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Agricultural Experiment Station

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

Plainsman Research Center
2016 Research Reports

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in cooperation with the Plainsman Agri-Search Foundation

This Plainsman Research Center booklet is dedicated to:

Edward Langin

He was the visionary behind the Plainsman Agri-Search Foundation, the paramount research and grower association model. This year, through the request of Plainsman members to the Colorado Association of Wheat Growers and the Colorado Wheat Administrative Committee, we are proud to announce that a Hard Red Winter Wheat was named "Langin," in his honor.

This Plainsman Research Center booklet is also dedicated to:

The Neill Foundation Board:

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

This grant from the Neill Foundation will allow Plainsman to more effectively harvest small and large research studies. These studies are the first step to create cost effective change, helping growers become economically viable and sustainable stewards of the land. Thank you.

The spirit of Bernard lives on through your generous funding decisions. We truly appreciate your continued support.

Plainsman Research Center, 2016 Research Reports

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2016 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.	Evapor-ation In.
Jan.	71	10	48.2	20.1	0.06	0.03	0.40	0.40	31.55	
Feb.	85	9	56.3	25.0	0.34	0.26	3.00	2.50	35.52	
Mar.	84	9	65.0	28.4	0.03	0.02	0.00	0.00	42.23	
Apr.	82	21	67.7	38.0	4.92	1.70	0.00	0.00	49.17	3.35
May	87	29	73.7	43.9	1.43	0.59	0.00	0.00	54.65	8.62
Jun.	99	48	91.3	59.0	3.23	1.48	0.00	0.00	67.23	11.04
Jul.	104	54	94.5	63.4	3.88	1.93	0.00	0.00	72.10	12.82
Aug.	98	53	87.1	60.7	3.53	1.06	0.00	0.00	69.81	8.29
Sept.	95	39	85.0	53.5	0.17	0.09	0.00	0.00	65.97	10.17
Oct.	98	26	79.1	41.5	0.01	0.01	0.00	0.00	58.65	4.74
Nov.	88	13	63.9	32.2	0.37	0.36	0.00	0.00	47.90	
Dec.	73	-14	45.0	14.4	0.44	0.32	2.50	2.50	34.10	
Total Annual			**71.4**	**40.01**	**18.41**		**5.90**			**59.03**

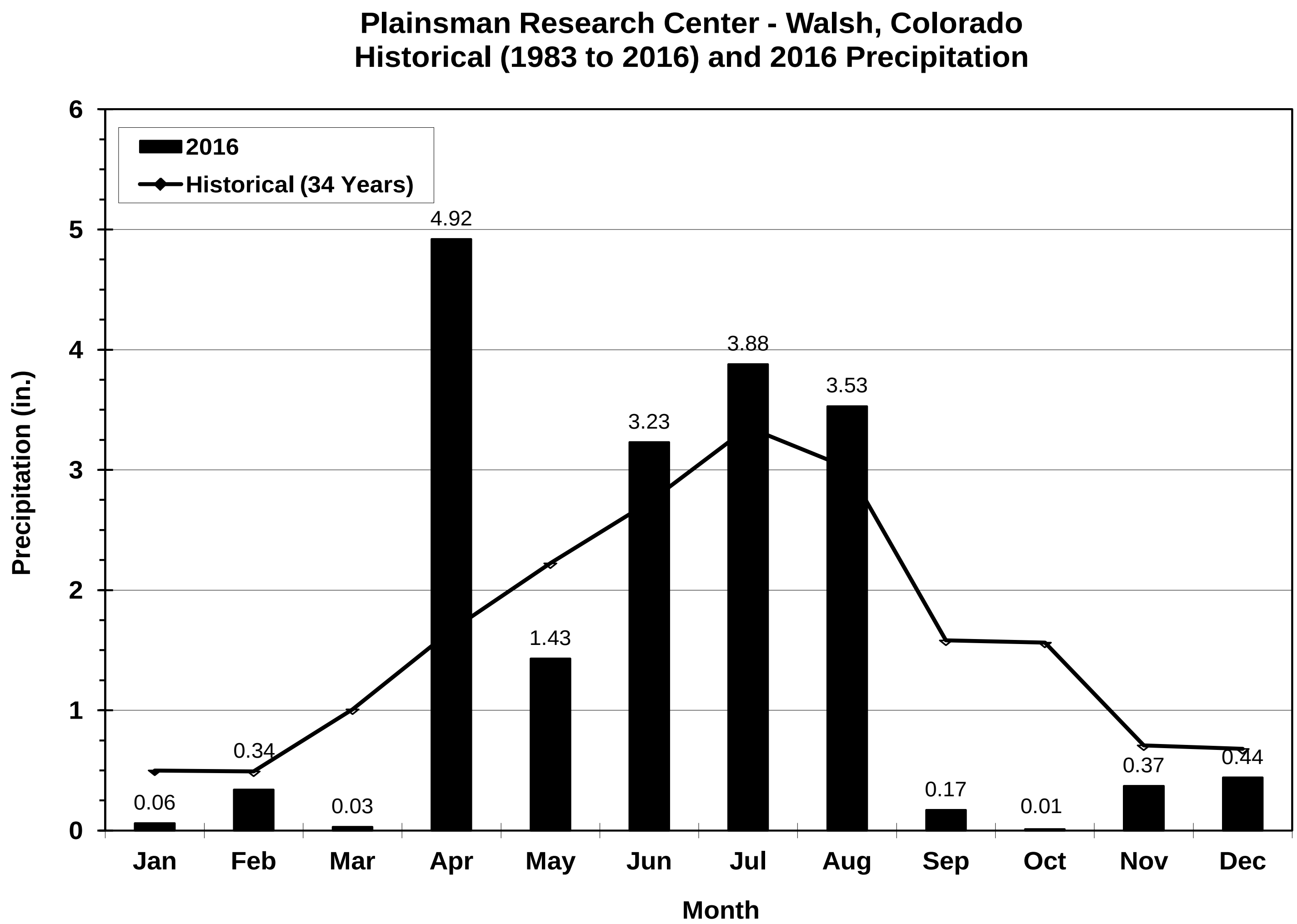
*** NOTE: Evaporation read April 15 through October 15th.
Wind velocity is recorded at two feet above ground level.
Total evaporation from a four foot diameter pan for the period indicated.

