8” and silt loam 8”-24” depths from soil analysis.

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.5	1.0	2.1	35	3.3	377	0.7	4.5
8”-24”				22				
Comment	Alka	VLo	Hi	VHi	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	0	40	2	0
Applied	100	40	0.3	0

Yield Goal: 90 bu/a.
Actual Yield: 100 bu/a.

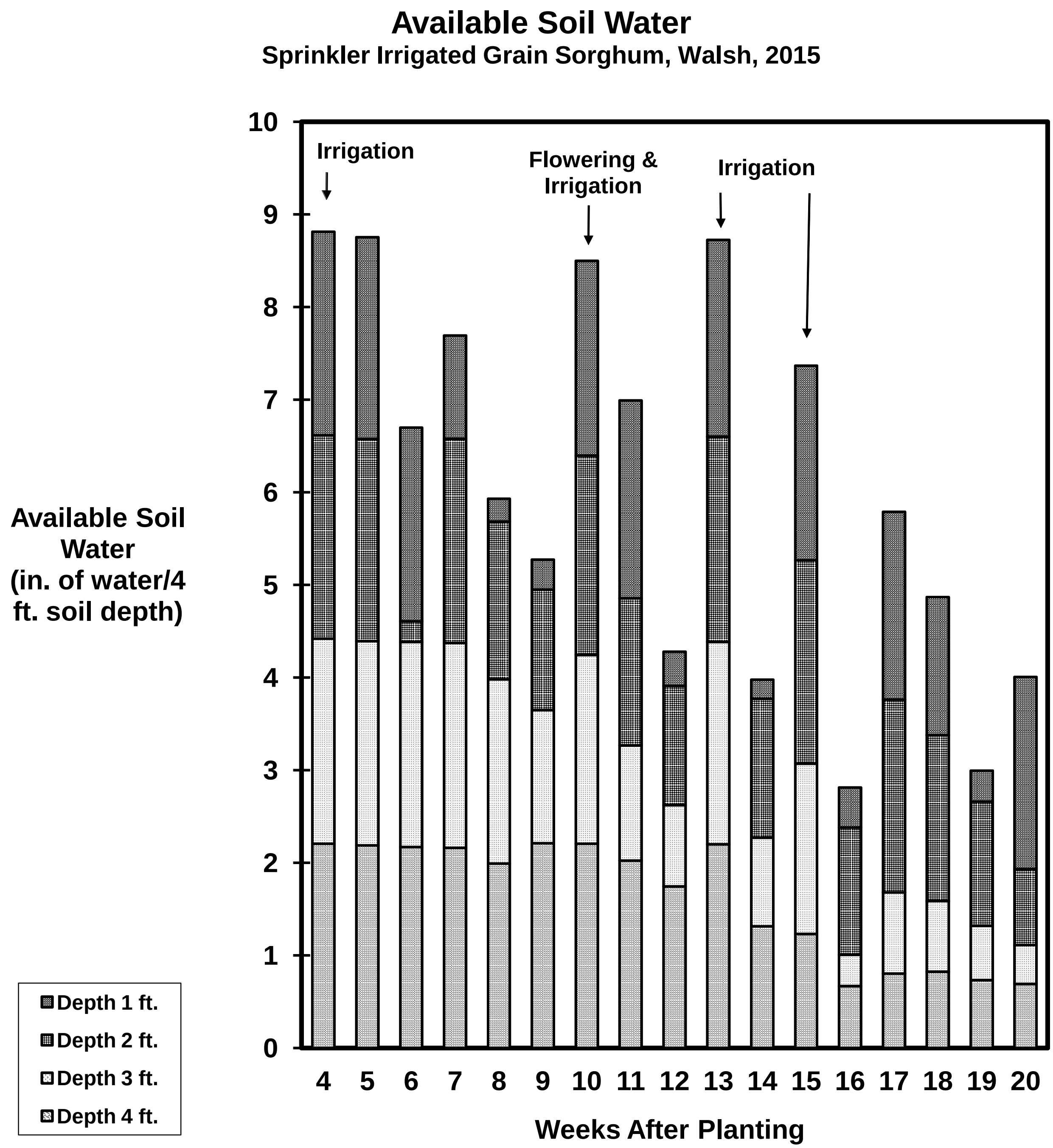


Fig. . Available soil water in limited sprinkler irrigation grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 14.25 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Sprinkler Irrigated Grain Sorghum, Plainsman Research Center, Walsh, 2015.

Brand	Hybrid	Grain Yield	Seed Moisture Content	Test Weight	Plant Density	Plant Height	50% Flowering Date	50% Maturity Date
		bu/a	%	lb/bu	plants/a (1000X)	in		
Alta	AG3103	117	15.7	62	39.4	55	8/14	9/28
Mycogen Seeds	1G600	113	14.5	61	38.2	47	8/10	9/24
Alta	AG1301	111	14.2	61	37.6	45	8/9	9/24
Sorghum Partners	KS585	110	15.4	61	36.2	43	8/10	9/24
Channel	7B30	108	15.6	61	35.0	47	8/9	9/24
AgVenture	AV6R41	108	15.0	61	41.0	47	8/8	9/22
Channel	6B60	102	14.3	61	34.0	49	8/6	9/20
AgVenture	AV7R01	100	14.8	62	33.4	48	8/10	9/24
Pioneer Seeds	86G32	99	14.8	61	36.4	46	8/2	9/16
Channel	6B13	98	14.3	62	35.2	51	8/9	9/24
Mycogen Seeds	1G588	97	13.1	60	34.6	46	8/4	9/15
Alta	AG1201	94	13.6	60	37.0	40	8/1	9/14
Alta	AG2115	92	14.4	61	32.4	46	8/8	9/21
AgVenture	AV6R01	89	13.3	60	36.4	45	8/1	9/15
Mycogen Seeds	M3838	85	14.5	62	24.4	43	8/10	9/26
Mycogen Seeds	627	82	15.4	60	28.4	45	8/8	9/23
Average		100	14.6	61	35.0	46	8/7	9/21
LSD 0.20		4.3						

Planted: June 1; Harvested: October 28, 2015.
50% Flowering Date: minimum date on which a hybrid flowers on half of its population.
50% Maturity Date.
Sprinkler irrigated grain sorghum received 10 in/acre of applied water.
Yields are adjusted to 14.0% seed moisture content.

Sprinkler Irrigation Corn Study at Walsh, 2015

COOPERATORS: Plainsman Agri-Search Foundation; K. Larson, B. Pettinger, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To identify corn hybrids that produce highest yields given sprinkler irrigation.

RESULTS: The average yield for all 14 hybrids tested was 160 bu/a. All four seed firms (Channel, LG Seeds, Mycogen Seeds, and Producers Hybrids) entered in this trial had at least one hybrid that produced above the trial average.

PLOT: Four rows with 30” row spacing, at least 600’ long. SEEDING DENSITY: 26,500 seeds/a. PLANTED: April 29. HARVESTED: November 16 and December 9.

PEST CONTROL: Preemergence Herbicides: Balance 1.75 oz/a, Glyphosate 32 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Glyphosate 32 oz/a. CULTIVATION: None. INSECTICIDE: Oberon 6 oz/a for mite control.

Summary: Growing Season Precipitation and Temperature \1
Walsh, Baca County.

Month	Rainfall	Irrigation \2	GDD \3	>90 F	>100 F	DAP \4
	in	in	--------no. of days--------			
April	0.00	0.00	20	0	0	2
May	5.64	2.00	344	0	0	33
June	1.75	4.00	738	16	1	63
July	5.54	4.00	846	20	1	94
August	2.68	4.00	803	19	0	125
September	1.05	4.00	680	17	1	155
October	2.93	0.00	355	1	0	186
November	0.30	0.00	69	0	0	193
Total	19.89	18.00	3855	73	1	193

\1 Growing season from April 29 (planting) to November 7 (freeze, 28F).
\2 Total in-season water from irrigation and precipitation was 37.89 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

FIELD HISTORY: Previous Crop: Sorghum. FIELD PREPARATION: Disked and strip-tilled.

COMMENTS: Planted in good soil moisture for seed germination and stand establishment. Weed control was good. The growing season precipitation was above average. May and July were wet. A June 11 hailstorm reduced plant population and an August 18 hailstorm stripped leaves and caused stalk lodging. Grain yields and test weights were good despite the hailstorms. We applied 18 in/a of irrigation.

SOIL: Silt loam for 0-8” and silt loam 8”-24” depths from soil analysis.

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.8	0.7	2.4	12	5.2	487	0.8	4.8
8”-24”				21				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	21	20	2	0
Applied	150	40	0.4	0

Yield Goal: 150 bu/a.
Actual Yield: 160 bu/a.

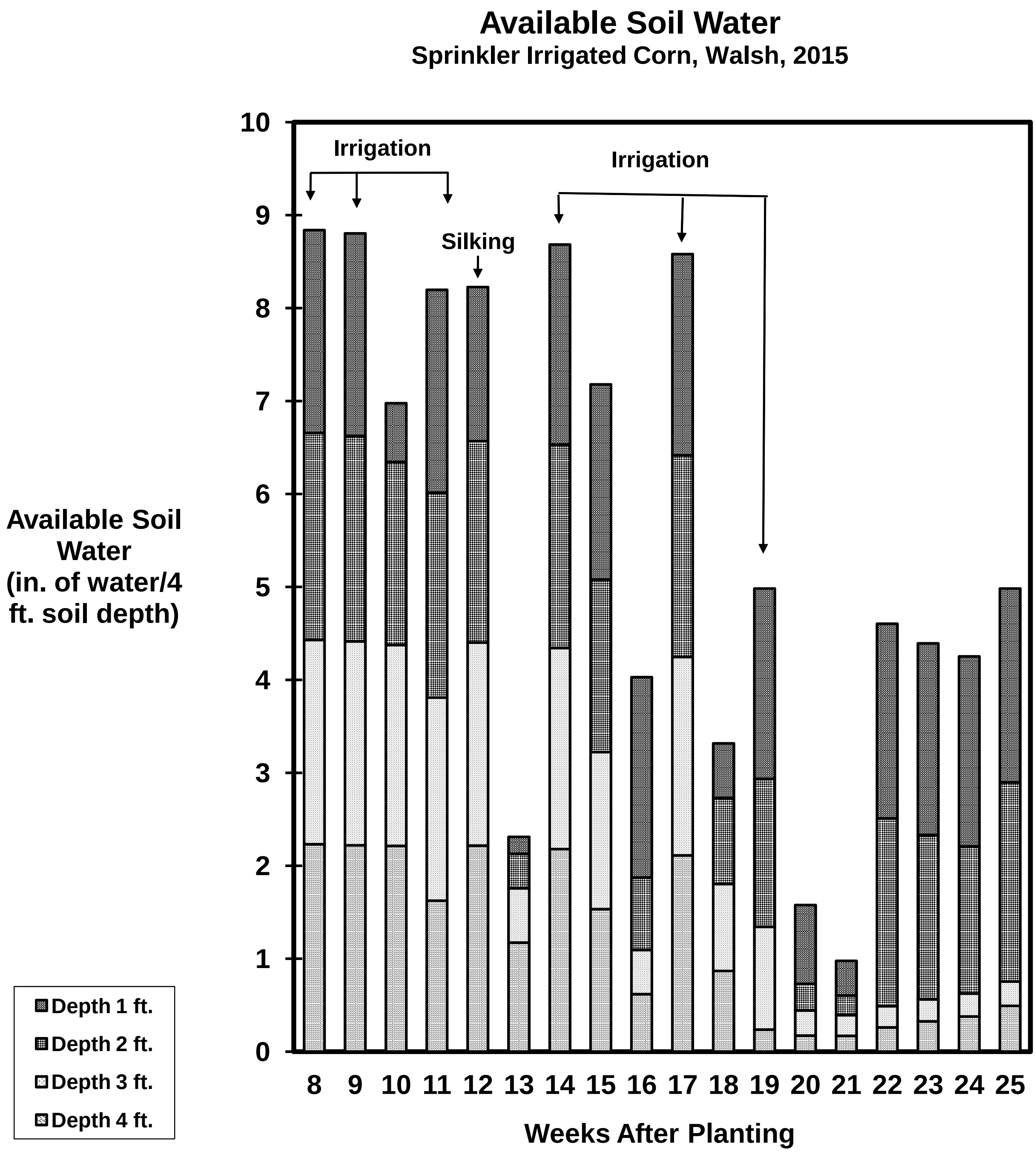


Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 19.89 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Sprinkler Irrigated Corn, Plainsman Research Center, 2015.

Firm	Hybrid	Grain Yield	Seed Moisture	Test Wt.	Plant Density	50% Silking Date
		bu/a	%	lb/bu	plants/a (X 1000)	
Channel	214-00DGVT2RIB	168	13.8	61	23.4	25-Jul
Mycogen Seeds	2V717	167	13.3	59	22.6	23-Jul
LG Seeds	LG2636VT3RIB	165 (104)[a]	13.8	58	24.0	19-Jul
Producers Hybrids	7268STXRIB	163	13.3	60	23.2	23-Jul
LG Seeds	LG5618STXRIB	162	13.0	60	23.4	24-Jul
LG Seeds	LG5579VT3RIB	162	13.6	60	22.0	19-Jul
Mycogen Seeds	2V709	161	13.6	60	24.2	22-Jul
Mycogen Seeds	2T777 (non Bt)	159	13.7	59	22.4	23-Jul
Producers Hybrids	7213VT2RIB	159	13.2	59	23.6	18-Jul
Channel	217-41DGVT2RIB	158	13.4	59	24.6	22-Jul
Mycogen Seeds	2C799	157	13.0	59	24.4	24-Jul
LG Seeds	LG5622STXRIB	154	13.5	61	22.2	23-Jul
Channel	215-81VT2RIB	152	13.2	59	22.2	22-Jul
Mycogen Seeds	2Y669	151[b]	13.6	60	24.8	20-Jul
Average		160	13.4	60	23.4[c]	21-Jul
LSD 0.20		6.6				

[a]The yield in the parentheses is yield after snow drift caused severe ear drop.

[b]This hybrid had 5% ear drop before the snowstorm.

[c]Harvest Density after a July 11 hailstorm caused an average of 3000 plants/a loss.
Planted: April 29; Harvested: November 16 and December 9, 2015.
Grain Yield adjusted to 15.5% moisture content.
Sprinkler irrigated corn received a total of 18 in./acre of applied water.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2015

Kevin Larson and Brett Pettinger

PURPOSE: To evaluate corn borer resistant (Bt gene insertion) and nonresistant hybrids under sprinkler irrigation.

RESULTS: Only the nonresistant corn borer hybrid displayed any first generation corn borer damage and this shot-hole damage was very minor. The nonresistant corn borer hybrid and two corn borer resistant hybrids had second-generation corn borer damage (stalk holes and lodging), but their damage was minimal, 10% and 3% stalk holes, respectively. This low infestation of second generation corn borer damage is similar to the damage levels we have been reporting after multiple years of planting Bt hybrids. Grain yields were good, averaging 160 bu/a.

DISCUSSION: All 13 Bt hybrids tested showed excellent resistance to first generation corn borer compared to the nonresistant hybrid. The nonresistant corn borer hybrid had 8% of plants lodged due to corn borer girdling. This low level of corn borer lodging is comparable to recent corn borer damage levels since Bt corn hybrids became widely accepted. The low level of corn borer damage may be attributable to our region's extensive use of corn borer resistant hybrids. Even with a few years of low corn borer levels, we still advocate the use of corn borer resistant hybrids.. However, if these low infestation levels continue, it may be economical to replace some acreage with less expensive nonresistant corn borer hybrids. Growers can monitor the corn borer infestation levels in their refuges to indicate if switching is warranted. Corn borer resistant Bt hybrids continue to be a very effective tool against corn borer damage. Therefore, to keep Bt hybrids effective in controlling corn borer, always remember to plant nonresistant hybrids as a mating refuge or use Refuge In a Bag (RIB) seed mixtures to help delay corn borer resistance to the Bt events.

Sprinkler Irrigated Corn, Corn Borer Ratings, Plainsman Research Center, 2015.