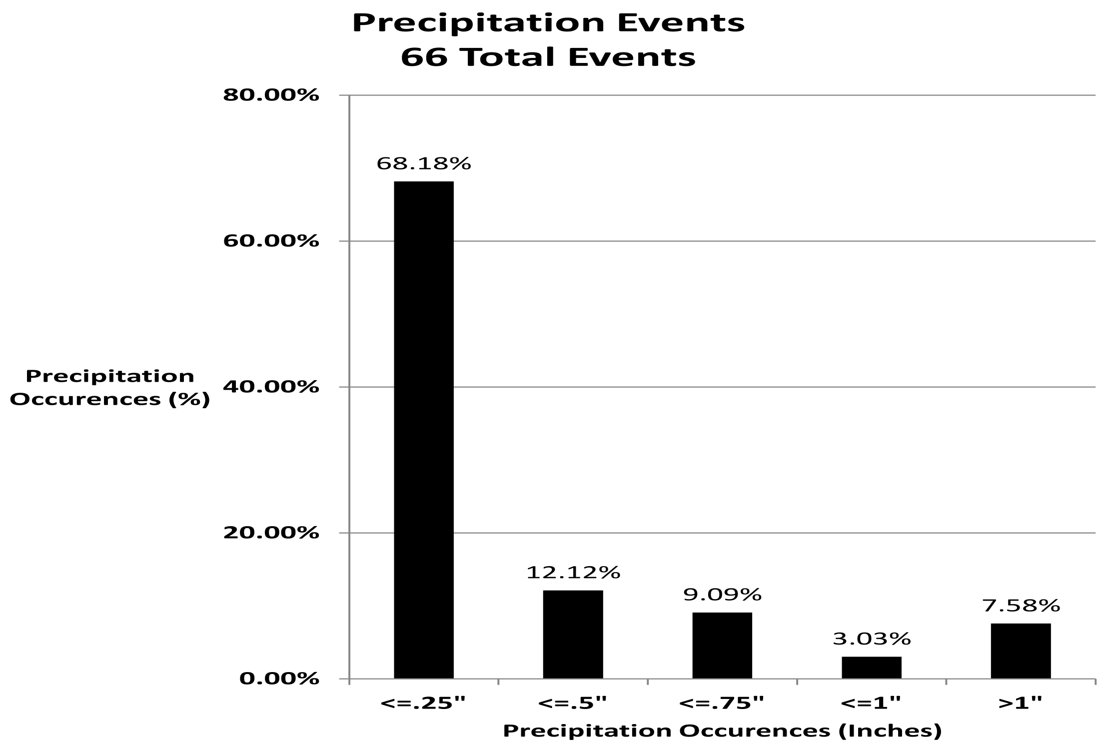
	2016	2015
Highest Temperature:	104 F on July 24	102 F on June 22
Lowest Temperature:	-14 F on December 18	-2 F on January 1
Last freeze in spring:	29 F on May 2	30 F on April 27
First freeze in fall:	26 F on Oct. 7	31 F on Nov. 6
Frost free season:	158 frost free days	193 frost free days

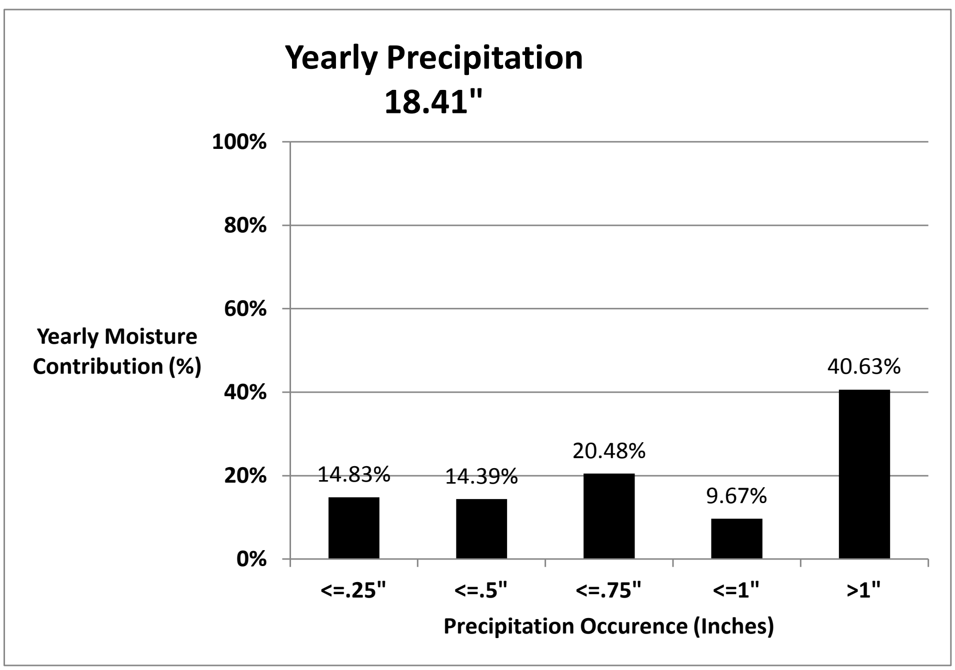
Avg. Precipitation for 34 years: 18.95 inches

Maximum Wind:

Jan.	37 mph on 6th & 22nd	July.	37 mph on 17th
Feb.	37 mph on 24th	Aug.	40 mph on 23rd
Mar.	53 mph on 24th	Sept.	39 mph on 5th
Apr.	55 mph on 16th	Oct.	39 mph on 4th
May	45 mph on 30th	Nov.	41 mph on 28th
Jun.	33 mph on 14th	Dec.	48 mph on 26th


Plainsman Research Center - Walsh, Colorado
Historical (1983 to 2016) and 2016 Precipitation
2016
Historical (34 Years)
Precipitation (in.)
6
5
4
3
2
1
0
4.92
3.88
3.53
3.23
1.43
0.34
0.06
0.03
0.17
0.01
0.37
0.44
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Precipitation Events
66 Total Events
80.00%
60.00%
40.00%
20.00%
0.00%
Precipitation Occurences (%)
68.18%
12.12%
9.09%
3.03%
7.58%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurences (Inches)


Yearly Precipitation
18.41"
100%
80%
60%
40%
20%
0%
Yearly Moisture Contribution (%)
14.83%
14.39%
20.48%
9.67%
40.63%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurence (Inches)

Variety Performance in the 2016 Eastern Colorado Winter Wheat Trials

Jerry Johnson and Sally Sauer

Colorado State University faculty, staff, and students work hard to provide current, reliable, and unbiased wheat variety information to Colorado producers. Support of our research keeps public variety testing thriving in Colorado. Farmer support of 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 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 46 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 five 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, 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 ft^2 (except the Fort Collins IVPT, which was 80 ft^2) 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 and seeding rates conformed 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 2015-2016 growing season can be characterized by three factors:

- Planting into generally dry soils followed by rain later in the fall that resulted in good stands. Fall temperatures and precipitation were above average.

- Drought conditions in the winter or spring. Very warm temperatures in February throughout Colorado. Very little snow in the southeast but precipitation was above average in February but below average in March.

- Above-average precipitation in April, May and June that led to stripe rust but high yields. Awesome early April precipitation all across Eastern Colorado up to 300% above average in parts of the northeast. There was a heat wave that started in early June and accelerated the development of wheat.

General Growing Conditions in Southeast Colorado - Kelly Roesch

With the return of a more normal rainfall pattern during the summer and fall of 2015, wheat producers had more ideal planting conditions than they had been experiencing through the past several years of drought. There was some improvement in the subsoil moisture profile and most fields had adequate moisture for germination and emergence to provide a good level of ground cover going into the winter months. A mild and somewhat dry winter kept the wheat crop in a condition that led to very little if any winterkill.

As the wheat began coming out of dormancy in March, warm temperatures and dry, windy conditions began to bring back memories of past drought years. The fear of drought was somewhat alleviated as widespread rainfall April 8th through April 22nd resulted in accumulations of 2 to 3½ inches of beneficial moisture. Cool and damp conditions experienced in May provided prime growing conditions for the wheat crop and also for the development of stripe rust. Fungicides were widely applied as the stripe rust was identified and then warmer temperatures in June helped to slow the proliferation of the rust spores. Above-average rainfall in June and July, combined with the rains received in April, left most fields with a 50% wetter than normal growing season when compared to the 10-year average. The increased moisture provided the necessary conditions for the development of tall and strong plants with full heads.

Harvest began in earnest the last week of June and was promptly halted in most locations by widespread rainfall June 28 through July 1. As the fields dried out, good harvest progress was made July 6th-15th. Although the majority of the fields were cut by July 20th, some harvest activity was still taking place on July 25th. Dryland yields ranged from 20 to 100 bu/ac with many farms averaging 60 to 70 bu/ac, making the 2016 wheat harvest one that won't soon be forgotten in Southeast Colorado. The bountiful yields led to long lines at grain elevators and storage facilities quickly running out of room. Lack of storage led to large ground piles, resulting in an even larger negative basis that started at -\$0.90/bu at the beginning of harvest and went to -\$1.40/bu near the end of harvest. Producers utilized on farm storage to the extent possible with the hope that price and basis will improve later this fall.

2016 Dryland Winter Wheat Variety Performance Trial at Lamar

Variety	Brand/Source	Yield	Test Weight	Plant Height
		bu/ac	lb/bu	in
CO11D446	Colorado State Univ. exp.	72.7	57.5	30
Hatcher	PlainsGold	71.3	55.9	29
CO11D421	Colorado State Univ. exp.	70.4	56.3	29
Antero	PlainsGold	68.7	57.4	31
Byrd	PlainsGold	67.9	57.7	31
CO14A058	Colorado State Univ. exp.	67.9	55.9	29
Ripper	PlainsGold	67.7	56.9	32
CO11D1397	Colorado State Univ. exp.	67.1	58.0	25
CO14A065	Colorado State Univ. exp.	67.0	55.6	28
Avery	PlainsGold	66.7	57.5	30
CO12D1028	Colorado State Univ. exp.	66.5	58.1	28
CO12D2010	Colorado State Univ. exp.	66.2	55.7	27
CO11D1306W	Colorado State Univ. exp.	65.9	57.9	29
TAM 204	Watley Seed	65.1	53.1	27
CO11D1312	Colorado State Univ. exp.	64.9	57.1	30
CO11D1539	Colorado State Univ. exp.	64.8	56.4	36
CO11D1767	Colorado State Univ. exp.	63.3	56.7	31
CO12D2011	Colorado State Univ. exp.	62.6	58.2	28
Cowboy	Crop Res. Found. of Wyoming	62.0	55.9	31
CO12D922	Colorado State Univ. exp.	61.2	56.8	31
Settler CL	Husker Genetics	61.2	56.4	26
WB-Grainfield	WestBred Monsanto	61.0	58.3	31
WB4721	WestBred Monsanto	60.7	58.2	27
CO12D906	Colorado State Univ. exp.	60.0	58.4	24
Akron	Colorado State University	59.6	56.3	30
Denali	PlainsGold	59.6	57.8	33
LCS Chrome	Limagrain Cereal Seeds	59.3	57.0	26
CO11D1236	Colorado State Univ. exp.	58.8	56.8	32
Brawl CL Plus	PlainsGold	58.7	57.2	30
SY Monument	AgriPro Syngenta	57.9	56.4	29
Sunshine	PlainsGold	57.2	57.7	29
Oakley CL	Kansas Wheat Alliance	57.2	57.6	25
SY Sunrise	AgriPro Syngenta	57.1	56.0	26
Winterhawk	WestBred Monsanto	57.0	57.9	31
LCH13NEDH-14-69	Limagrain Cereal Seeds	56.5	56.1	30
TAM 114	AGSECO	56.3	58.1	28
Prairie Red	PlainsGold	55.4	56.1	29
Snowmass	PlainsGold	55.4	57.1	28
Doublestop CL Plus	Oklahoma Genetics	55.1	56.7	31
LCH13-032	Limagrain Cereal Seeds	54.9	57.7	30
Joe	Kansas Wheat Alliance	54.6	57.2	29
LCS Mint	Limagrain Cereal Seeds	54.6	57.0	26
KanMark	Kansas Wheat Alliance	54.3	56.6	29
MTS1024	Montana State Univ. exp.	52.2	54.9	25
SY Wolf	AgriPro Syngenta	51.8	53.9	27
Ruth	Husker Genetics	48.6	57.6	29
Average		**61.0**	**56.9**	**29**
[a] LSD (P<0.30)		3.8		

[a] If the difference between two variety yields equals or exceeds the LSD value then they are significantly different with less than 30% probability that the difference is due to random error.