Firm	Hybrid	Grain Yield	Test Wt.	1st Gen. Shot Holes	2nd Gen. Stalk Holes	2nd Gen. Plants Lodged	50% Silking Date
		bu/a	lb/bu	--------plants/a---------			
Channel	214-00DGVT2RIB	168	61	0	0	0	25-Jul
Mycogen Seeds	2V717	167	59	0	0	0	23-Jul
LG Seeds	LG2636VT3RIB	165 (104)[a]	58	0	0	0	19-Jul
Producers Hybrids	7268STXRIB	163	60	0	0	0	23-Jul
LG Seeds	LG5618STXRIB	162	60	0	0	0	24-Jul
LG Seeds	LG5579VT3RIB	162	60	0	0	0	19-Jul
Mycogen Seeds	2V709	161	60	0	0	0	22-Jul
Mycogen Seeds	2T777 (non Bt)	159	59	3	10	8	23-Jul
Producers Hybrids	7213VT2RIB	159	59	0	0	0	18-Jul
Channel	217-41DGVT2RIB	158	59	0	0	0	22-Jul
Mycogen Seeds	2C799	157	59	0	3	3	24-Jul
LG Seeds	LG5622STXRIB	154	61	0	0	0	23-Jul
Channel	215-81VT2RIB	152	59	0	0	0	22-Jul
Mycogen Seeds	2Y669	151[b]	60	0	3	3	20-Jul
Average		160	60	0.2	1.1	0.9	21-Jul
LSD 0.20		6.6		1.3	1.9	2.3	

[a]The yield in the parentheses is yield after snow drift caused severe ear drop.

[b]This hybrid had 5% ear drop before the snowstorm.

Planted: April 29; Harvested: November 16 and December 9, 2015.

Grain Yield adjusted to 15.5% moisture content.

Sprinkler irrigated corn received a total of 18 in./acre of applied water.

Comparison of Single Row and Twin Row Spacings on Sprinkler Irrigated Corn 2015

Summary

Brett Pettinger and Kevin Larson

Results of twin-row corn research performed in other parts of the country have sparked the interest of the Plainsman Agri-Search Foundation in recent years. The methodology of twin row requires centering a pair of row units 8 inches apart on traditional 30 inch spacing. Theoretically, this concept should give producers benefits of narrow spacing, while allowing harvest with a typical 30 inch corn head. Arid climate, high evaporation rates and variable water supply across the High Plains Region create unique growing conditions. The goal of this study is to determine efficacy of twin row spacing across multiple production environments and management systems.

Three separate locations were chosen for testing in 2015. One plot was located on the Plainsman Research Farm and is considered limited irrigated (less than 20 acre inches applied), while the other two plots were placed on cooperative farmers under full irrigation (Over 20 acre inches applied). Hybrid selection and seeding rates varied by plot location based on irrigation capacity and application frequency.

In two of the three testing locations, twin row spacing showed some yield advantage. A unique situation occurred within the third testing location after a hail event forced replanting on June 18. Yields from this plot showed significant decline with twin row versus single row spacing. Further investigation revealed that all seeding rates with twin row spacing showed infection of *Gibberella* stock rot, which caused declining yields as seeding rate was increased. Many factors go in to this explanation, but we believe that the late planting date and early crop canopy, coupled with a hybrid that was susceptible to stock rot, created an ideal environment for the disease.

Making general statements about these twin row studies is difficult, considering each site had different hybrids, seeding rates, planting dates and growing conditions. However, observations across different plot locations did prove that twin row corn achieves canopy faster than single row. With normal planting dates, we did see a trend for increased economic return in twin row spacing at the lower seeding rates. Further studies will be needed to develop long term trends in this area. It is currently our recommendation for twin row spacing in late planted corn for growers to use caution when selecting hybrids and seeding rates.

We would like to thank Vic and Tanner Dunivan of Dunivan Farms and Tim Hume of North Fork Farms for allowing these studies to be located on their farms. Also a special thank you to Matt Tedder of Tedder Ag Technologies (Walsh, CO) and Monosem, Inc. of Edwardsville, KS for generously donating the use of a twin row planter. Matt Tedder was instrumental in getting these plots planted on time, donated the use of a crop drone for aerial photos of the plots and spent many hours preparing the planter for our specific use.

Comparison of Single and Twin Row Spacings in Sprinkler Irrigated Corn 2015

Brett Pettinger and Kevin Larson

Plot Location: Plainsman Research Farm

Materials and Methods

Available plot location and irrigation capacity for this particular test resulted in selecting slightly lower seeding rate categories than seen with the 2015 cooperative farmer tests. Two seeding populations of 26,600 and 31,000 seeds per acre were selected for evaluation. Field preparation consisted of an early spring strip till operation applying 150 pounds of nitrogen via anhydrous ammonia and 5 gallons of 10-34-0 approximately 6 inches deep. Other corn tests on Plainsman's small center pivot dictated placing this test near the far south side of the field. The corn variety selected for testing was Channel 217-41DGVT2PRIB, which is categorized as a semi-flex ear variety. The study was planted on May 1, 2015 using a Monosem 4 row twin planter applying 5 gallons per acre of 10-34-0 in furrow. Stand counts and visual canopy observations were taken on June 30, 2015 for the 26.6k rate and July 6, 2015 was the observation date of the 31k treatment. Stand counts were taken using a .005 acre measurement in each replication and averaged for the plot.

Results and Discussion

13.73 inches of natural precipitation fell during the growing season. An additional 18 acre inches of supplemental irrigation was applied. Two large hail events occurred during the test. The first occurred on June 11th. Although stand counts for this trial had not yet been taken, we can be relatively certain this event caused some stand loss (approximately 2,000 plants per acre were lost in the adjacent variety trial). The second hail event occurred on August 16th. Hail damage from this event mostly effected the leaf area of the corn plants but did cause some stalk bruising and limited ear loss. Yields for the 26.6k seeding rate for twin row was 176.1 bu/acre while single row was 173.2 bu/acre. This 2.9 bushel per acre advantage was not statistically different. Yields in the 31k seeding rate treatment showed twin row at 174.8 bu/acre while single row yielded 172.4. Again we did see a yield advantage to twin row (2.4 bu/acre), but it was not statistically significant (see figure 1). Due to treatment segregation, yield comparisons between the two seeding rates cannot be made. Canopy observations revealed an advantage to twin row spacing in both seeding rates. The canopy advantage to twin row over single row was 17.5% for the 26.6k seeding rate and 12.5% for the 31k seeding rate (see chart 1). Although yield differences were under statistical significance, the evidence of yield advantage to twin row spacing in both seeding rate categories shows promise of increasing returns with no added seed cost.

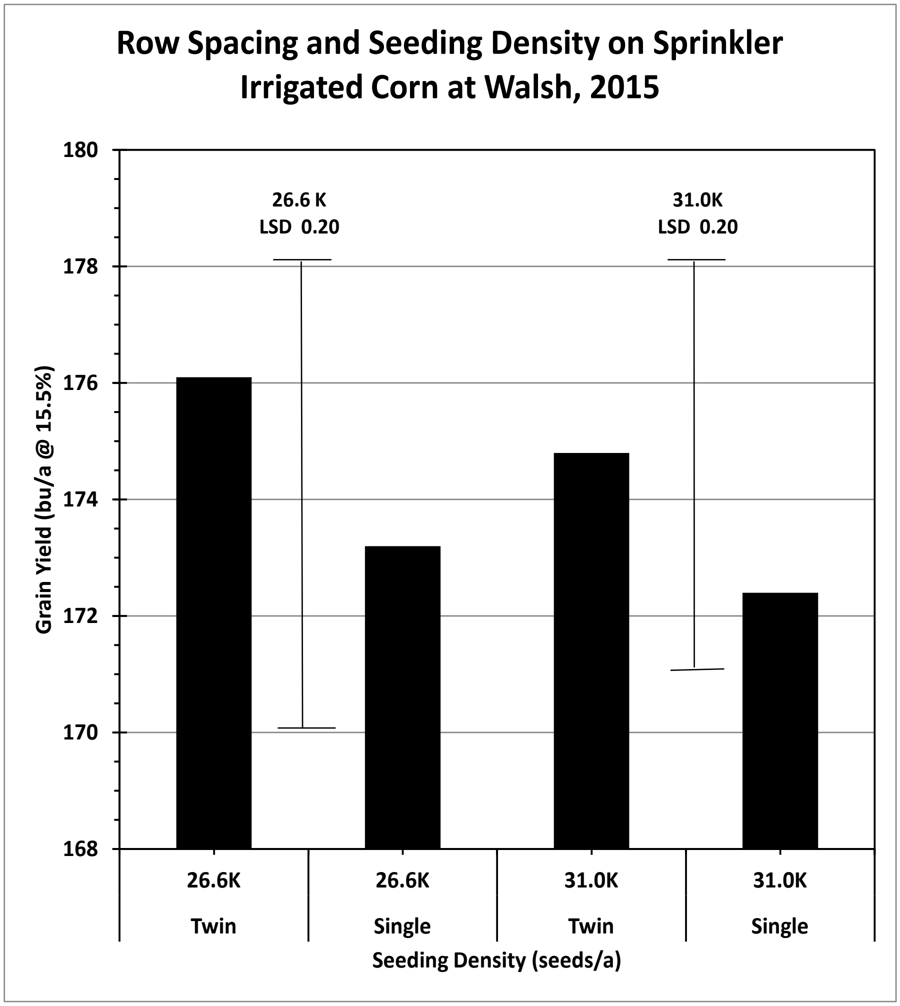


Figure 1. Yield comparison of single and twin row spacings at 26.6 and 31 thousands seeds per acre seeding rates.

Row Spacing	**Single**	**Twin**	**Single**	**Twin**
Seeding Rate	26,600	26600	31000	31000
Stand Count	23700	25300	27400	26600
Canopy Observation	37.50%	55%	62.50%	75%

Table 1. Stand counts and canopy observations were taken on June 30, 2015 for the 26.6k seeding rate. Observations taken July 6, 2015 for 31k seeding rate.

Comparison of Single and Twin Row Spacings in Sprinkler Irrigated Corn 2015

Brett Pettinger and Kevin Larson

Cooperative Farmer: Dunivan Farms

Materials and Methods

This plot was designed to test twin and single row configurations under full irrigation using a non-flex Dekalb DKC64-83RIB variety at seeding rates of 34,900 and 39,800 seeds per acre. Field preparation consisted of strip till application of 125 pounds nitrogen via anhydrous ammonia and 30 pounds phosphate via 10-34-0. In addition, 125 pounds of nitrogen and 30 pounds of phosphate in dry form were broadcast and incorporated with a disc plow. Due to differences between John Deere and Trimble guidance systems, guidance lines for the plot tractor were set immediately after strip till application and each seeding rate tested was blocked into a 16 row area (width of strip till applicator). Both guidance systems utilized RTK. The study was planted on May 15, 2015 using a drawn Monosem 4 row twin planter. The seed monitor used was very basic and did not read seeded population. Therefore, it is important to note that seeding rate categories are based upon planter transmission charts and show some variance to stand counts. In order to achieve consistency of seeded population, twin row strips were planted using 18 cell vacuum plates. One of each paired rows was shut off to plant single row and a 36 cell plate was installed. This enabled us to use the same transmission setting and that all seed plates would turn the same rpm regardless of row spacing. Tractor guidance lines were set to place each of the paired twin rows on either side of the strip till line, when planting single row these guidance lines were not adjusted so as to remove the variable of placing a single row directly above the fertilizer band. Stand counts were taken on June 25, 2015 using a .005 acre area in each replication. Plant height (brace root to tassle), as well as ear set measurements were taken on August 2, 2015.

Results and Discussion

The 34.9k seeding rate produced yields ranging from 220.1 to 227.2 bushels per acre with twin row spacing showing a 7.1 bushel per acre advantage. Single row spacing at this rate exhibited a 2 inch higher average plant height and 0.5 inch higher ear set. At the 39.8k seeding rate we observed yields from 227.4 to 231.3 bushels per acre. Yields for the single row treatment showed a 3.9 bushel advantage in yield and averaged 2.7 inches higher plant height while having a 0.7 inch higher ear set. Statistical analysis calculated a significant yield threshold of 10.62 bushels per acre with an LSD of 0.20. Therefore, the only statistically significant yield difference in this test occurred between the two seeding rates for single row spacings (231.3 bushels per acre for single row 39.8k seeding rate, 220.1 bushels per acre with single row 34.9k seeding rate).

From an economic standpoint, at an example cost of $350 per bag for seed corn, a 4900 seeds per acre increase (34.9k-39.8k) adds $21.44 per acre. Yield differences between the two single row seeding rates (11.2 bushels), justifies the added seed cost with a differential breakeven cost of $1.91 per bushel. Comparing twin row yield at the 34.9k seeding rate to the single row spacing at the 39.8k rate gives a 4.1 bushels per acre advantage to the single row. Considering added seed cost, differential breakeven cost for increased yield with single row is $5.23 per bushel. At lower commodity prices, this does show benefit to lower seeded twin row spacing because of increased yields resulting with no added seed costs when comparing to single row.

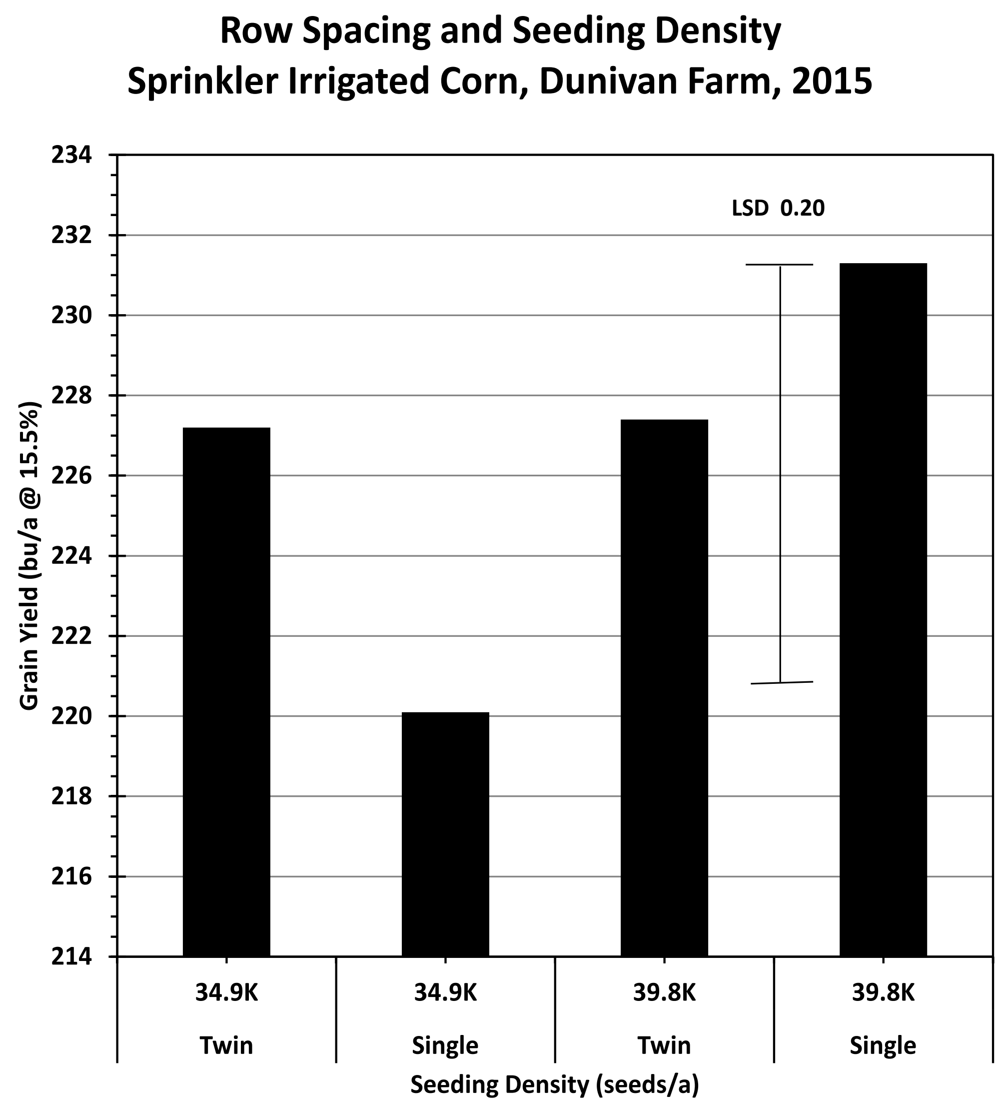


Figure 1. Yield comparison of single and twin row spacings at 34.9 and 39.8 thousand seeds per acre seeding rates.