2016 Dryland Winter Wheat Variety Performance Trial at Sheridan Lake

Variety	Brand/Source	Yield	Test Weight	Plant Height
		bu/ac	lb/bu	in
Antero	PlainsGold	115.5	58.6	32
CO11D446	Colorado State Univ. exp.	115.1	60.0	27
LCH13NEDH-14-69	Limagrain Cereal Seeds	114.0	59.3	28
Avery	PlainsGold	113.9	59.3	33
CO11D1397	Colorado State Univ. exp.	111.8	60.2	29
CO11D1539	Colorado State Univ. exp.	111.1	57.5	33
Cowboy	Crop Res. Found. of Wyoming	110.7	58.1	29
CO11D1767	Colorado State Univ. exp.	110.7	56.7	30
Byrd	PlainsGold	110.3	60.7	33
LCS Mint	Limagrain Cereal Seeds	110.2	58.9	34
CO11D1306W	Colorado State Univ. exp.	109.3	61.3	33
CO12D2010	Colorado State Univ. exp.	108.9	57.1	32
CO12D2011	Colorado State Univ. exp.	108.6	60.6	31
CO12D922	Colorado State Univ. exp.	108.5	59.2	34
CO11D421	Colorado State Univ. exp.	108.3	59.4	32
CO11D1312	Colorado State Univ. exp.	108.0	59.3	31
KanMark	Kansas Wheat Alliance	106.9	60.1	30
Joe	Kansas Wheat Alliance	106.7	60.6	31
CO11D1236	Colorado State Univ. exp.	105.5	59.7	33
WB-Grainfield	WestBred Monsanto	105.1	60.9	32
Oakley CL	Kansas Wheat Alliance	104.8	60.3	30
CO12D906	Colorado State Univ. exp.	104.1	60.4	33
Ruth	Husker Genetics	102.9	60.2	33
Denali	PlainsGold	102.4	60.2	34
Sunshine	PlainsGold	102.2	57.4	33
Snowmass	PlainsGold	101.0	60.2	33
Hatcher	PlainsGold	100.9	58.0	33
WB4721	WestBred Monsanto	100.8	60.4	32
TAM 114	AGSECO	100.2	61.2	34
SY Monument	AgriPro Syngenta	99.9	59.3	31
Ripper	PlainsGold	99.8	58.6	29
Settler CL	Husker Genetics	99.5	58.5	29
LCS Chrome	Limagrain Cereal Seeds	99.0	60.1	32
Winterhawk	WestBred Monsanto	97.8	61.5	33
Brawl CL Plus	PlainsGold	97.0	57.2	34
SY Wolf	AgriPro Syngenta	96.1	54.8	31
LCH13-032	Limagrain Cereal Seeds	95.9	60.9	28
CO12D1028	Colorado State Univ. exp.	95.5	59.4	30
CO14A065	Colorado State Univ. exp.	94.6	56.9	30
SY Sunrise	AgriPro Syngenta	93.4	60.4	26
Akron	Colorado State University	93.3	55.7	35
MTS1024	Montana State Univ. exp.	91.8	56.5	31
TAM 204	Watley Seed	91.5	57.0	28
CO14A058	Colorado State Univ. exp.	89.3	56.5	31
Prairie Red	PlainsGold	88.9	58.7	32
Doublestop CL Plus	Oklahoma Genetics	84.7	59.8	33
	Average	**102.7**	**59.1**	**31**
	[a]LSD (P<0.30)	4.2		

[a] If the difference between two variety yields equals or exceeds the LSD value then they are significantly different with less than 30% probability that the difference is due to random error.

2016 Dryland Winter Wheat Variety Performance Trial at Walsh

Variety	Brand/Source	Yield bu/ac	Test Weight lb/bu	Plant Height in
CO11D1539	Colorado State Univ. exp.	66.4	55.3	31
CO12D922	Colorado State Univ. exp.	66.1	58.1	32
CO11D446	Colorado State Univ. exp.	64.6	56.0	28
CO11D1236	Colorado State Univ. exp.	64.0	54.4	32
CO11D1312	Colorado State Univ. exp.	62.6	55.5	32
Joe	Kansas Wheat Alliance	62.2	59.2	31
CO12D2011	Colorado State Univ. exp.	62.1	58.1	31
Antero	PlainsGold	62.0	56.4	33
Winterhawk	WestBred Monsanto	61.7	58.2	32
CO11D1306W	Colorado State Univ. exp.	60.9	57.6	31
Sunshine	PlainsGold	60.7	57.1	32
WB-Grainfield	WestBred Monsanto	60.5	58.2	32
Byrd	PlainsGold	60.4	57.1	31
CO11D1397	Colorado State Univ. exp.	60.0	56.3	28
CO11D421	Colorado State Univ. exp.	59.6	56.4	34
CO12D1028	Colorado State Univ. exp.	59.4	57.3	32
Avery	PlainsGold	58.7	55.4	34
CO11D1767	Colorado State Univ. exp.	58.0	53.8	32
LCH13NEDH-14-69	Limagrain Cereal Seeds	57.6	56.9	29
CO12D2010	Colorado State Univ. exp.	57.5	54.7	30
TAM 204	Watley Seed	57.3	55.0	30
Hatcher	PlainsGold	57.3	56.6	31
Snowmass	PlainsGold	57.2	57.5	31
CO12D906	Colorado State Univ. exp.	57.2	55.7	29
Denali	PlainsGold	56.6	57.8	32
Brawl CL Plus	PlainsGold	56.5	58.0	32
LCS Chrome	Limagrain Cereal Seeds	55.4	56.4	30
SY Sunrise	AgriPro Syngenta	55.0	57.7	28
Akron	Colorado State University	54.8	56.5	32
LCH13-032	Limagrain Cereal Seeds	54.8	57.7	30
TAM 114	AGSECO	54.3	57.3	31
WB4721	WestBred Monsanto	54.0	56.5	32
LCS Mint	Limagrain Cereal Seeds	54.0	57.1	31
KanMark	Kansas Wheat Alliance	54.0	56.8	30
CO14A058	Colorado State Univ. exp.	53.2	52.4	32
Oakley CL	Kansas Wheat Alliance	53.2	57.8	30
Settler CL	Husker Genetics	53.1	55.7	33
Doublestop CL Plus	Oklahoma Genetics	53.0	59.0	31
Prairie Red	PlainsGold	53.0	56.1	31
SY Monument	AgriPro Syngenta	51.9	56.4	32
Ripper	PlainsGold	51.6	52.7	31
SY Wolf	AgriPro Syngenta	51.3	57.3	29
Ruth	Husker Genetics	50.8	58.0	30
Cowboy	Crop Res. Found. of Wyoming	50.0	53.7	33
CO14A065	Colorado State Univ. exp.	48.1	52.3	30
MTS1024	Montana State Univ. exp.	33.2	51.4	30
	Average	**56.6**	**56.3**	**31**
	[a]LSD (P<0.30)	2.4		

[a] If the difference between two variety yields equals or exceeds the LSD value then they are significantly different with less than 30% probability that the difference is due to random error.