Row Spacing	Single	Twin	Single	Twin
Seeding Rate	34,900	34900	39800	39800
Stand Count	30000	30600	34200	34800
Ear Set (Inches)	42.5	42	43.5	42.8
Plant Height (Inches)	115	113	112	109.3

Table 1. Stand count, ear set, and plant height for single and twin row corn at 34.9 and 39.8 thousand seeds per acre seeding rates.

Comparison of Single and Twin Row Spacings in Sprinkler Irrigated Corn 2015

Brett Pettinger and Kevin Larson

Cooperative Farmer: North Fork Farms, Walsh, CO
Tim Hume

Materials and Methods

This test was designed to quantify corn yield differences between single and twin row spacings in a full irrigation, high yield environment. The original study was intended to test seeded populations of 36,400 and 42,500 seeds per acre. This study was planted on May 28, 2015. Unfortunately, a very large hail event on June 11th, damaged plant stands so badly, the entire field was compromised. This caused a decision to alter the trial design and replant on June 18, 2015. Channel 215-52VT3 hybrid variety (semi-flex) was used to plant large blocks of three seeding rates which were first quantified by seeding rate (calculated by planter transmission setting) and revised based upon stand count. The categories tested were 30.8, 32.2 and 35.8 thousand plants per acre. Field preparation consisted of an early spring strip till application of 250 pounds nitrogen via anhydrous ammonia, 9 gallons 10-34-0 and .5 pounds zinc per acre. 5 gallons of 10-34-0 and .5 pounds of zinc were applied at each planting. Both single and twin row spacings were planted with the same Monosem 4 row twin planter. Single row spacing was accomplished by turning off one seed meter in each of the paired rows and switching to a seed plate with twice as many holes to accomplish the same seeding rate for twin and single rows by using the same sprocket selection on the planter's transmission. The available test area was quite large (180 feet wide), each treatment comprised at least 2.5 acres. In order to have a more manageable harvest area, a representative area of 400 feet in length was blocked off for yield testing(1.65 acres harvested). Stand counts and canopy measurements were taken on July 16, 2015. The plot received 20 acre inches of supplemental irrigation from planting date to harvest.

Results and Discussion

Mr. Hume's yields across the entire field averaged approximately 211 bushels per acre. Obviously this was quite an accomplishment for such a late planting date. The test area yield results ranged from 206.7 bushels per acre for single row 35,800 plants down to 158.3 bushels per acre for twin row with the same stand counts. Single row yield results showed a steady yield increase from 188.3 bushels per acre for 30,800 plant population to 206.7 bushels per acre for plant population of 35,200. Twin row spacing yields showed an inverse trend, peaking at the lowest seeding rate (179.3 bu/acre) and declining as planted population increased (158.3 bu/acre at 35.2k plant population). Please see figure 1 for yield results. We did not expect such a drastic yield decline in twin row spacing as plant population increased. Further investigation in the test area revealed evidence of *Gibberella* Stock Rot in all single and twin row treatments. Ground observations and aerial photography from a drone showed a significantly higher disease infestation throughout the twin row testing areas when compared to single row treatments. Analysis of stand counts and canopy observations shows a supportive pattern to increased infestation as plant population and early canopy percentage observations increase in the twin row treatments (See table 1). This leads us to believe that the early canopy advantage in twin row spacing created a more conducive environment for this disease early in the season. *Gibberella* Stock Rot is caused by fungi which are normally present throughout the United States. Warm, moist conditions create an environment that allows infiltration of plant tissues. Damages caused by this disease vary based upon plant maturity at the time of infection. Most of the damage caused in this particular plot resulted in short stocks that appeared to be broken off at the first node and never produced an ear. Another insight into the severity of *Gibberella* Stock Rot found is that this particular corn hybrid has shown susceptibility to the disease in other regions of the United States.

The extremely late planting date, early canopy development and hybrid susceptibility were the major driving forces of the onset of this disease. Because of this, it is the recommendation of our research team for farmers to exercise caution in hybrid selection, seeding density and row spacing selection when such late planting dates must be used.

Twin Row Observations

Population Category	Stand Count	Canopy	Yield
30800	30800	65%	179.3
32200	31200	65%	165.5
35200	34800	70%	158.3

Single Row Observations

Population Category	Stand Count	Canopy	Yield
30800	30800	35%	188.3
32200	33200	40%	200.4
35200	35500	35%	206.7

Table 1. Stand count, canopy and yield observations for single and twin row corn.

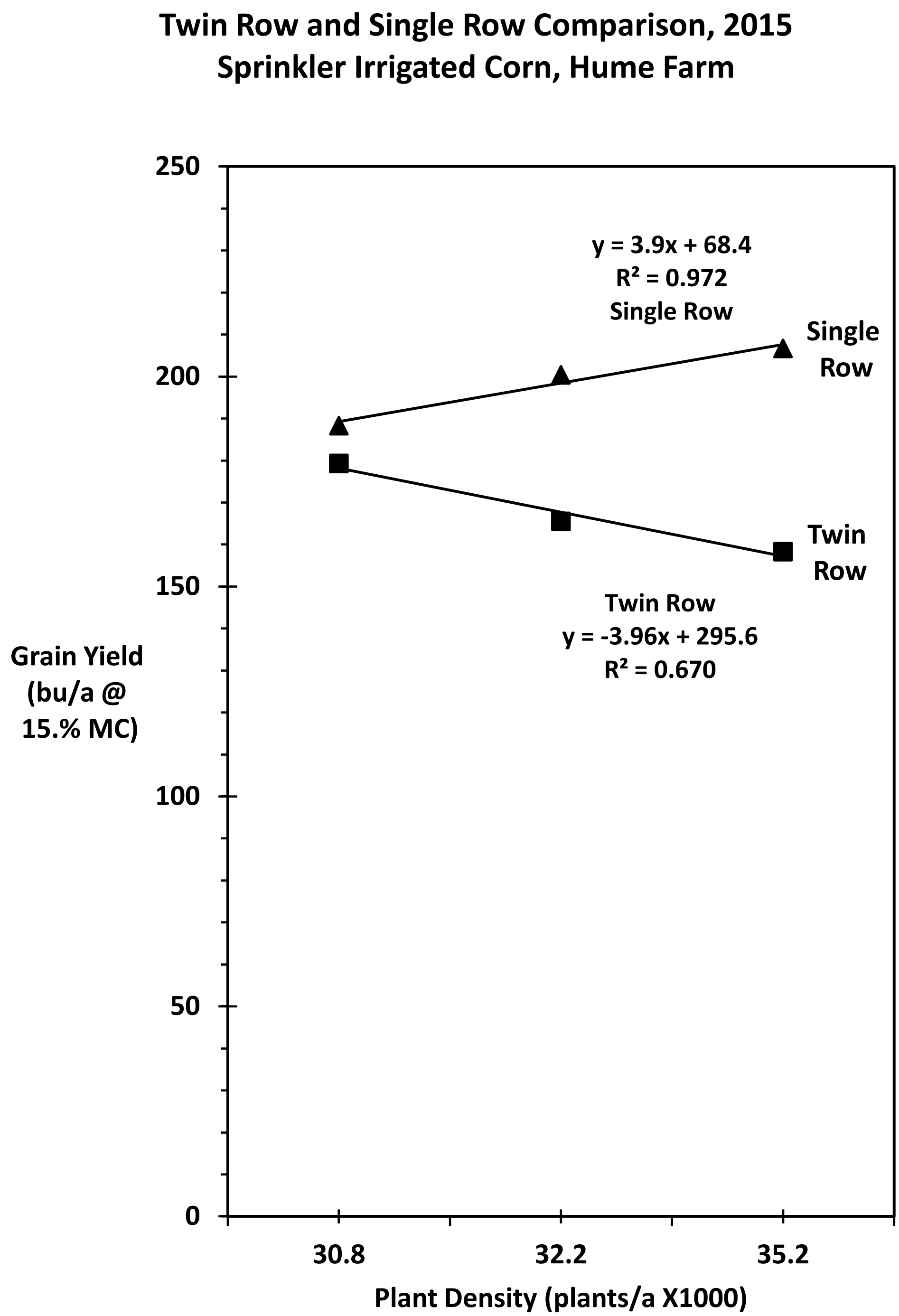


Figure 1. Yield trends for single and twin row spacings in relation to plant density.

Subsurface Drip Irrigated Grain Sorghum Twin Row and Single Row Comparison at Walsh, 2015

Brett Pettinger and Kevin Larson

Local farmer interest in planting corn and sorghum in twin rows has fueled the demand for quantifiable research results. This method of planting utilizes a pair of rows spaced 7.5 to 8 inches apart centered between what is traditionally a 30 inch spacing. Theoretically, twin row spacing should give the benefits of faster canopy development, less in-row plant competition and higher yields while still allowing for harvest with traditional corn or row crop heads.

Materials and Methods

Field preparation consisted of streaming 100 pounds of nitrogen via 28-0-0 using streaming nozzles spaced at 20 inches apart. Pre-plant herbicides used were Metachlor, Atrazine, Dicamba, 2-4-D and Glyphosate. The study was planted with a 4 row twin Monosem planter on May 15, 2015 using Sorghum Partners KS585 hybrid grain sorghum at a seeding rate of 42,500 seeds per acre for both single and twin row. In order to accomplish both row spacings with the same planter, one of the seed meters in each pair of row units was shut off to plant single row. 5 gallons of 10-34-0 was applied in seed furrow at planting time. Two separate irrigation zones were used for this test with subsurface drip tape spaced 60 inches apart. Each zone was designed in block form to test one replication for assurance of consistent irrigation between the treatments of single and twin rows.

Results and Discussion

The study received 13.73 inches of rainfall during the growing season. Two large hail events on June 11th and August 16th caused stand reduction and plant damage. The plot received approximately 8 inches of supplemental irrigation, most of which was applied between boot and fill stages. Damage from the first hail event on June 11th caused catastrophic damage to corn and sunflower studies less than 700 feet from this plot. Even with significant hail damage the trial averaged 81.5 bushels per acre. Average yields across the two replications showed the twin row grain sorghum averaged 3 bushels per acre higher than the single 30 inch row spacing. Statistically, this yield advantage was highly significant with an LSD of 0.20.

Interpretation

We now have two years of experience with twin row spacing in dryland and limited irrigated grain sorghum that has consisted of both traditional research and demonstrations. Thus far, grain sorghum twin row spacing has shown positive yield advantages in 5 out of 6 research plots and demonstrations which the Plainsman Research Center staff has been involved in. We recognize that twin row spacing in grain sorghum shows tremendous promise. It is the recommendation of our research team for area growers to consider hybrid maturity, seeding rate and projected irrigation (if any) while making the decision to plant grain sorghum in twin row spacing versus single. More is to be learned in management techniques to optimize the benefits of twin row spacing.

Table .-Subsurface Drip Irrigated Grain Sorghum Twin Row and Single Row Comparison at Walsh, 2015.

Row Orientation	Row Spacing	Grain Yield	Test Weight	Seed Moisture	Seeding Rate
	in	bu/a	lb/bu	%	seeds/a (X1000)
Twin	8 (30)	83.0	60.2	13.9	42.5
Single	30	80.0	60.7	14.2	42.5
Average		81.5	60.5	14.1	42.5
LSD 0.20		1.39			

Planted: May 15; Harvested: October 26, 2015.
Grain sorghum hybrid: Sorghum Partners KS585.
Row spacing: twin rows were spaced 8 in. apart and centered on 30 in. rows; single rows were spaced 30 in. apart.
Grain yields were adjusted to 14% seed moisture content.

Dragonline Precision Mobile Drip Irrigation and Long Drop Spray Nozzle Comparison of Sprinkler Irrigated Grain Sorghum when Planted in Straight and Circular Rows

Kevin Larson, Brett Pettinger and Monty Teeter

Drag dripline irrigation technology has been available for several years; however, it was not successfully implemented until Monty Teeter of Teeter Irrigation discovered the performance flaw. He found that it was essential to use pressure compensating dripline hose, as well as the implementation of other key technologies, to make drag dripline technology feasible. He has named this drag dripline technology, "Dragonline Precision Mobile Drip Irrigation (PMDI)." Sprinklers equipped with Long Drop Spray Nozzles (LDSN) are very efficient; nonetheless, water still covers the ground and the lower crop leaves, which causes evaporative losses. Applying surface drip irrigation minimizes evaporative losses occurring with spray nozzles. We conducted this sprinkler irrigation comparison of Dragonlines and LDSNs on grain sorghum to quantify the potential production advantage and to determine if planting in circular rows, instead of the commonly used straight rows, is required to keep the driplines precisely placed between the crop rows to optimize this new drag dripline technology.

Materials and Methods

We planted grain sorghum, Sorghum Partners KS585, at 52,600 seeds/a on June 2 and 3 in circular and straight row patterns. We seedrow applied 5 gal/a of 10-34-0 and 0.38 lb/a of Zn chelate at planting. We strip-tilled 150 lb N/a and 5 gal/a of 10-34-0 to the site. For weed control in the grain sorghum, we applied preemergence herbicides: glyphosate 32 oz/a, Sharpen 2.0 oz/a, atrazine 1.0 lb/a and S-Metolachlor 21 oz/a; and for post emergence herbicides we applied: Huskie 16 oz/a, atrazine 0.5 lb/a, AMS 1 lb/a and Activator 90 8 oz/a. We disked twice to control volunteer corn. We cultivated one time to control volunteer corn and to make a small furrow for the driplines to follow. The entire pivot was irrigated with LDSNs until June 23 after cultivation and reinstallation of the Dragonlines. The Long Drop Spray Nozzles and the Dragonlines were on 60 in. spacings. Teeter Irrigation removed the existing spray nozzles and installed the appropriate length of driplines on half of each sprinkler tower, leaving the other half of the tower with spray nozzles. Two towers were equipped with alternating sections of Dragonlines and LDSNs, providing two replications for our comparative study. From June 23 to September 23, 2.0 in/a irrigations were applied every other week through the Dragonlines and spray nozzles. The grain sorghum crop received 11 in/a in total irrigation. To monitor available soil moisture application and use of the Dragonlines and LDSNs, we installed gypsum blocks at 6, 18, 30, and 42 in. soil depths. We recorded electrical resistance readings of the gypsum blocks at weekly intervals. Resistance readings vary with the amount of soil water present. We calculated available soil water from the resistance readings using soil water depletion curves.

We harvested the grain sorghum plots on November 13 with a self-propelled combine and weighed the grain in a digital scale cart. Grain yields were adjusted to 14.0% seed moisture content.

Results and Discussion

The Dragonlines planted in circular rows produced the highest yield of 127.1 bu/a; however, there was no significant yield difference between sprinkler irrigations applied through the Dragonlines and the Long Drop Spray Nozzles when planted in circular rows. Surprisingly, Dragonlines planted in straight rows produced significantly more yield than LDSNs planted in straight rows. We expected that Long Drop Spray Nozzles would have more uniform coverage area than the narrow irrigation paths from the Dragonlines when irrigating across straight planted rows, especially on 60 in. spacings. The irrigation paths of the Dragonlines did not show uneven heights of the grain sorghum heads and, in fact, produced higher yields than the LDSNs. Comparing grain production of Dragonlines and LDSNs in circular rows to straight rows, the circular rows were significantly more productive than the straight rows. Planting in circular rows instead of straight rows is recommended for Dragonline PDMI as well as for Long Drop Spray Nozzles to get full yield advantage from these sprinkler irrigation application systems. Available soil water measured by gypsum blocks showed that Dragonlines had more available water from later in-season irrigations than the Long Drop Spray Nozzles. Higher available soil water after irrigations would lead to the higher grain production achieved by the Dragonlines compared to the LDSNs.

Besides the potential for higher yield through more efficient water application and placement, there are other advantages to the Dragonlines compared to the LDSNs. One advantage of Dragonlines is elimination, or at least a reduction, in sprinkler wheel tracks. Bouncing across wheel tracks is hard on equipment and removing a sprinkler stuck in deep muddy tracks is difficult work. Another advantage of Dragonlines is that they are cut to length to exactly match required nozzle flow, eliminating the overwatering of the inside spans, which occurs even with smallest spray nozzles. The most significant disadvantages to drag driplines are that it requires more management and perhaps filtration compared to conventional spray nozzles.