Summary of 2-Year (2015-2016) Dryland Variety Performance Results

Variety[b]	Brand/Source	Market Class[c]	2-Year Average[a] Yield bu/ac	Yield % trial average	Test Weight lb/bu	Plant Height in
Joe	Kansas Wheat Alliance	**HWW**	81.5	115%	59.5	34
Antero	PlainsGold	**HWW**	81.2	115%	57.8	33
CO11D1767	Colorado State Univ. exp.	HRW	80.3	114%	57.0	33
CO11D1539	Colorado State Univ. exp.	HRW	78.8	111%	57.2	35
CO11D1236	Colorado State Univ. exp.	HRW	76.1	108%	58.6	35
SY Monument	AgriPro Syngenta	HRW	75.9	107%	58.4	33
Oakley CL	Kansas Wheat Alliance	HRW	75.3	106%	58.0	31
CO11D446	Colorado State Univ. exp.	HRW	74.7	106%	59.0	31
CO11D1306W	Colorado State Univ. exp.	**HWW**	74.1	105%	59.4	34
TAM 114	AGSECO	HRW	74.0	105%	59.9	33
WB-Grainfield	WestBred Monsanto	HRW	73.6	104%	59.2	34
Denali	PlainsGold	HRW	73.0	103%	59.1	35
Ruth	Husker Genetics	HRW	72.8	103%	60.1	34
LCS Mint	Limagrain	HRW	72.1	102%	58.6	34
Avery	PlainsGold	HRW	71.5	101%	58.0	35
Winterhawk	WestBred Monsanto	HRW	71.1	101%	59.1	34
Sunshine	PlainsGold	**HWW**	70.8	100%	56.7	33
Hatcher	PlainsGold	HRW	69.4	98%	57.0	33
CO11D1397	Colorado State Univ. exp.	HRW	69.4	98%	57.4	31
Cowboy	Crop Res. Foundation of WY	HRW	69.3	98%	56.5	32
Byrd	PlainsGold	HRW	69.3	98%	58.7	34
SY Wolf	AgriPro Syngenta	HRW	68.7	97%	56.4	32
KanMark	Kansas Wheat Alliance	HRW	68.5	97%	58.5	30
TAM 204	Watley Seed	HRW	67.6	96%	55.1	30
Settler CL	Husker Genetics	HRW	66.8	94%	56.8	32
Snowmass	PlainsGold	**HWW**	66.8	94%	58.0	34
Brawl CL Plus	PlainsGold	HRW	63.4	90%	58.1	33
MTS1024	Montana State Univ. exp.	HRW	60.6	86%	54.5	32
Ripper	PlainsGold	HRW	59.5	84%	55.7	32
Akron	Colorado State Univ.	HRW	59.3	84%	56.0	34
Prairie Red	PlainsGold	HRW	56.7	80%	56.7	31
Average			**70.7**		**57.8**	**33**

[a]The 2-year average yield and plant heights are based on eight 2016 and nine 2015 trials. Test weights are based on nine 2016 trials and six 2015 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 (2014-2016) Dryland Variety Performance Results

			3-Year Average[a]			
Variety[b]	Brand/Source	Market Class[c]	Yield bu/ac	Yield % trial average	Test Weight lb/bu	Plant Height in
Antero	PlainsGold	**HWW**	74.6	114%	58.6	31
Oakley CL	Kansas Wheat Alliance	HRW	69.3	106%	58.8	29
SY Monument	AgriPro Syngenta	HRW	69.3	106%	59.3	30
CO11D446	Colorado State Univ. exp.	HRW	69.2	106%	59.8	29
Avery	PlainsGold	HRW	69.0	106%	59.3	32
Denali	PlainsGold	HRW	68.2	105%	60.3	32
WB-Grainfield	WestBred Monsanto	HRW	67.0	103%	60.0	31
LCS Mint	Limagrain	HRW	66.3	102%	59.7	31
Byrd	PlainsGold	HRW	66.2	101%	59.8	31
Cowboy	Crop Res. Foundation of WY	HRW	66.1	101%	58.3	30
Sunshine	PlainsGold	**HWW**	65.8	101%	57.5	30
Winterhawk	WestBred Monsanto	HRW	65.7	101%	60.4	31
Hatcher	PlainsGold	HRW	65.2	100%	58.2	30
SY Wolf	AgriPro Syngenta	HRW	64.9	100%	57.5	30
Settler CL	Husker Genetics	HRW	64.0	98%	57.7	29
KanMark	Kansas Wheat Alliance	HRW	63.2	97%	59.6	27
Snowmass	PlainsGold	**HWW**	63.2	97%	59.1	32
Brawl CL Plus	PlainsGold	HRW	60.6	93%	59.2	31
Ripper	PlainsGold	HRW	58.5	90%	57.3	29
Akron	Colorado State Univ.	HRW	57.7	89%	57.8	31
Prairie Red	PlainsGold	HRW	55.9	86%	57.7	29
Average			**65.2**		**58.8**	**30**

[a]The 3-year average yield is based on eight 2016, nine 2015, and nine 2014 trials. Test weights are based on nine 2016, six 2015, and eight 2014 trials. Plant heights are based on eight 2016, nine 2015, and nine 2014 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, 2016

Kevin Larson, Brett Pettinger, and Perry Jones

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

MATERIALS AND METHODS: Fifteen wheat varieties were planted on October 9, 2015 at 50 lb seed/a in 20 ft. by 800 ft. strips with two replications. We stream applied 50 lb N/a and seedrow applied 5 gal/a of 10-34-0 (20 lb P_2O_5, 6 lb N/a). Ally 0.1 oz/a, dicamba 2oz/a and 2,4-D ester 0.38 lb/a was sprayed for weed control. Two 2 ft. by 2.5 ft. forage samples were taken at jointing (March 22) and at boot (April 22). We measure the forage for fresh weight, oven-dried the samples, and recorded dry weight at 15% moisture content. An infestation of cutworms was controlled with Lambda-Cy at 3.84 oz/a. Russian Wheat Aphid did not reach the critical threshold and the field was not sprayed for them. Low levels of Stripe Rust were detected but not controlled. Wheat viruses (a complex of WSMV and TrMV) were quite pronounced on susceptible varieties. We harvested the plots on July 6 and 7 with a self-propelled combine and weighed them in a digital weigh cart. Grain yields were adjusted to 12% seed moisture content.