Table .--Dragonline PMDI and Long Drop Spray Nozzle
Comparison of Straight and Circular Rows
on Grain Sorghum at Walsh, 2015.

Treatment	Grain Yield		Test Weight	Moisture
	bu/a		lb/bu	%
Circular Rows				
Dragonline	127.1	a	59.6	12.9
Long Drop Spray Nozzle	121.9	ab	59.4	12.9
Straight Rows				
Dragonline	121.6	b	59.7	13.5
Long Drop Spray Nozzle	114.8	c	60.4	13.7
LSD 0.20	5.37			
Average	**121.4**		**59.8**	**13.3**

Planted: June 2 & 3; Harvested: November 13, 2015.
The entire pivot was irrigated with LDSNs until
June 23 before cultivation and reinstallation of the
driplines.
From June 23 to September 23, 2.0 in./a irrigations
were applied every other week.
The study received 11 in. of total irrigation.

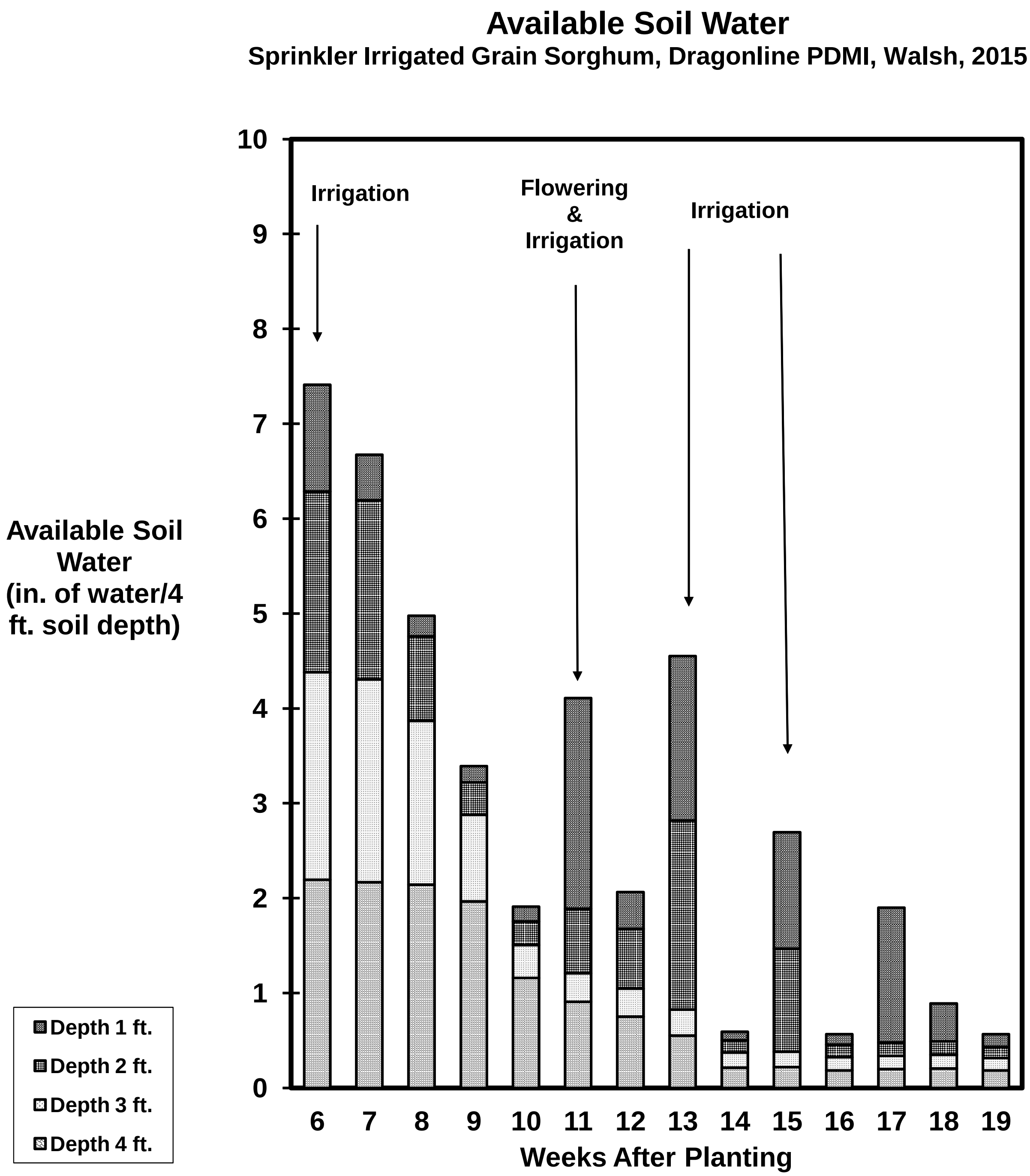


Fig. . Available soil water in sprinkler irrigation grain sorghum using Dragonline PDMI at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 14.25 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

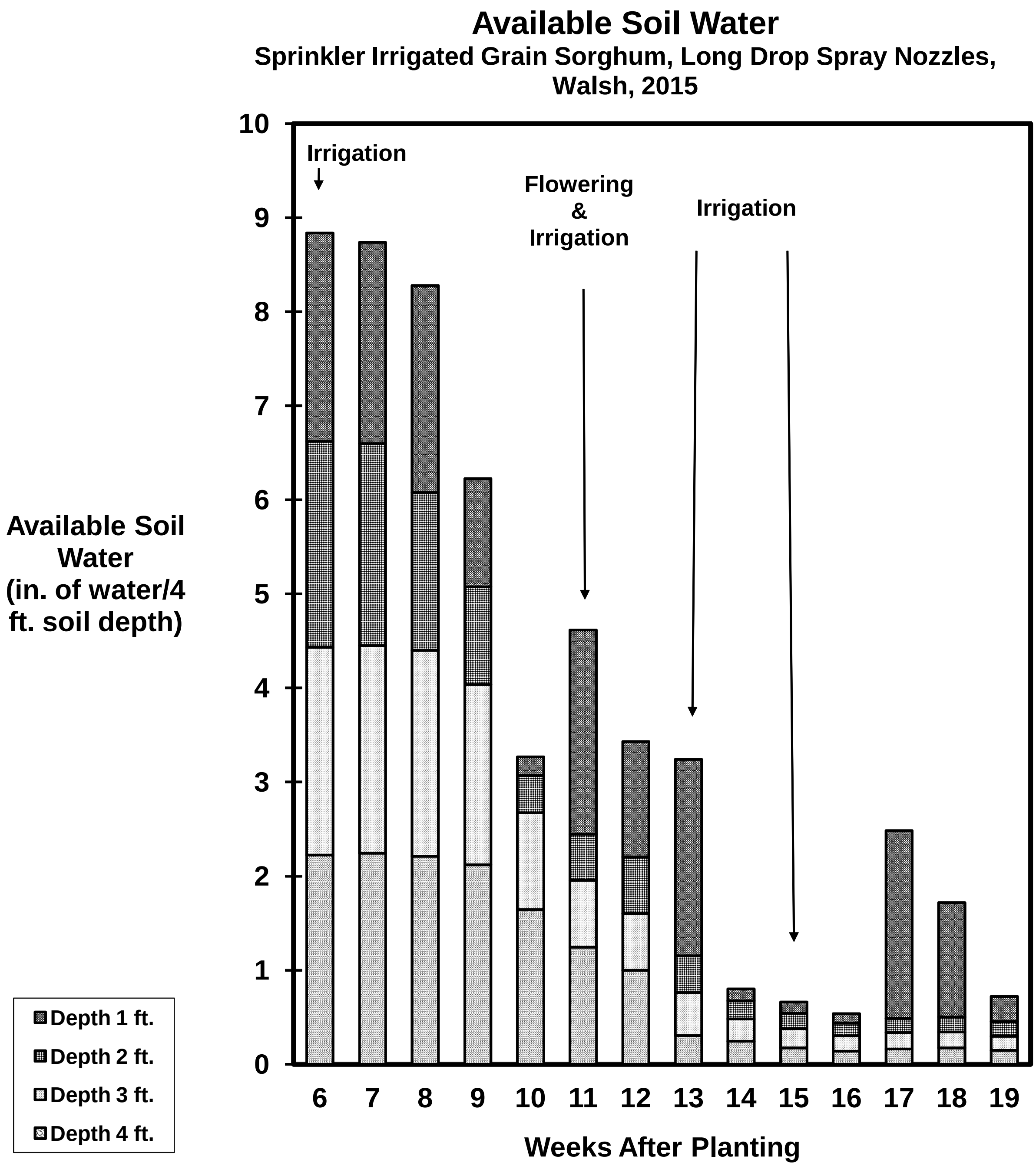


Fig. . Available soil water in sprinkler irrigation grain sorghum using Long Drop Spray Nozzles at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 14.25 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Long-Term N Effects on Irrigated Sunflower-Corn Rotation at Walsh, 2015

Kevin Larson and Brett Pettinger

Purpose: To study the long-term N fertilizer effects on irrigated Sunflower-Corn and Corn-Corn (continuous corn) rotations where N rate are applied to the same treatment site for multiple years.

Materials and Methods: All crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted each year, except in 2012. We did not plant sunflowers in 2012 because we mistakenly applied corn herbicides over all the plots, including the plots reserved for sunflower planting. This year, all crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted. We planted corn, Mycogen 2V709, on April 30 at 22,000 seeds/a, and sunflower, Mycogen 8H449CL, on June 2 at 26,500 seeds/a. A hailstorm on June 11 forced us to replant both the corn and the sunflowers. Before replanting, we swept the corn and sunflower plots to destroy the remaining hail-damaged crop plants. We replanted the corn on June 22 with Mycogen 2A499, a 99-day relative maturity corn. The sunflowers were replanted on June 18, but they failed to make a stand and were swept out. The stand of the replanted corn was somewhat erratic and was further reduced and damaged by another hailstorm on August 16. For our N treatments, we streamed liquid N (28-0-0) at 100, 150, or 200 lb/a with two replications. We seedrow applied 20 lb P_2O_5/a to the corn, but not the sunflowers. In addition to the seedrow applied P, the corn received 0.38 lb/a of Zn chelate. For weed control, we applied pre-emergence glyphosate 32 oz/a, 0.5 lb/a of 2,4-D, and Banvel 4 oz/a to both the corn and sunflower plots. The corn also received pre-emergence Balance Pro 1.75 oz/a, Sharpen 2.0 oz/a, Atrazine 1.0 lb/a, and COC 16 oz/a. For post emergence weed control in the corn, we applied two applications of Glystar Plus at 32 oz/a. For weed control in the sunflower, we applied pre-emergence Spartan 2 oz/a. No post emergence weed control was applied to the sunflower because they failed to establish a stand. The corn received approximately 15 in/a of irrigation. We harvested two replications of the 20 ft. by 650 ft. plots of corn on December 22 with a self-propelled combine and weighed them in a digital weigh cart. Corn yields were adjusted to 15.5% seed moisture content. There was no sunflower harvest because they failed to establish a stand.

Results and Discussion: Corn grain yields were very low due to hail damage from two hailstorms. The first hailstorm on June 11 required a late replanting date and resulted in marginal plant stands. The second hailstorm on August 16 stripped leaves and damaged stalks, which further reduced plant populations and yields. Grain yield in the continuous corn rotation increased linearly with increasing N rates, despite the low yields obtained this year. Typically, continuous corn requires high rates of N for high grain yields, but this year with low yields, it is surprising that the 100 lb N/a rate was not sufficient nitrogen for the current yield range of 61 bu/a to 65 bu/a. The corn in Sunflower-Corn rotation produced a low, but higher yield level, 61 bu/a to 74 bu/a, than the continuous corn rotation; however, unlike the continuous corn rotation, yields decreased with increasing N rates for the Sunflower-Corn rotation. With the low yields this year, we anticipated no yield increase with increasing N rates. This lack of N response to increasing N rates for the Sunflower-Corn rotation is similar to the no or low N response we reported in previous years.

There was no sunflower harvest for this study, and therefore, no sunflower analysis could be performed this year. In the past, we reported no or declining sunflower yield with increasing N in combination with low residual soil N. The recommended N fertilizer rates for our yield goals were 0 lb/a for sunflower and 0 lb/a for corn. Our yield goal for the corn was 150 bu/a, our actual average grain yield was 65 bu/a.

Table .-Soil Analysis.

Depth	pH	Salts mmhos/cm	OM %	N	P	K	Zn	Fe	S
				ppm					
0-8”	7.8	0.7	2.1	22	6	377	0.7	4.5	14.0
8-24”				24					

This is the tenth year of this long-term N on Sunflower-Corn rotation study. We started this study because of 1) the lack of N response for dryland sunflower in our long-term N on Wheat-Sunflower-Fallow study, 2) the role of N in reducing oil yield, and 3) reports from growers that their irrigated corn following sunflower often produced their highest yields. This year, the difference in average corn yield between the Sunflower-Corn and continuous corn rotations was 4.3 bu/a with the corn following sunflower producing higher yields than continuous corn. The higher corn production following sunflower recorded this year is in accord with our previous results and to growers' observations.

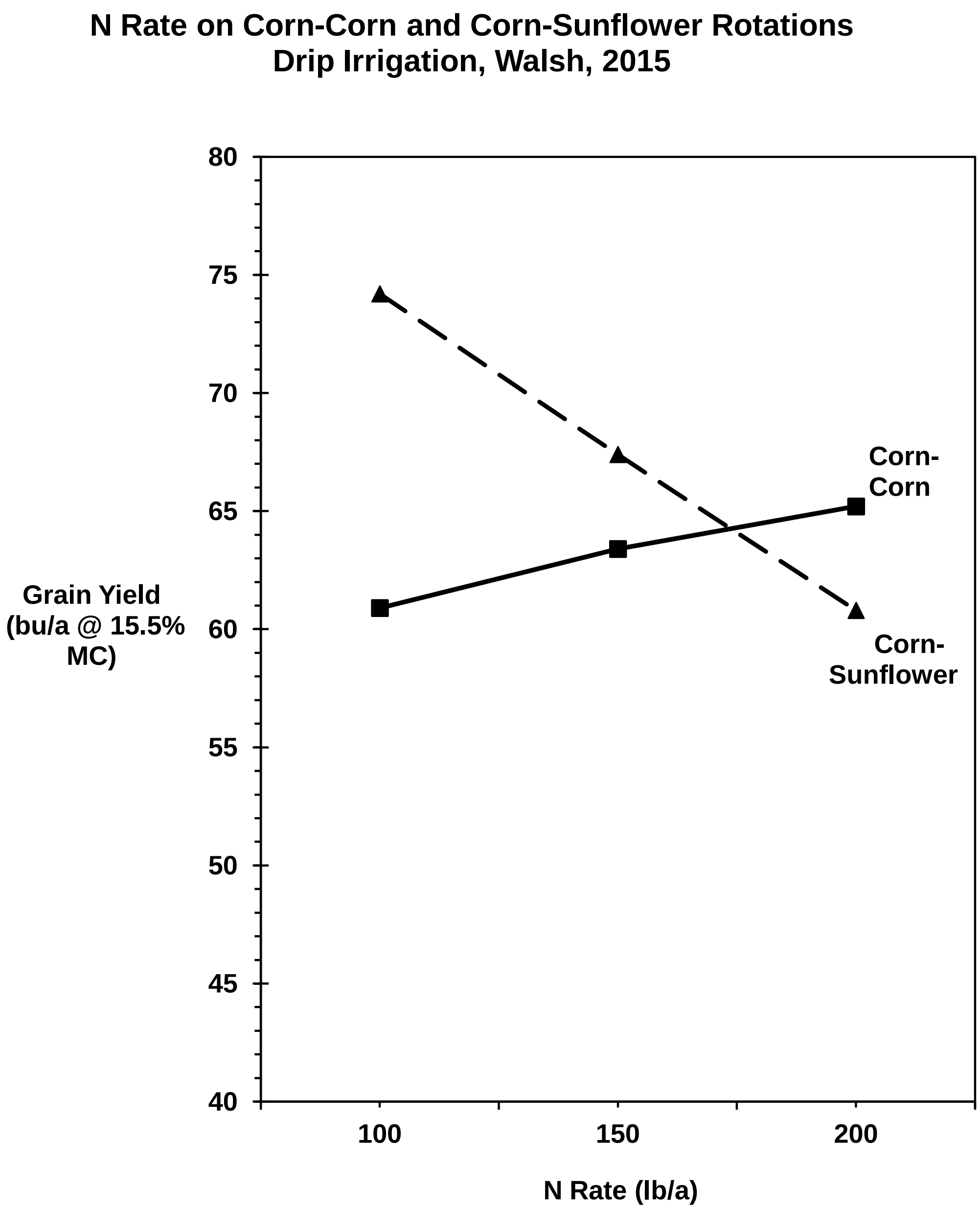


Fig. . N rate on drip irrigated corn in Sunflower-Corn rotations at Walsh. The N rates were 100, 150, and 200 lb N/a as 32-0-0. The corn hybrid was Mycogen 2V709 planted at 22,000 seeds/a.