RESULTS: Grain yields were very good due to moist planting conditions, which resulted in solid stands, and well-timed moisture during flowering, particularly a wet April (4.92 in. of rain). The trial averaged 50.4 bu/a. About 14 bu/a separated the highest yielding variety, Antero, from the lowest yielding variety, TAM 107. Hatcher had the highest forage yield at jointing and at boot. Five varieties: Antero, Byrd, Denali, Hatcher and WB Grainfield, had above average two-year averages compared to the other wheat tested. Antero, Byrd, Denali and Hatcher produced above average three-year average yields.

DISCUSSION: This year I chose Antero and Hatcher as the best overall dual-purpose wheat varieties of the 15 wheat varieties tested. Antero produced the highest grain yield, the second highest forage yield at jointing, and the sixth highest forage yield at boot. Hatcher produced the highest forage yields at jointing and at boot, and the sixth highest grain yield. If forage production is a higher priority than grain production, then Hatcher is a more desirable dual purpose variety; but if grain production is a higher priority than forage production, then Antero is a more desirable dual purpose variety. This is the third consecutive harvest year that Antero was honored as one of the best overall dual-purpose wheat varieties.

Grain yield averages for this trial, during the last three harvest years, have been below our long term average in 2013 at 12 bu/a, near our long term average in 2014 at 33 bu/a, (the wheat was hailed out in 2015), and above our long term average in 2016 at 50 bu/a. Three wheat varieties tested: Antero, Byrd and Denali, had at least average grain yields each of the last three production seasons. Producing above average yields in response our wide-ranging seasonal conditions suggests that these three wheat varieties can handle our weather extremes. We recommend planting these three varieties for high grain yields to counter our diversity weather conditions.

Table .Dryland Wheat Strips, Forage and Grain Yield at Walsh, 2016.

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	6812	2553	16809	4950	29	54.5	55.7
Avery	6243	2078	17759	5224	30	53.4	54.0
Grainfield	6181	2059	16604	4878	28	55.7	53.6
Winterhawk	5308	1780	18787	5096	30	54.6	53.2
Sunshine	6506	2327	17605	5312	29	54.4	52.8
Hatcher	7433	2599	22515	6458	26	53.7	52.7
Byrd	5504	2139	14862	4564	27	54.0	51.6
Denali	5080	1704	17954	5048	32	53.5	51.1
Snowmass	5070	1964	14715	4121	28	53.7	50.1
TAM 113	6129	2541	14610	4257	27	53.4	49.5
Mint	5573	1940	15049	4248	29	53.0	48.9
TAM 111	7322	2488	17351	4926	30	53.1	47.7
Brawl CL+	6028	2218	14297	4110	31	55.5	47.3
T158	5112	1981	14534	4388	28	55.5	45.9
TAM 107	3811	1504	12456	3857	26	53.3	41.5
Average	5874	2125	16394	4762	29	54.1	50.4
LSD 0.20	998.8	665.7	2677.8	874.7			2.07

Planted: October 9, 2015; 50 lb seed/a; 5 gal/a 10-34-0.
Grain Harvested: July 6 and 7, 2016.
Jointing sample taken March 22, 2016.
Boot sample taken April 22, 2016.
Wet Weight is reported at field moisture.
Dry Weight is adjusted to 15% moisture content.
Grain Yield is adjusted to 12% moisture content.

Table .--Summary: Dryland Wheat Strips Variety Performance Tests at Walsh, 2013-2016.

		Grain Yield					Yield as % of Trial Average				
Firm	Variety	2013	2014	2016	2-Year Avg	3-Year Avg	2013	2014	2016	2-Year Avg	3-Year Avg
		----------------bu/a----------------					------------------%------------------				
AGSECO	TAM 113	11	32	50	41	31	92	97	100	98	97
AgriPro	TAM 111	13	33	48	41	31	108	100	96	96	98
Colorado State	Antero	15	35	56	46	35	125	106	112	108	110
Colorado State	Byrd	13	37	52	45	34	108	112	104	106	106
Colorado State	Denali	14	35	51	43	33	117	106	102	102	104
Colorado State	Hatcher	11	34	53	44	33	92	103	106	104	102
Colorado State	Brawl CL+	14	30	47	39	30	117	91	94	92	95
Colorado State	Snowmass	11	32	50	41	31	92	97	100	98	97
Westbred	Winterhawk	12	31	53	42	32	100	94	106	100	100
Westbred	WB Grainfield	--	32	54	43	--	--	97	108	102	--
Average		12	33	50	42	32					

Grain Yields were adjusted to 12.0 % seed moisture content.
No wheat yields recorded for 2015 due to hail.

Dryland Wheat Row Spacing Study

Kevin Larson and Brett Pettinger

Purpose: To determine which wheat row spacing is most productive for the dryland conditions in Southeastern Colorado.

Materials and Methods

We tested five row spacing arrangements: 6 in., 7.5 in., 12 in., 15 in. and twin 7.5 in. (two rows 7.5 in. apart, centered on 30 in., with a 22.5 in. space between the outside rows) using two different cone planters. One of the cone planters had six planter row units 12 in. apart (our small plot cereal drill) and the other cone planter had eight planter row units in a 7.5 in. twin row arrangement (our small plot, twin row, row crop planter). By using GPS guidance to offset planting rows, we were able to achieve the five row spacing configurations. We planted Byrd wheat seed at 45 lb/a on October 5, 2015 in a Randomized Complete Block Design with 2 replications. Plot length was 288 ft. and plot width depended on row spacing configuration, but plot harvest width was always 10 ft. wide. . We stream applied 50 lb N/a. Ally 0.1 oz/a, dicamba 2oz/a and 2,4-D ester 0.38 lb/a was sprayed for weed control. An infestation of cutworms was controlled with Lambda-Cy at 3.84 oz/a. Russian Wheat Aphid did not reach the critical threshold and the field was not sprayed for them. Low levels of Stripe Rust were detected but not controlled. Wheat viruses (a complex of WSMV and TrMV) were quite evident on the Byrd wheat for all row spacings. We harvested the plots on June 30 with a self-propelled combine equipped with a digital scale. Grain samples were taken for moisture and test weights. Grain yields were adjusted to 12% seed moisture content.