Dryland Crop Rotation Study
Kevin Larson and Brett Pettinger

This is the eleventh cropping year for our dryland rotation study. We established these rotations because of results from our dryland rotation sequencing study and growers' desire to include winter wheat in the rotations. The dryland rotation sequencing study was designed for spring crops, and the inclusion of winter wheat with its fall planting and early summer harvesting times would not fit into the design pattern of the sequencing study. To include winter wheat into a dryland rotation study, we began a new dryland rotation study with these three rotations in 2005: 1) Wheat-Sorghum-Fallow, 2) Wheat-Sunflower-Fallow, and 3) Sorghum-Millet. In 2006, we added a fourth rotation, Millet/Wheat-Fallow, to this rotation study. This year we changed the Wheat-Sunflower-Fallow to Wheat-Corn-Fallow because the sunflower crops failed too often.

Materials and Methods

This is our ninth harvest year in testing the following rotations: Wheat-Grain Sorghum-Fallow (W-S-F) and Sorghum-Millet (S-M). We added a fourth rotation of Millet/Wheat-Fallow (M/W-F) in 2006. This year we changed the Wheat-Sunflower-Fallow rotation to Wheat-Corn-Fallow. In 2008 and 2011, no crops were harvested because of drought. We planted wheat, Byrd, at 50 lb/a on October 10, 2014; Proso millet, Huntsman, at 12 lb/a on June 24; grain sorghum, Channel 5C35, at 35,000 seeds/a on June 6; and corn, Mycogen 2V709, at 12,500 seeds/a on May 1, 2015. We applied 50 lb/a of N to the study site. Before planting we sprayed two applications of glyphosate at 32 oz/a, LoVol at 0.5 lb/a, and dicamba 6 oz/a. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Activator 90 8 oz/a; millet, Comet 21 oz/a and 2,4-D 6 oz/a; grain sorghum, atrazine 0.75 lb/a, Sharpen 2.0 oz/a, Huskie 16 oz/a, atrazine 0.5 lb/a; corn, atrazine 0.75 lb/a, Sharpen 2.0 oz/a, Balance 1.75 oz/a, glyphosate 32 oz/a. In addition, we swept all the fallow plots to control glyphosate-resistant kochia. We harvested the crops with a self-propelled combine equipped with a digital scale: millet, September 14; grain sorghum, November 11; and corn, November 14. The wheat crop was not harvest because of hail damage. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

The S-M rotation produced the highest annual rotation production of 2576 lb/a. The S-M rotation had relatively high yields for both grain sorghum and millet. All the other rotations have wheat in their rotations and there was no wheat harvest because of hail, therefore all the rotations with wheat suffered yield and revenue losses. The rotation with the second highest annual rotation production of 1038 lb/a was W-C-F, which was changed this year from Wheat-Sunflower-Fallow to Wheat-Corn-Fallow.

Along with the highest annual rotation production, the S-M rotation also returned the highest annual rotation variable net income of $117.98/a for 2015. The S-M rotation has a crop each year and this year both crops had good production; whereas, the W-S-F and the W-C-F rotations were essentially tied for the second highest annual rotation income. The incomes of W-S-F and W-C-F rotations were considerably lower than the S-M rotation because they have two crops in three years and the wheat in their rotations failed. Because we have all phases of each crop rotation present each year, we can compare annual rotation production and income even without a full crop rotational cycle. For example, the 2015 total production for the S-M rotation was 5146 lb/a. The crop rotational phases were: grain sorghum, 3646 lb/a; millet 1500 lb/a. The annual rotation production would be 2537 lb/a, which is half the total production because the S-M rotation takes two years to complete one rotation cycle.

This year the M/W-F rotation produced the least variable net income because it had the lowest millet yield and wheat, the other crop in its rotation, failed.

The long term annual rotational income, after the last seven harvest years, favors the S-M rotation with $124.72/a. The S-M rotation is an annual cropping rotation of grain sorghum and proso millet with no summer fallow period. The S-M rotation has typical winter fallow periods between the summer crops, which are sufficient fallow periods under average winter moisture conditions. The rotation with the second highest long term income is W-S-F with $85.17/a. The W-S-F rotation has extended fallow periods with a summer fallow preceding the wheat and a long winter fallow before the sorghum. During the recent dry years, the extended fallow periods of the W-S-F rotation have contributed to its higher production and income.

In past years, winter wheat performed better than the spring crops in both yield and income. However recently, the wheat crop failed in three of the last four years: two times it was lost to hail and one year it winterkilled. Corn replaced sunflower in the W-Sunflower-F rotation because the sunflower crops failed six out of seven cropping years. Without sunflower crop income this year, and no wheat crop, rotations containing grain sorghum, millet and corn had higher incomes. This suggests that rotations that include adapted crops will spread income risk and may increase crop rotation revenue over multiple years.

Table .-Dryland Crop Rotation Study, Crop Production, 2015.

	Crop Production						
	--------2015 Crop--------					2015 Total	Annual
Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow	Rotation Production	Rotation Production
	----------lb/a----------						
S-M		3646	1500			5146	2573
W-S-F	0	2901			0	2901	967
M/W-F	0		1333		0	1333	667
W-C-F	0			3114	0	3114	1038
Average	0	3274	1417	3114	0	3124	1311
LSD 0.20	--	215.7	1020.4				

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The wheat was completely destroyed by hail and was not harvested.
This is the first year of W-C-F, previously it was W-Sunflower-F.

Table .-Dryland Crop Rotation Study, Variable Net Income, 2015.

	--------2015 Crop--------					2015 Total	Annual Rotation
Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow	Crop Net Income	Variable Net Income
	----------$/a----------						
S-M		164.57	71.39			235.96	117.98
W-S-F	-26.46	121.34			-38.46	56.42	18.81
M/W-F	-26.46		60.89		-38.46	-4.03	-2.02
W-C-F	-26.46			119.19	-38.46	54.27	18.09
Average	-26.46	142.95	66.14	119.19	-38.46	85.65	38.21

Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Net Income divided by the number of years to complete one rotation cycle.
The wheat crop was not harvest because of hail damage.

Table .-Dryland Crop Rotation Study, Walsh, 2015.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		--------------------	--------------------	$/a	--------------------	--------------------	--------------------
<u>Wheat</u>	50 lb	10.00	16.46	0 bu	4.50/bu	0.00	-26.46
M/W-F				0.0	4.50	0.00	-26.46
W-C-F				0.0	4.50	0.00	-26.46
W-S-F				0.0	4.50	0.00	-26.46
<u>Millet</u>	12 lb	4.20	18.21	25.3 bu	3.50/bu	88.55	66.14
S-M				26.8	3.50	93.80	71.39
M/W-F				23.8	3.50	83.30	60.89
<u>Grain Sorghum</u>	35,000 seeds	5.25	41.76	58.5 bu	3.25/bu	189.96	142.95
S-M				65.1	3.25	211.58	164.57
W-S-F				51.8	3.25	168.35	121.34
<u>Corn</u>	12,500 seeds	52.80	42.07	55.6 bu	3.85/bu	214.06	119.19
W-C-F				55.6	3.85	214.06	119.19
Fallow	---	---	38.46	---	---	-38.46	-38.46
Average			31.39			90.82	52.67

Planted: Grain Sorghum, Channel 5C35 at 35,000 seeds/a on June 6; Millet, Huntsman at 12 lb/a on June 24; and Corn, Mycogen 2V709 at 12,500 seeds/a on May 1; Wheat, Byrd at 50 lb/a on October 10, 2014.
Harvested: Millet, September 14; Grain Sorghum, November 11; Corn, November 14. Wheat was not harvested due to hail damage.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .-Dryland Crop Rotation Study, Annual Rotation Income, 2007 to 2015.

Rotation	Annual Rotation Variable Net Income 2007	2009	2010	2012	2013	2014	2015	Total Crop Net Income	Average Annual Rotation Variable Net Income
	$/a								
S-M	118.18	141.76	262.97	98.38	27.79	105.98	117.98	873.03	124.72
W-S-F	120.47	105.16	198.75	39.81	56.60	56.59	18.81	596.19	85.17
M/W-F	121.22	143.26	135.55	52.97	41.67	-21.87	-2.02	470.79	67.26
W-Sun-F	103.07	27.69	99.95	-32.88	8.17	-32.93	--	173.07	28.84
W-C-F							18.09	18.09	18.09
Average	115.74	104.47	174.31	39.57	33.55	26.94	33.69	528.27	76.50

No crops were harvested in 2008 and 2011 because of drought.
The 2012 (hail), 2014 (winterkill) and 2015 (hail) wheat crops were not harvested.
The sunflower crops were not harvested in 2006, 2009, 2012, 2013, and 2014.
In 2015 corn replaced sunflower in the W-Sun-F rotation.
Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Variable Net Income
divided by years to complete one rotational cycle.

Dryland Millet and Wheat Rotation Study

Kevin Larson and Brett Pettinger

This was the ninth cropping year for our dryland millet and wheat rotation study. We established these rotations to identify which millet and wheat and fallow rotation sequences produce the highest net incomes. Each rotation represents different fallow length. We began this new dryland rotation study with these six rotations in 2006: 1) Wheat-Fallow (15-month fallow period), 2) Wheat-Wheat (3-month fallow period), 3) Millet-Millet (8-month fallow period), 4) Wheat-Millet-Fallow (23-month fallow period, 11 months between wheat harvest and millet planting, and 12 months between millet harvest and wheat planting), 5) Millet/Wheat-Fallow, (no fallow between millet harvest and wheat planting and 11 months between wheat harvest and millet planting), and 6) Wheat/Millet-Fallow (no fallow between wheat harvest and millet planting and 11 months between millet harvest and wheat planting).

Materials and Methods

This was our eighth crop harvest for the following rotations: Wheat-Fallow (W-F), Wheat-Wheat (W-W), Millet-Millet (M-M), Wheat-Millet-Fallow (W-M-F), Millet/Wheat-Fallow (M/W-F), and Wheat/Millet-Fallow (W/M-F). We planted winter wheat, Byrd, at 50 lb/a on September 10, 2014 and Proso millet, Huntsman, at 12 lb/a on June 24, 2015. We applied 50 lb N/a to the study site. Before planting we sprayed two applications of glyphosate at 32 oz/a, dicamba 6.0 oz/a, and LoVol 0.5 lb/a and swept the fallow plots to control glyphosate resistant kochia. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Activator 90 8 oz/a; millet Comet 21 oz/a and 2,4-D ester 6 oz/a; and fallow, glyphosate 32 oz/a, dicamba 6 oz/a and LoVol 0.5 lb/a two times. We harvested the millet on September 15 and the wheat on July 2 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14% moisture content for the millet and 12% moisture content for the wheat. We recorded cost of production and yields in order to determine rotation revenues. There were no crops harvested in 2008 because of drought. Only wheat was harvested in 2011: the millet was not planted because of drought. This year, millet in the W/M-F rotation failed to establish a stand because hail caused an abundance of volunteer wheat.

Results and Discussion

Both wheat and millet yields were low, averaging 10 bu/a for wheat and 12 bu/a for millet. The wheat yields were low because of a hailstorm on June 11 that caused considerable lodging and seed shattering. The rest of the wheat on the Plainsman farm was completely obliterated; in fact, this is the only wheat we harvested. The late June planting date for the millet undoubtedly contributed to its low yield. In a nearby dryland rotation study which included grain sorghum and millet (M-S) rotation, the grain sorghum phase had a very good yield, while the yield of the millet phase was only fair. The planting date of the grain sorghum was June 6 (near the optimum planting date); whereas, the June 24 planting date of the millet was beyond its optimum planting date. This year, three of the six rotations produced positive annual rotation variable net incomes. This year the W-W rotation generated the highest amount of income,

$12.23/a. The continuous wheat (W-W) rotation also provided the highest average net return of $40.58/a for the past seven harvest years.

For the nine years that we have conducted this study, we have had multiple crop failures and missed plantings, therefore rotational affects are, at best, difficult to generalize and quantify. This year, hail lowered wheat yields, and millet yields were reduced by a late planting date. The W/M-F rotation did not establish a millet stand because hail caused volunteer wheat to blanket the area. After the past seven harvest years, and acknowledging crop failures and missed plantings, the W-W rotation produced the highest and the W-M-F the second highest average annual rotation variable net income of $40.58/a and $30.77/a, respectively. The four other rotations provided around $10/a to $24/a in average annual rotation variable net income after seven harvest years. In 2014, late planting dates for both wheat and millet reduced yields (and the M-M rotation failed to establish a stand). In 2013, dry conditions reduced yields of both wheat and millet crops, and we failed to plant millet in the W/M-F rotation. In 2012, millet was the only crop harvested because the wheat crop was completely lost to hail, and we failed to plant millet in the M/W-F and W/M-F rotations. In 2011, we had wheat production, but no millet production; therefore, we were able to plant and harvest only the wheat for in all phases of the rotations containing wheat. In 2010, there was sufficient precipitation to plant and harvest all wheat and millet crops in all rotations. The W-W rotation had the highest annual rotation variable net income in 2010. In 2009, adequate spring and summer moisture produced good yields for most crops with the wheat and millet producing similar yields. No crops were harvested in 2008 because of drought. Winter wheat performed better than millet in both yield and income in 2007.   In 2007, it was too dry for the millet planted immediately after wheat harvest (millet in the W/M-F) to establish a stand. We missed planting wheat in the M/W-F rotation in 2008. In 2009, we did not plant millet in the W/M-F rotation because of delayed volunteer wheat control.

There appears to be no relationship between fallow length and yields and incomes of the wheat and millet rotations in this study. The rotation with the highest annual rotation variable net income after the past seven cropping years is W-W, which has the shortest fallow period of 3 months. The W-M-F rotation has the second highest annual rotation variable net income after seven years and it has the longest fallow length of 23 months (when totaling both fallow periods between the wheat and millet). When correlating production performance against precipitation, the W-W rotation tended to perform better in wetter years (with the exception of 2007, which was a dry year but had good winter moisture), while the W-M-F rotation tended to perform better in drier years.

Table .Dryland Millet-Wheat Rotation, Crop Production, 2015.

Rotation	Wheat	Millet	Fallow	2015 Total Rotation Production	Annual Rotation Production
	-----------2015 Crop----------				
	-------------------------lb/a----------------------------				
W-F	594			594	297
W-W	510			510	510
W-M-F	780	1092		1872	624
M/W-F	432	1064		1496	748
W/M-F	588	0		588	294
M-M		437		437	437
Average	581	648		916	485
LSD 0.20	134.5	245.5			

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The wheat crop was damaged by hail.
The W/M-F rotation failed to make a stand because the volunteer wheat was too dense.

Table .Dryland Millet-Wheat Rotation, Variable Net Income, 2015.

Rotation	-----------2015 Crop---------- Wheat	Millet	Fallow	2015 Total Crop Net Income	Annual Rotation Variable Net Income
	-------------------------$/a----------------------------				
W-F	18.53		-44.54	-26.01	-13.01
W-W	12.23			12.23	12.23
W-M-F	32.48	45.16	-44.54	33.10	11.03
M/W-F	-2.87	43.41	-44.54	-4.00	-2.00
W/M-F	18.08	-23.09	-44.54	-49.55	-24.78
M-M		4.21		4.21	4.21
Average	15.69	17.42	-44.54	-5.00	-2.05

Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Net Income divided by the number of years to complete one rotation cycle.
The W/M-F rotation failed to make a millet stand.
The wheat crop was damaged by hail.