Results and Discussion

Grain yields were very good due to moist planting conditions, which resulted in solid stands, and well-timed moisture during flowering, particularly a wet April (4.92 in. of rain). The study averaged 69.3 bu/a. The 12 in. row spacing treatment produce the highest yield, 75.6 bu/a, and was significantly higher yielding than the other row spacing treatments. There were no significant yield differences between the other row spacing treatments: 6 in., 7.5 in., 15 in. and twin 7.5 in. We included the twin 7.5 in. treatment because we thought growers would find it humorous, and because it was easy to identify even without a plot map. At our wheat field day, we were surprised at the positive reaction to the twin 7.5 in. treatment. Many growers felt that, even if the 7.5 in. twin did not produce the highest wheat yield, if next season we planted grain sorghum in 7.5 in. twin rows in the 22.5 in. gap between the twin row wheat stubble that the additional grain sorghum yield would more than compensate for the lower wheat yield. Because of growers' research suggestions for this twin row system, we have developed a new twin row study in a Wheat-Sorghum-Fallow rotation. Next year we will begin this W-S-F rotation study, where we compare twin row and single row spacings.

Dryland Wheat Row Spacing Study at Walsh, 2016.

Row Spacing	Grain Yield[1]		Test Weight	Grain Moisture
	bu/acre		lbs/bu	%
12 in.	75.6	a	54.3	12.4
6 in.	69.7	b	54.4	12.6
7.5 in.	68.5	b	54.0	12.4
15 in.	67.3	b	55.5	12.4
Twin 7.5 in.	65.6	b	54.5	12.4
Average	69.3		54.5	12.4
LSD 0.05	5.71			

Planted: October 5, 2015; Byrd at 45 lb/acre.

Harvest: June 30, 2016.

[1]Grain yields are adjusted to 12% moisture content.

Singulated and Non-Sinulated Seeding Comparison for Dyland Wheat Production

Brett Pettinger and Kevin Larson

Purpose: To determine if singulated seeding is most productive than non-singulated seeding for dryland wheat production in Southeastern Colorado.

Materials and Methods

We tested two seeding delivery systems: 1) singulated seeding using a Monosem 8 in. twin row planter and 2) non-singulated seeding using a 7.5 in. twin row cone planter. Both planters were four row twins. The cone planter twin spacing was arranged with two rows 7.5 in. apart, centered on 30 in., with a 22.5 in. space between the outside rows. The Monosem twin spacing was arranged with two rows 8 in. apart, centered on 30 in., with a 22 in. space between the outside rows. To achieve uniform narrow row spacings, we planted solid stands of 7.5 in. spacings for the cone planter or 8 in. spacings for the Monosem planter by planting then shifting the planters to plant between the 22.0 in. or 22.5 in. gaps. We planted Winterhawk wheat seed on October 7, 2015 in a Randomized Complete Block Design with 2 replications. For the singulated treatment, we seeded at 634,000 seeds/acre and for the non-singulated treatments we seeded at 50.0 lb/a. The Winterhawk seed had 12,777 seeds/lb and 50 lb times 12,777 seeds/lb equals 638,850 seeds/a. Plot dimensions were 10 ft bt 210 ft. We stream applied 50 lb N/acre. Ally 0.1 oz/a, dicamba 2oz/a and 2,4-D ester 0.38 lb/a was sprayed for weed control. An infestation of cutworms was controlled with Lambda-Cy at 3.84 oz/a. Russian Wheat Aphid did not reach the critical threshold and the field was not sprayed for them. Low levels of Stripe Rust were detected but not controlled. Wheat viruses (a complex of WSMV and TrMV) were quite evident on the Winterhawk wheat for both seedings. We harvested the plots on June 30 with a self-propelled combine equipped with a digital scale. Grain samples were taken for moisture and test weights. Grain yields were adjusted to 12% seed moisture content.

Results and Discussion

Wheat yields were very good due to moist planting conditions, which resulted in good stands, and well-timed moisture during flowering, particularly a wet April (4.92 in. of rain). The study averaged 61.6 bu/a. The non-singulated seeding produced the highest yield, but it did not produce significantly more yield than the singulated seeding. This suggests that there is no yield advantage switching from standard non-singulated delivery planters to singulated delivery planters for wheat seeding. This lack of yield advantage may only hold true for narrow row (7.5 in. and 8 in.) wheat seedings. Since we did not test wider, more common row spacings, we cannot generalize on these wider arrangements for singulation performance.

Dryland Wheat Singulated and Non-Singulated Seeding, Walsh 2016.

Seeding	Row Spacing	Seeding Rate	Grain Yield[2]		Test Weight	Grain Moisture
	inches	*/acre	bu/acre		lbs/bu	%
Singulated	8.0	634,000 seeds	59.7	a	55.7	12.2
Non-Singulated	7.5	50.0 lb[1]	63.4	a	56.4	12.0
Average			61.6		56.1	12.1
LSD 0.20			3.85			

Planted: October 7, 2015 with Winterhawk.

Harvest: June 30, 2016.

[1]The 50 lb/acre seeding rate equalled 638,850 seeds/acre.

[2]Grain yields are adjusted to 12% moisture content.

Dryland Hybrid Rye Performance Trial, Walsh, 2016

Kevin Larson, Plainsman Research Center
KWS Cereals USA

Rye (*Secale cereale*) is an ancient grain grown in colder European regions, but has had limited production in Eastern Colorado. The demand for rye has been restricted by its primary uses: rye bread and rye whiskey. With the recent flourishing of whiskey distillers in Colorado, the demand for rye grain has exponentially increased. This study investigates some of the basic agronomic characteristics of rye production for Eastern Colorado: seeding rate, heading date, flowering date, plant height, plant lodging, grain yield, test weight for rye hybrids grown under dryland conditions.