Table .-Dryland Millet and Wheat Rotation Study, Walsh, 2015.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
	lb/a	$/a	$/a	bu/a	$/a	$/a	$/a
Wheat							
W-F	50	10.00	16.02	9.9	4.50	44.55	18.53
W-W	50	10.00	16.02	8.5	4.50	38.25	12.23
W-M-F	50	10.00	16.02	13.0	4.50	58.50	32.48
M/W-F	50	10.00	25.27	7.2	4.50	32.40	-2.87
W/M-F	50	10.00	16.02	9.8	4.50	44.10	18.08
Wheat Average	**50**	**10.00**	**17.87**	**9.7**	4.50	**43.56**	**15.69**
Millet							
M-M	12	4.20	18.89	7.8	3.50	27.30	4.21
W-M-F	12	4.20	18.89	19.5	3.50	68.25	45.16
M/W-F	12	4.20	18.89	19.0	3.50	66.50	43.41
W/M-F	12	4.20	18.89	0	3.50	0.00	-23.09
Millet Average	**12**	**4.20**	**18.89**	**11.6**	3.50	**40.51**	**17.42**
Fallow	---	---	44.54	---	---	0.00	-44.54
Average			18.32			43.56	-3.81

Planted: Millet, Huntsman at 12 lb/a on June 27; Wheat, Byrd at 50 lb/a on October 15, 2013.
Harvested: Millet on September 23; Wheat on July 7.
Wheat herbicides: Express 0.33 oz/a, 2,4-D, 0.38 lb/a, Activator90 8 oz/a;
Wheat herbicide cost: $10.02/a
Millet herbicides: Comet 21 oz/a, 2,4-D ester 6 oz/a: Millet herbicide cost: $12.89/a
Fallow herbicides: glyphosate 32 oz/a, 2,4-D 0.5 lb/a, dicamba 6 oz/a;
Fallow herbicide cost: $10.27/a per application (two applications, $6.00/a per application)
Swept fallow once to control glyphosate resistant kochia. Kochia control cost: $12/a
Wheat in M/W-F additional herbicide: glyphosate 32 oz/a cost $3.25/a.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .Millet-Wheat Rotation, Annual Rotation Income, 2009 to 2015.

Rotation	2009	2010	2011	2012	2013	2014	2015	Total Crop Net Income	Average Annual Rotation Variable Net Income
	Annual Rotation Variable Net Income								
	$/a								
W-F	52.13	112.08	63.66	-21.47	-27.93	-15.78	-13.01	162.68	23.24
W-W	105.30	170.76	78.46	-19.04	-26.02	-25.42	12.23	284.04	40.58
W-M-F	72.66	116.42	37.05	-1.65	12.05	-21.12	11.033	215.41	30.77
M/W-F	32.87	123.45	-34.96	-25.79	-1.95	-24.21	-2.00	69.42	9.92
W/M-F	38.57	118.77	59.48	-21.47	-23.58	-12.48	-24.78	159.30	22.76
M-M	73.83	93.66	-23.30	47.39	-0.56	-23.09	4.21	167.93	23.99
Average	62.56	122.52	30.07	-7.00	-11.33	-20.35	-2.05	176.46	25.21

No millet was harvested in 2011 because of drought.
No wheat was harvested in 2012 because of hail damage.
Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Variable Net Income divided by years to complete one rotational cycle.

The Effects of Spring and Winter Cover Crops on Dryland Crop Production

Kevin Larson and Brett Pettinger

One of the Natural Resource Conservation Service (NRCS) current foci is on cover crops and their affects on soil health. Much of this recent work with cover crops is from much higher precipitation and much lower evaporation locations, such as the Upper Midwest (Conservation Tillage & Technology Conference, 2011), than we have in Southeastern Colorado. Few cover crop studies have been conducted on dryland rotations in low moisture, high evaporation climates such as we experience in our region and the reports from these dryland cover crop studies have been less than favorable (Larson, 1995; Schlegel and Havlin, 1997; Vigil and Nielsen, 1998). We began this study to measure the effects of cover crops on yields of common dryland crop rotations in our semi-arid climate where water conservation is the key to successful dryland crop production.

Materials and Methods

We tested cover crops and N rates in two common crop rotations: Wheat-Fallow (W-F) and Wheat-Sorghum-Fallow (W-S-F). Our treatments for this cover crop study were: four spring and four winter cover crops, three N rates, and two crop rotations. We planted spring cover crops: oats at 60 lb/a, rapeseed at 5 lb/a, hairy vetch at 30 lb/a, and Spring N Mix at 58 lb/a (lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a). We planted the spring cover crops in the W-S-F rotation on March 19, 2014 during the summer fallow period after sorghum harvest. We had planned to terminate the spring cover crops in July before wheat planting, however this year the spring cover crops failed. We planted winter cover crops: triticale at 60 lb/a, rapeseed at 5 lb/a, hairy vetch at 30 lb/a, Winter N Mix at 43 lb/a (hairy vetch, 8 lb/a; winter pea, 8 lb/a; sweet clover, 2 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudan grass, 3 lb/a). We planted the winter cover crops for the wheat in the W-F rotation on October 2, 2013. Normally we terminate them in April, but this year the winter cover crops failed. We planted the winter cover crops prior to sorghum planting in the W-S-F rotation on August 29, 2014 into wheat stubble and we sprayed a tank mix of glyphosate, 2,4-D and dicamba to terminate the cover crops and to control weeds in the N plots on March 27, 2015. All cover crop seeds were from Green Cover Seed in Bladen, Nebraska. Our three N rates were 0, 25, and 50 lb/a stream applied as 28-0-0 or 32-0-0. No N was applied to the cover crop plots. After establishing the rotations, all phases of each rotation were present each year. We were only able to test grain sorghum in the W-S-F rotation because the wheat crops in the W-F and W-S-F rotations were severely damaged by hail and were not harvested. We planted Channel 5C35 at 35,000 seeds/a on June 6, 2015 and seedrow applied 5 gal 10-34-0/a at planting. For in-season broadleaf weed control in the grain sorghum crop, we applied a tank mix of Huskie 16 oz/a, atrazine 0.5 lb/a, AMS 2 lb/a, and Activator 90 8 oz/a. We inserted gypsum blocks at 6 in., 18 in., and 30 in. depths to measure soil water use by the cover crops. We harvested the grain sorghum on November 7, 2015 with a self-propelled combine equipped with a digital scale. Grain sorghum grain yields were adjusted to 14.0% seed moisture content.

Results and Discussion

Precipitation during the growth and termination of the winter cover crops (seven months, September through March) for the W-S-F rotation was 7.60 in. After seven months of growth, the average dry matter production of the cover crops was 3679 lb/a. The cover crops forage yields ranged from 3481 lb/a for the winter N mix to 3799 lb/a for hairy vetch. There was no significant forage difference between the cover crops at the 0.20 alpha level.

When terminated after seven months of growth, the cover crops used: 6.03 in. for hairy vetch, 4,92 in. for Winter N Mix, 4.61 in. for rapeseed, and 3.28 in. for triticale of soil water to a depth of three feet. The fallow 0N check used 0.79 in. of soil water to a depth of three feet during the same seven month period. Therefore, subtracting soil water used by cover crops from soil water used during no-till fallow equals the water use cost of cover crops. The water use cost to a soil water depth of three feet was 5.24 in. for hairy vetch, 4.13 in. for Winter N Mix, 3.82 in. for rapeseed, and 2.49 in. for triticale. Winter N Mix and triticale had the lowest water use of the cover crops tested.

The treatment with the highest grain sorghum yield was N at 25 lb/a with 42.9 bu/a, which was significantly higher than all the cover crop yields. The grain yields of the 0 lb N/a and 50 lb N/a treatments were significantly higher than all the cover crop treatments except the hairy vetch treatment. There were no significant grain yield differences between the N treatments, nor were there significant grain yield differences between the cover crop treatments.

The 0 lb N/a treatment produced the highest variable net income, $128.38/a, because it had high grain yield and no treatment cost. The 25 lb N/a treatment had the highest grain yield and the second highest variable net income of $118.93/a. The lowest variable net income, $21.68/a, was from the Winter N Mix cover, which had the lowest yield and the second highest treatment cost. Because of the failure of the cover crops preceding the wheat and the lost of the wheat crops to hail, the effects of the cover crops on subsequent wheat yields cannot be determined; however, the detrimental effects of cover crops preceding grain sorghum is clearly evident in lower grain yields and reduced incomes.

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Table .-Cover Crop Study, Grain Sorghum after Winter Cover Crop, Walsh, 2015.

Treatment	Grain Sorghum Yield	Test Wt.	Cover Dry Matter	Cover N	Fixed N	Treatment Cost	Fixed N Income	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	lb/a	$/a	$/a	$/a
Rapeseed	25.4	49.8	3769	91.1		16.75		65.80
Triticale	25.0	51.2	3667	129.1		28.80		52.45
Hairy Vetch	28.9	51.9	3799	152.6	23.5	69.00	14.10	39.03
Winter N Mix	20.9	51.5	3481	128.7		46.25		21.68
0 N	39.5	56.1				0.00		128.38
25 N	42.9	54.5				20.50		118.93
50 N	40.8	55.3				35.50		97.10
Average	31.9	53	3679	125.3		30.97		74.76
LSD 0.20	13.0		1402					

Cover crops planted: August 29, 2014.
Cover crops terminated: March 27, 2015.
Grain sorghum planted: June 6; Harvested: November 7, 2015
Cover crop seeding rate: Winter N Mix, 43 lb/a; hairy vetch, 30 lb/a; rapeseed, 5 lb/a; triticale, 50 lb/a.
Winter N Mix: hairy vetch, 8 lb/a; sweet clover, 2 lb/a; winter forage pea, 8 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudangrass BMR, 3 lb/a.
Cover seed cost: Winter N Mix, $34.25/a; hairy vetch, $57/a; rapeseed, $4.75/a; triticale, $16.80/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a; N application, $5.50/a.
Grain sorghum price: $3.25/a.

Table .-Cover Crop Study, Wheat (W-F) after Winter Cover Crop, Walsh, 2015.

Treatment	Wheat Yield	Test Weight	Cover Dry Matter	Cover N	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	$/a	$/a
Triticale	0	0	0	0	28.80	-28.80
Rapeseed	0	0	0	0	16.75	-16.75
Winter N Mix	0	0	0	0	46.25	-46.25
Hairy Vetch	0	0	0	0	69.00	-69.00
0 N	0	0			0.00	0.00
25 N	0	0			20.50	-20.50
50 N	0	0			35.50	-35.50
Average	0	0	0	0.0	30.97	-30.97
LSD 0.20						

Winter cover crops planted: October 2, 2013, winter cover for W-F; winter cover crops failed to make stands.
Cover crop dry matter reported at 0% moisture.
Cover crop N is calculated from dry matter protein divided by 6.25.
Wheat planted: September 22, 2014; wheat hailed out.
Winter cover crop seeding rate: Winter N Mix, 43 lb/a; hairy vetch , 30 lb/a; rapeseed, 5 lb/a; triticale, 50 lb/a.
Winter N Mix: hairy vetch, 8 lb/a; sweet clover, 2 lb/a; winter forage pea, 8 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudangrass BMR, 3 lb/a.
Cover seed cost: Winter N Mix, $34.25/a; hairy vetch, $57/a; rapeseed, $4.75/a; triticale, $16.80/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a; N application, $5.50/a.
Wheat price: $4.50/a.

Table .-Cover Crop Study, Wheat (W-S-F) after Spring Cover Crop, Walsh, 2015.

Treatment	Wheat Yield	Test Weight	Cover Dry Matter	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	$/a	$/a
Oats	0	0	0	24.60	-24.60
Rapeseed	0	0	0	16.75	-16.75
Spring N Mix	0	0	0	41.65	-41.65
Hairy Vetch	0	0	0	69.00	-69.00
0 N	0	0		0.00	0.00
25 N	0	0		20.50	-20.50
50 N	0	0		35.50	-35.50
Average	0	0	0	29.71	-29.71
LSD 0.20					

Spring cover crops planted: March 19, 2014, spring cover for wheat in W-S-F; spring cover crops failed.
Wheat planted: September 22, 2014; wheat hailed out.
Spring cover crop seeding rate: Spring N Mix, 58 lb/a; hairy vetch , 30 lb/a; rapeseed, 5 lb/a; oats, 60 lb/a.
Spring N Mix: lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a.
Cover seed cost: Spring N Mix, $29.65/a; hairy vetch, $57/a; rapeseed, $4.75/a; oats, $12.60/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a; N application, $5.50/a.
Wheat price: $4.50/a.

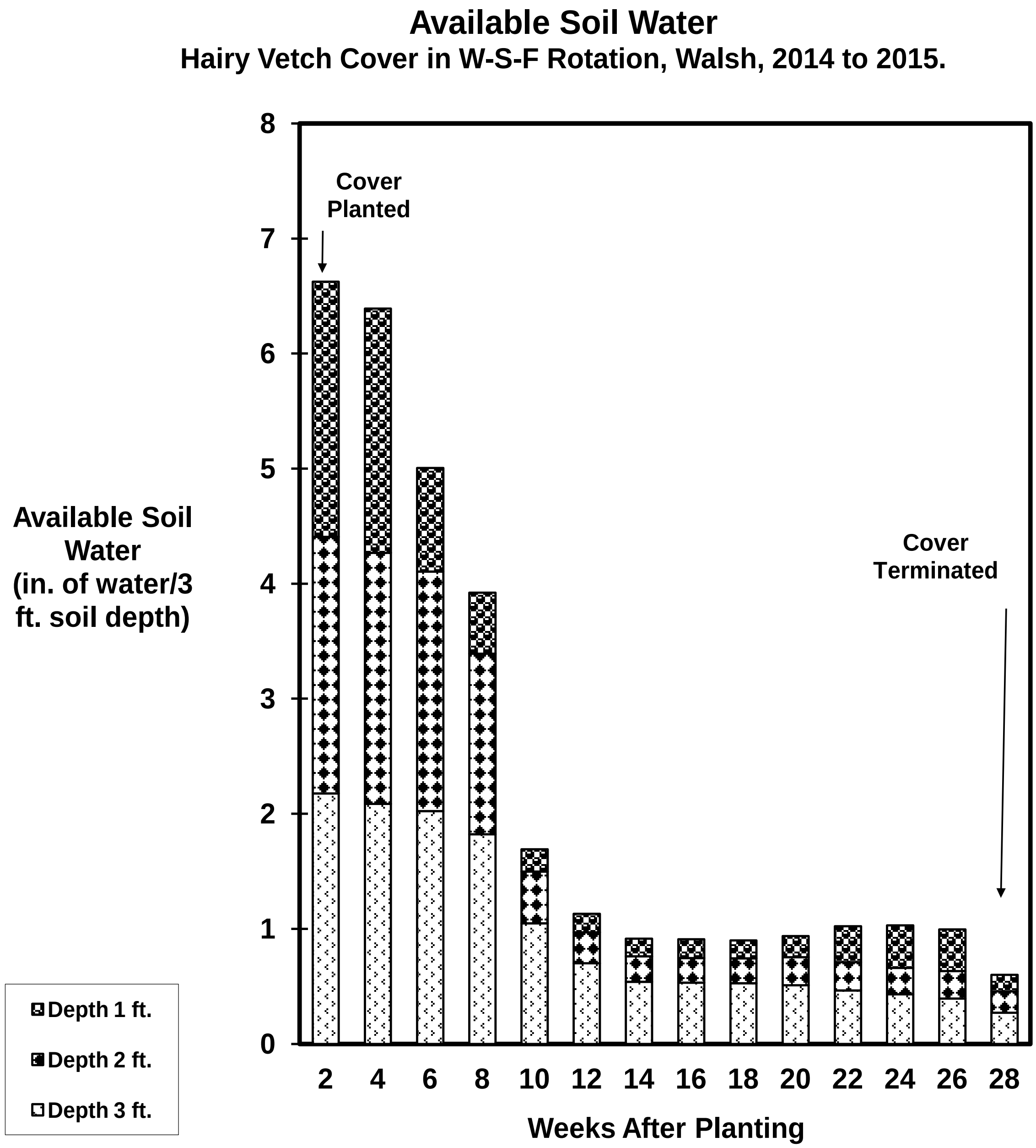

Fig.   . Available soil water of hairy vetch cover in W-S-F Rotation at Walsh.Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.60 in. Any increase in available soil water between weeks is from rain.

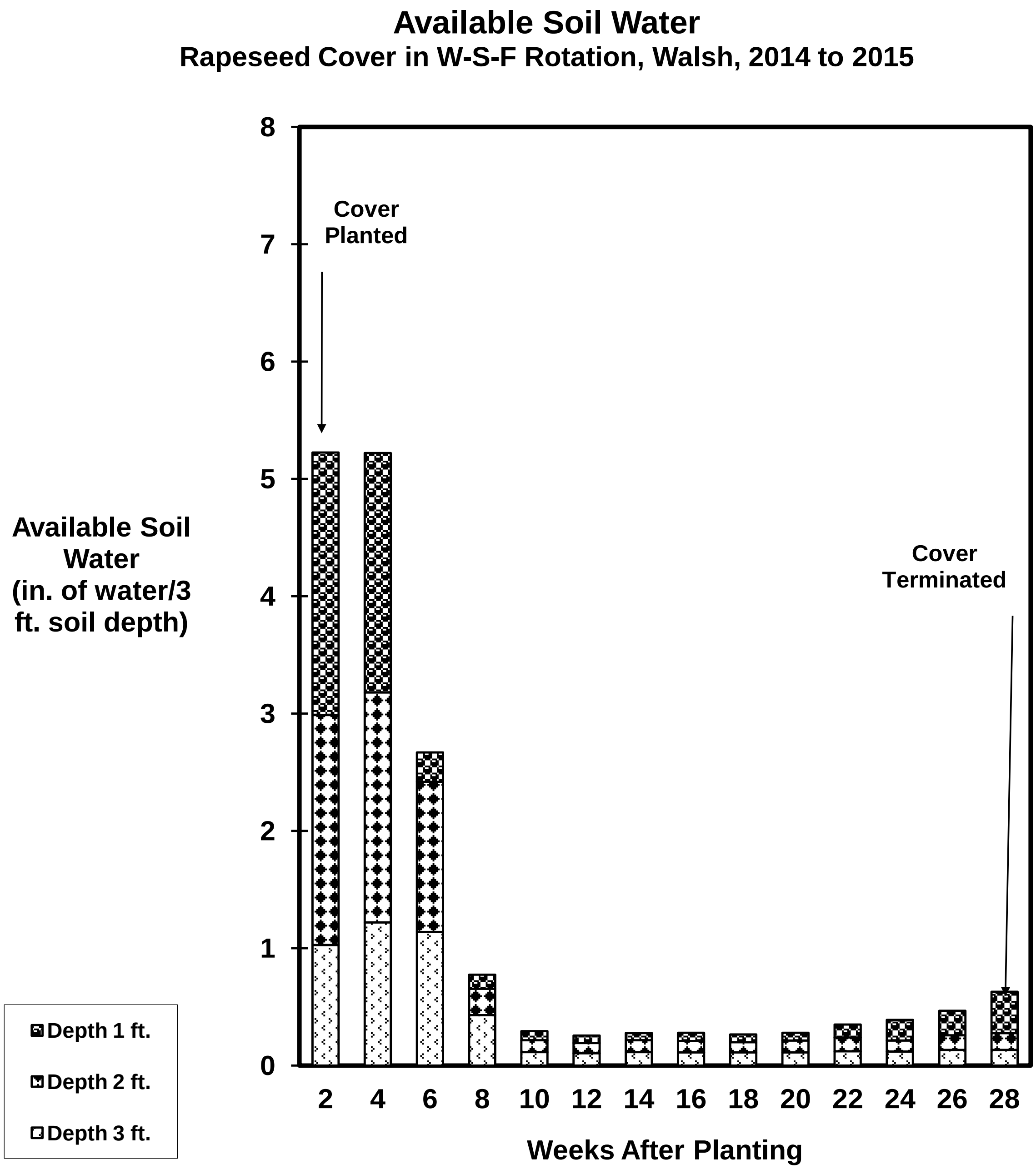

Fig. . Available soil water of rapeseed cover in W-S-F rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.60 in. Any increase in available soil water between weeks is from rain.

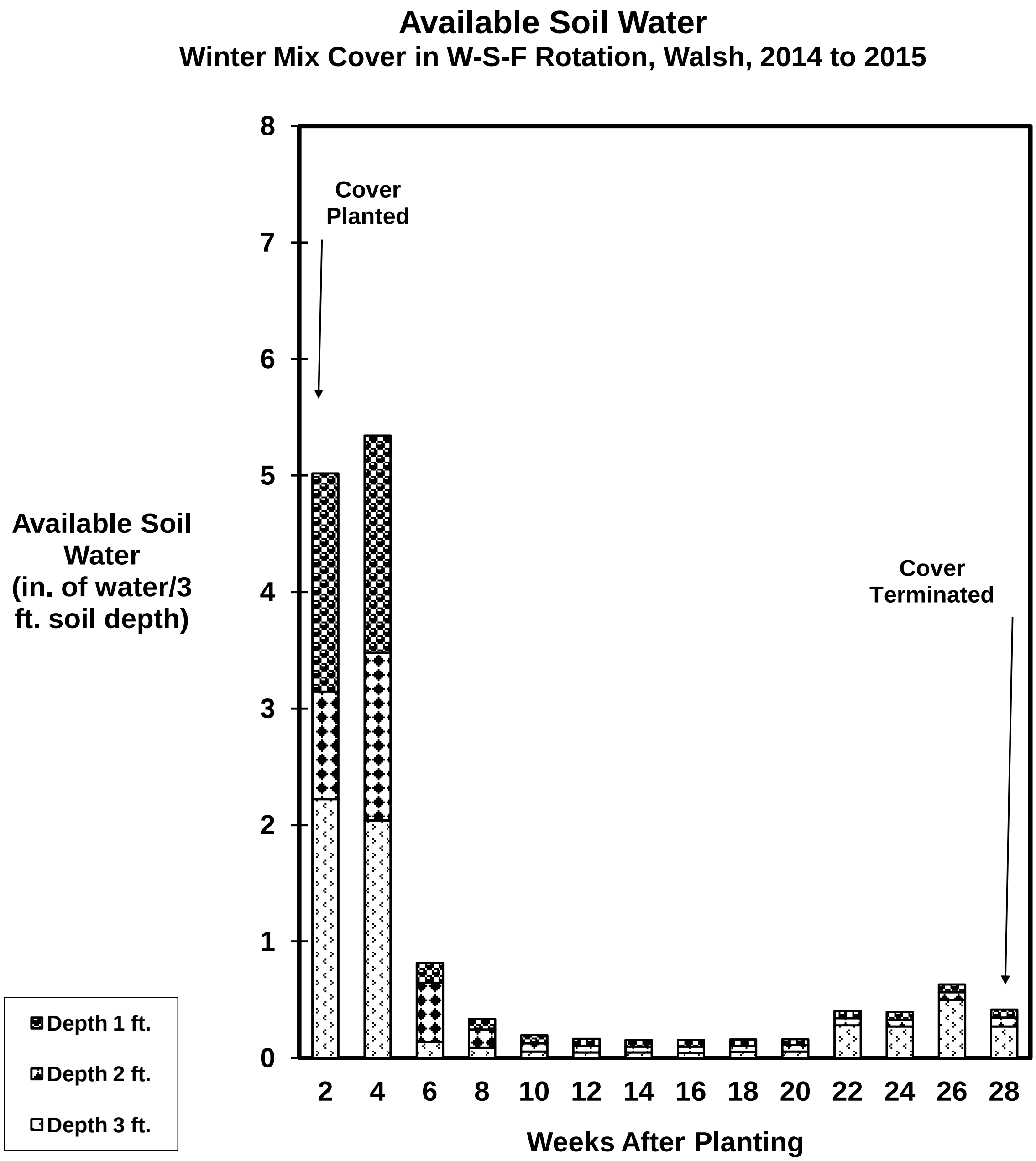

Fig. . Available soil water of winter mix cover in W-S-F Rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.60 in. Any increase in available soil water between weeks is from rain.

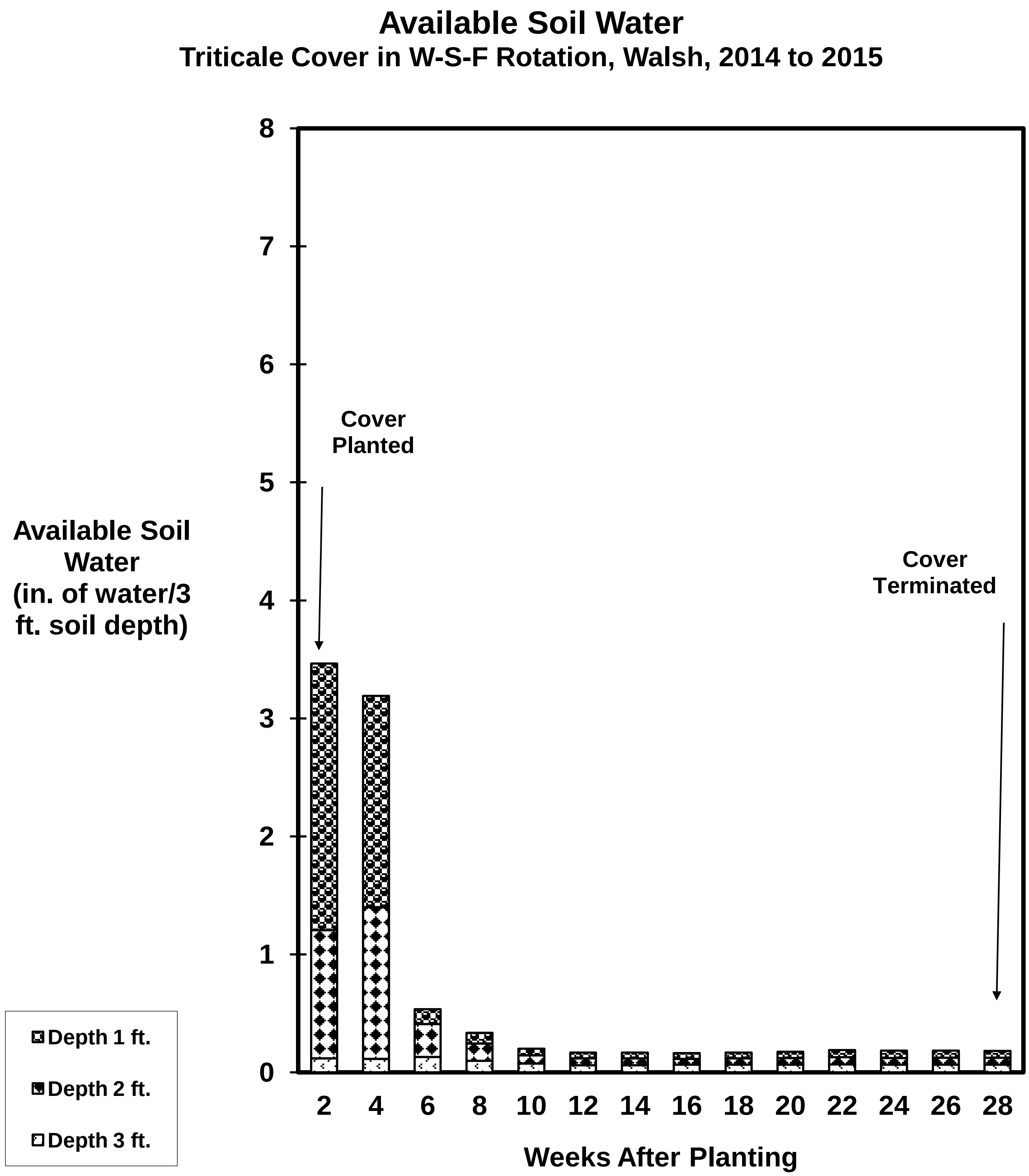

Fig. . Available soil water of triticale cover in W-S-F Rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.60 in. Any increase in available soil water between weeks is from rain.

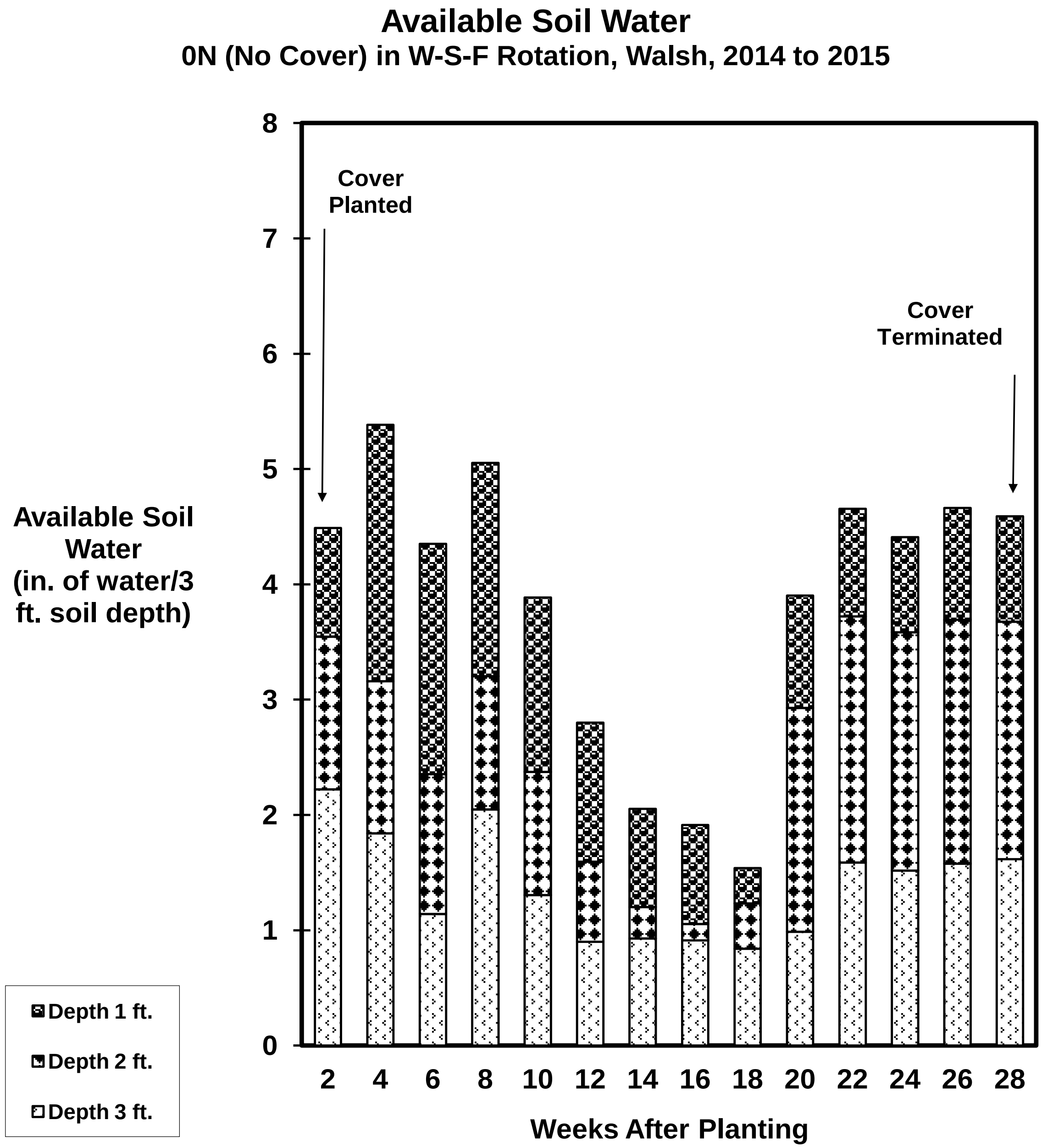

Fig. . Available soil water of 0N (no cover) in W-S-F rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.60 in. Any increase in available soil water between weeks is from rain.

Long Term Evaluation of CRP Conversion Back into Crop Production

Kevin Larson and Brett Pettinger

The Conservation Reserve Program has been one of the most important USDA programs for Colorado. It has added millions of dollars to Colorado farm income, regardless of weather and commodity fluctuations. In 2011, Colorado had 1.87 million acres in CRP, and of that total, 571,000 acres expired October, 2012 (USDA, FSA, 2011). Because of high commodity prices and funding uncertainty for CRP extensions, many CRP acres were converted back into crop production. CRP has provided soil erosion protection by growing perennial grass cover. We developed this study to see which CRP grass conversion method, chemical (no-till) or tillage, provides the highest variable net return over multiple years for two common crop rotations, Wheat-Fallow (W-F) and Wheat-Sorghum-Fallow (W-S-F).

Materials and Methods

We are testing our long term CRP conversion in two common crop rotations: Wheat-Fallow (W-F) and Wheat-Sorghum-Fallow (W-S-F). After establishing the rotations, all phases of each rotation will be present each year. We began our long term CRP conversion study on March 29, 2012 using chemical or tillage. Because we were still establishing the crop rotations, grain sorghum was the only crop studied for the 2012 cropping season. For the 2013 cropping season, we were able to harvest the first wheat crops and the extended-fallow grain sorghum crop. For chemical CRP conversion prior to wheat and extended-fallow grain sorghum crops, we applied glyphosate at 128 oz/a and ammonium sulfate (AMS) at 2 lb/a on six application dates: March 29, April 25, May 18 and June 21, July 27, and October 3, 2012. For tillage CRP conversion prior to wheat and extended-fallow grain sorghum crops, we disked four times with an offset disk on four dates: March 29, April 23, May 18 and June 21, 2012, and swept two times on July 27 and October 9, 2012.

For this fourth cropping season, we treated both the chemical and tillage treatments the same starting in March. For the chemical treatment, we sprayed glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2 lb/a four times throughout the season: August 7, September 20, March 30 and May 28. The tillage treatment was swept two times, August 14 and September 20, and sprayed twice with the same herbicide mix as the chemical treatment on March 30 and May 28.. For in-season broadleaf weed control in the grain sorghum crop, we applied a tank mix of Huskie 16 oz/a, atrazine 0.5 lb/a, Activator 90 8 oz/a and AMS 1 lb/a. For in-season broadleaf weed control in the wheat crop, we applied Ally Extra 0.4 oz/a, 2,4-D ester 0.38 lb/a, and Activator 90 8oz/a. For N fertilization, we streamed 32-0-0 at 50 lb N/a on 20 in. spacing. We planted wheat, Byrd at 50 lb/a and seedrow applied 5 gal 10-34-0/a, on October 10, 2014. For the sorghum crop, we planted Channel 5C35 at 35,000 seeds/a on June 6, 2015 and seedrow applied 5 gal 10-34-0/a at planting. The wheat was not harvested because of hail damage. We harvested the grain sorghum on November 5, 2015 with a self-propelled combine equipped with a digital scale. Grain sorghum yields were adjusted to 14% seed moisture content.

<u>Results and Discussion</u>

On August 3, 1990, Ken Lair, Soil Conservation Service, planted these 11 perennial grass strips: Hycrest, crested wheat grass; Bozorsky, Russian wildrye; Oahe, intermediate wheatgrass; Luna, pubescent wheatgrass; 9053823, smooth brome; Paiute, orchard grass; Granada, yellow bluestem; WWSpar, old world bluestem; Caucasian, bluestem; Ironmaster, bluestem; Morpa, weeping lovegrass. Each of our CRP conversion treatments transects all 11 perennial grass strips.

For this CRP conversion study, we are investigating the effects of maintaining the grass cover on subsequent crop yields over multiple years. So far, we have had only one harvested wheat crop (this year the wheat was hailed out), but this is our fourth harvested grain sorghum crop. The first wheat crop following our initial burn down or tillage to control the perennial grasses has been our only harvested wheat crop. .

For our initial wheat crop, dry conditions and multiple late freezes damaged tillers and resulted in very poor wheat yields for both chemical and tillage CRP conversion treatments. Wheat yields ranged from 0.3 bu/a to 2.1 bu/a. Both CRP conversion methods had significant cash losses in variable net incomes, averaging -$80/a for tillage and -$100/a for chemical. Wheat production was too low to offset the high cost of CRP conversion, regardless of conversion method. Nonetheless, chemical conversion was more costly than tillage conversion for this first wheat crop, and thus lost as much as -$24/a more than tillage conversion.

We are still in the process of establishing the crop rotations, which in 2013 created our first summer fallow period before the sorghum crop. In 2013, the extended fallow period produced good grain sorghum yields for both CRP conversion methods, 35.3 bu/a for chemical and 24.6 bu/a for tillage. The higher cost of chemical conversion compared to tillage conversion was more than offset by the higher grain sorghum production obtained with chemical conversion compared to tillage conversion. Chemical CRP conversion provided $16/a more variable net income than tillage conversion with the summer fallow grain sorghum crop.

In 2014, the grain sorghum crop produced high yields, 70.6 bu/a for the chemical treatment and 52.7 bu/a for the tillage treatment. Since we have already controlled the perennial grasses, we no longer needed the additional tillage operations and extra chemical rates to maintain the tillage and no-till plots. With fewer tillage and chemical operations in 2014, the cost of both treatments was lower and the difference between chemical and tillage treatments was less. However, the chemical treatment still costs $16.64/a more than the tillage treatment, but because of its higher yield, the chemical treatment provided $50.48/a more than the tillage treatment.

This year, grain sorghum was the only crop harvested because the wheat crop was severely damaged by hail. The chemical treatment produced 10.1 bu/a more grain sorghum yield than the tillage treatment. This year, there were fewer chemical and tillage operations because the CRP grasses were controlled in previous years. With fewer chemical applications needed to maintain the chemical treatment plots, the difference between the tillage and chemical treatment costs was much smaller than the preceding years. The chemical treatment cost was only $4.52/a higher than the tillage treatment cost. Moreover, the higher grain yield of the chemical treatment more than compensated for its higher treatment cost by producing $28.31/a more income than the tillage treatment.

Total rotational variable net income (rotational income minus CRP conversion cost and treatment maintenance cost) for the first four years of this study (2012 to 2015) produced strongly negative incomes for the W-F rotation, -$240/a for the chemical treatment and -$198/a for the tillage treatment. The negative incomes for the W-F rotation are due to harvesting only one low yielding wheat crop. By 2013, after the second grain sorghum crop, the W-S-F rotation was producing positive rotational variable net incomes. Grain sorghum production accounted for nearly all of the total rotational variable net incomes from 2012 to 2015, $299/a for chemical treatment and $185/a for tillage treatment. For the first four years of this CRP crop conversion study, the chemical treatment produced $114/a more than the tillage treatment.

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Table .Long Term CRP Conversion After Using Tillage or Chemical, Fourth Season, Wheat-Sorghum-Fallow, Grain Sorghum Crop, Walsh, 2015.

CRP Conversion	Rotation	Test Weight	Grain Sorghum Yield	Gross Income	Treatment Cost	Variable Net Income
		lb/bu	bu/a	$/a	$/a	$/a
Chemical	W-S-F	54	32.3	104.98	57.04	47.94
Tillage	W-S-F	55	22.2	72.15	52.52	19.63
Average		55	27.3	88.56	54.78	33.78
LSD 0.20			1.5			

Chemical: glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2lb/a applied four times.
Chemical cost: $8.26/a and $6.00/a for each application.
Chemical application dates: August 7, September 20, March 30 and May 28.
Tillage: swept two times.
Tillage cost: $12/a per sweeping.
Tillage application dates: August 14 and September 20.
Tillage and no till treated the same starting in March.
N fertilizer applied at 50 lb/a as 28-0-0.
Grain sorghum, Channel 5C35, planted at 35,000 seeds/a and seedrow applied 5 gal 10-34-0/a at planting.
Grain sorghum planted on June 6; harvested on November 5, 2015.
Grain sorghum price: $3.25/bu.
Variable Net Income is Gross Income minus Treatment Cost.

Table .-CRP Conversion, Chemical and Tillage Comparison, Annual Rotational Income, 2012 to 2015.

Rotation & Conversion Treatment	Conversion Cost	Variable Net Income 2012	2013	2014	2015	2012-2015 Total Rotational Net Income	Average Annual Rotation Variable Net Income
	--------$/a--------						
Chemical							
W-S-F	113.10	-34.80	86.04	200.11	47.94	299.29	99.76
W-F	113.10	--	-102.23	-80.80	-57.04	-240.07	-120.04
Tillage							
W-S-F	84.00	-34.63	50.50	149.63	19.63	185.13	61.71
W-F	84.00	--	-97.88	-60.00	-40.52	-198.40	-99.20
Average		-34.72	-15.89	52.24	-7.50	11.49	-14.44

The first wheat crop was 2013. There was no wheat harvested in 2014 (winterkill) and in 2015 (hail).
Variable Net Income is gross income minus Conversion Cost and treatment cost.
Annual Rotation Variable Net Income is Total Rotation Variable Net Income divided by years.

Irrigated Mid and High Oleic Sunflower Hybrid Performance Trial at Walsh, 2015

COOPERATORS: Plainsman Agri-Search Foundation; Kevin Larson and Brett Pettinger Plainsman Research Center, Walsh, Colorado.

PURPOSE: To identify high yielding hybrids under irrigated conditions with 3500 heat units in a silty loam soil.
RESULTS: Of the 4 hybrids tested, Mycogen 8H449CL had the highest seed yield, 273 lb/a (83 lb/a of oil yield). For this limited irrigation trial, we applied 6 in./a of water.

PLOT: Four rows with 30 in. row spacing, at least 600 ft. long. SEEDING DENSITY: 26,500 seeds/a. PLANTED: June 2; replanted June 18, 2015. HARVESTED: January 4, 2016.

IRRIGATION: Subsurface Drip Irrigated: total water applied approximately 6 a-in./a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, Spartan 2.0 oz/a. Post Emergence Herbicides: Select 12 oz/a, COC 16 oz/a.
CULTIVATION: None. INSECTICIDES: Warrior (Sunflower Head Moth control).

Summary: Growing Season Precipitation and Temperature Walsh, Baca County.[a]

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------No. of Days--------		
June	1.75	738	16	1	28
July	5.54	846	20	1	59
August	2.68	803	19	0	90
September	1.05	680	17	1	120
October	2.93	355	1	0	151
November	0.30	69	0	0	158
Total	14.25	3491	73	3	158

[a]Growing season from June 2 (planting) to November 7 (first freeze, 28 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

FIELD HISTORY: Last Crop: Grain sorghum. FIELD PREPARATION: Sweep plow.

COMMENTS: Planted in adequate soil moisture. Weed control was good, except for a uncontrolled infestation of puncture vine. The growing season precipitation was above average, but with two hailstorms: a June 11 storm necessitated replanting and an August 16 storm caused head wounds for *Rhizopus* entry, which produced severe head damage. Seed yields and oil percentages were very poor because of the considerable *Rhizopus* head damage.
SOIL: Richfield silty loam for 0-8” and silty loam 8”-24” depths from soil analysis.

Summary: Soil Analysis from Drip Site.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.8	0.7	2.1	22	6	377	0.7	14.0
8”-24”				24				
Comment	Alka	Vlo	Hi	VHi	Lo	VHi	Lo	Lo

Iron was marginal.

Summary: Fertilization for Drip Site.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	0	0	10
Applied	100	0	0	0

Yield Goal: 2000 lb/a.
Actual Yield: 205 lb/a.

Drip Irrigated Sunflower, Mid and High Oleic Variety Trial, PRC, Walsh, 2015.

Firm	Hybrid	Mid or High Oleic	50% Flower	Plant Density	Plant Ht.	Test Wt.	Oil	Seed Yield	Oil Yield
			date	plants/a (X1000)	in	lb/bu	%	lb/a	lb/a
MYCOGEN	8H449CL	high	8/11	16.0	48	16.4	30.1	273	82
MYCOGEN	8H570sCL	high	8/13	15.2	34	18.4	32.1	208	67
MYCOGEN	8H859CL	high	8/12	14.8	48	18.4	33.1	194	64
MYCOGEN	8H456CL	high	8/15	16.6	52	16.3	30.2	145	44
Average			8/12	15.7	46	17.4	31.4	205	64
LSD 0.20								27.5	

Planted: June 2 and replanted June 18, 2015; Harvested: January 4, 2016.
Seed Yield adjusted to 10% seed moisture content.
Total water applied was 6 in./a of drip irrigation.
Rhizopus infestation after an August 16 hailstorm significantly decreased yields.

National Winter Canola Variety Performance and Great Plains Trials, Walsh 2015

Kevin Larson, Brett Pettinger and Mike Stamm

Purpose: To identify the best adapted, highest yielding varieties of winter canola.

Results and Discussion

There was adequate soil moisture at planting for seed germination. For our area, it is atypical to have adequate soil moisture for planting winter canola. This is because canola has such small seeds, which requires shallow planting depths; moreover, its narrow planting window (late August to mid-September) is frequently too short for sufficient rain to occur. We had nearly average moisture for this past winter and all of the varieties and lines had very good plant stands. However, winter survival rates were very poor due to very cold, near 0F temperatures in the middle of November. In the Great Plains Canola Variety Trial, where the entries are predominately KSU experimental lines developed by Mike Stamm, many of the KSU lines had much better winter survival rates than the commercial varieties. So, it appears that Dr. Stamm is making some progress toward developing varieties with better winter survival. Since all of the canola varieties and lines in the National and Great Plains trials had severe winterkill, only plant stands and winter survival rates were recorded.

Materials and Methods

We planted 45 winter canola varieties and lines for the National Winter Canola Trial on September 8, 2014, and we planted 36 winter canola varieties and lines for the Great Plains Winter Canola Trial on September 9, 2014. The trial was planted at 5 lb seed/a with a 12 in. row-spaced drill to a depth of 1.0 inch in adequate soil moisture. We stream-applied 50 lb N/a as 32-0-0 on 20 in. spacing. No other fertilizers were applied. For weed control, we applied Trifluralin at 24 oz/a and did not incorporate the herbicide. The canola was not harvested because it severely winterkilled.

Table .--National Winter Canola Variety Trial, Walsh, 2015.

Variety (Line)	Stand %	Winter Survival %	Variety (Line)	Stand %	Winter Survival %
KS4549	99	32	VSX-4	99	0
Riley	94	8	115W	99	0
DK IMISTAR CL	98	6	125W	98	0
KS4506	100	4	Claremore	97	0
15-20W	90	4	NK Petrol	100	0
KSUR21	97	3	NK Technic	100	0
CHROME	93	3	SY Fighter	94	0
DKW46-15	98	3	SY Harnas	98	0
Einstein	100	3	SY Marten	100	0
Safran	99	2	SY Saveo	99	0
15-19W	92	1			
KSR07363	92	0	Aveage	97	2
Sumner	85	0	LSD 0.05	6.8	6.7
Wichita	90	0			
HEKIP	93	0			
MH11J41	100	0			
MH11M16	100	0			
MH12AX37	99	0			
DK IMIRON CL	98	0			
DK SENSEI	100	0			
DK SEVERNYL	98	0			
DKW44-10	100	0			
DKW45-25	99	0			
DL14001R	99	0			
Garou	100	0			
Popular	98	0			
Raffiness	97	0			
Dimension	95	0			
Edimax CL	100	0			
Hornet	100	0			
Inspiration	98	0			
Mercedes	95	0			
Sitro	97	0			
Virginia	99	0			
VSX-3	100	0			
Aveage	97	2			
LSD 0.05	6.8	6.7			

Table .-Great Plains Canola Variety Trial,
Walsh, 2015.

Variety (Line)	Stand %	Winter Survival %
KS4498	99	47
KS4524	99	46
KS4613	100	35
Riley	95	34
KS4657	100	26
KS4517	97	25
KS4658	100	22
KS4518	99	21
KS4656	99	20
KS4623	99	17
KSNT127	99	16
KS4576	99	13
KSNT149	98	13
KS4593	100	12
KS4659	99	12
KS4675	99	11
KS4430	98	9
KS4612	99	9
Sumner	90	9
Wichita	97	9
KS4630	98	8
KS4636	94	8
KS4574	100	7
KS4616	99	7
KS4629	94	7
KSUR18	98	7
KS4686	99	6
KS4583	100	5
KS4594	99	5
KSUR1211	100	4
SKUR1219	99	4
KSUR1209	100	3
KS4645	98	2
Safran	98	1
KS4682	99	0
KSUR1210	95	0
Average	98	13
LSD 0.05	4.5	21.1