Materials and Methods

On October 2, 2015, we planted five rye hybrids: Brasetto, Bono, Guttino, Progas, and Magnifico, and one hard red winter wheat, Byrd, at two seeding rates, 700,000 seeds/acre and 1,000,000 seeds/acre. Each treatment plot consisted of 12 rows with 12 in. spacing, 36 ft. long and was replicated four times in a randomized complete block design. The soil for the study site was Wiley silt loam, which had been primarily no-till (with some limited tillage) in a Wheat-Fallow rotation for multiple years. We fertilized with 50 lbs of N/acre by streaming 28-0-0 on 20 in. spaced nozzles. For phosphate fertility, we seedrow applied at planting 5 gal./acre of 10-34-0 (20 lb P_2O_5/acre, 6 lb N/acre). Weed control was achieved with Ally at 0.1 oz/ac, 2,4-D ester at 0.38 lbs/ac, dicamba at 2.0 oz/ac, and Activator 90 at 4 oz/ac. Cutworms exceeded the threshold level and were aerially sprayed with Lambda Cyhalothorin at 3.84 oz/ac. We harvested the middle of the plots, with a harvest area of 10 ft. by 30 ft., on July 18, 2016 with a self-propelled combine and weighed the grain in a digital scale bucket. Grain samples were taken for moisture and test weight. Grain yields were adjusted to 12% for both the rye hybrids and the wheat check.

Results

The nine month growing season was wetter than average from October through June, mostly because April was very wet, 4.92 inches of rain.

Precipitation: October 2015 to June 2016.

	--------------Monthly Total Preciptation (inches)------------									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Total**
Precipitation	2.93	1.55	0.92	0.06	0.34	0.03	4.92	1.43	3.23	**15.41**

Plant stands for all rye hybrids were good, averaging 686,500 for the 700,000 seeds/acre seeding rate and 895,600 seeds/acre for the 1,000,000 seeds/acre seeding rate (Table 1). No winterkilling was observed for any of the rye hybrids, nor the wheat check (data not presented). Grain yields were very good with the rye hybrids averaging 3480 lbs/acre. Bono at the one million seeds/acre treatment produced the highest yield average of 3823 lbs/acre. Focusing on each rye hybrid individually, none produced significantly more yield at the one million seeds/acre treatment compared to the 700,000 seeds/acre treatment (P>0.05). All five rye hybrids produced higher grain yields than the hard red winter wheat check; however, only Bono produced significantly more than the wheat check (P>0.05, Table 2). Only 5 lbs/acre separated the one million seeds/acre treatment from the 700,000 seeds/acre treatment, when combining all rye hybrids together (Table 3). Test weights for all rye hybrids were low, ranging from 45.3 to 47.6 lbs/bushel. The low test weights may be due to abundant rains after seed maturation and before harvest. Plant heights remained nearly constant for each rye hybrid with no more than 0.5 inch change between the low (700,000 seeds/acre) and the high (1,000,000 seeds/acre) seeding rates. However, there were significant plant height differences at harvest, when comparing plant heights between rye hybrids (P>0.05). Only two days separated rye hybrids for days to heading, 219 to 221 days after planting, and days to anthesis, 224 to 226 days after planting (Table 4). All rye hybrids had five or six days between days to heading and days to anthesis. All rye hybrids, but not the wheat check, were completely lodged. Nonetheless, only small areas, 0 to 8 % of the harvest area, were completely flat on the ground and could not be harvested.

Discussion

The above average precipitation growing season produced very good grain yields for all of the rye hybrids, but only Bono produced significantly more yield than the hard red winter wheat check. All of the rye hybrids appeared to be well adapted to the dryland growing conditions of Southeastern Colorado, but because Bono had significantly higher yield than Magnifico, Bono may be the considered the best adapted hybrid and Magnifico the least adapted hybrid of the five rye hybrids studied. Nonetheless, other than significant plant height differences at harvest, Bono, Brasetto, Progas, and Guittino performed similarly for all parameters measured, including grain yield.

One agronomic concern for all the rye hybrids did arise: lodging at harvest. All the rye hybrids were completely lodged at harvest, whereas, the wheat check had no more than 10% lodging. This rye hybrid lodging required that combine harvesting be performed against the lodging direction in order to pick up the lodged plants. With unidirectional combining, we were able to harvest most of the lodged plants. Progas, Magnifico, Brasetto, and Guttino had small areas that were complete flat and could not be picked up and combined. Bono was the only rye hybrid that did not have these completely flat, not harvestable areas.

An advantage of the rye hybrids compared to the wheat check was their resistance to common wheat viral diseases. A virus complex (identified by the CSU Pathology Laboratory as WSMV and TrMV) infected the wheat check, but did not infect the rye hybrids.

Table 1.Hybrid rye and seeding rate performance trial at Walsh, Colorado 2016.

Cultivar	Seeding Rate	Plant Stand	Grain Yield[1]	Test Weight	Grain Moisture	Plant Height
	seeds/acre	plants/acre	lbs/acre	lbs/bu	%	inches
Bono	1M	927,850	3,823	47.6	9.5	42.5
Bono	700K	744,850	3,573	46.9	9.7	42.0
Brasetto	1M	866,850	3,468	46.2	9.6	39.5
Brasetto	700K	631,600	3,535	47.6	10.0	39.5
Progas	1M	862,500	3,420	45.3	9.3	44.0
Progas	700K	666,500	3,573	45.6	9.6	44.0
Guttino	1M	910,400	3,237	44.8	9.7	38.0
Guttino	700K	670,800	3,532	45.4	9.7	38.5
Magnifico	1M	910,450	3,315	46.4	9.7	42.0
Magnifico	700K	718,750	3,326	46.4	9.8	41.5
Byrd (wheat)	1M	815,100	3,407	50.4	10.9	31.0
Byrd (wheat)[2]	700K	666,450	3,162	53.4	9.7	31.0
Average		782,675	3,448	47.2	9.8	39.5
LSD 0.05			448.3			0.97

Planted: October 2, 2015; harvested: July 18, 2016.

[1]Grain yields are adjusted to 12% seed moisture content.

[2]Hard red winter wheat cultivar.

Table 2. Hybrid rye cultivar performance at Walsh, Colorado 2016.

Cultivar	Grain Yield[1]	Test Weight	Seed Moisture
	lbs/acre	lbs/bu	%
Bono	3,698	47.3	9.6
Brasetto	3,501	46.9	9.8
Progas	3,496	45.5	9.5
Guttino	3,384	45.1	9.7
Magnifico	3,321	46.4	9.8
Byrd (wheat)[2]	3,285	51.9	10.3
Average	3,448	47.2	9.8
LSD 0.05	317.0		

Planted: October 2, 2015; harvested: July 18, 2016.

[1]Grain yields are adjusted to 12% moisture content.

[2]Hard red winter wheat cultivar.

Table 3. Hybrid rye seeding rate performance at Walsh, Colorado 2016.

Seeding Rate	Grain Yield[1]	Test Weight	Seed Moisture
seeds/acre	lbs/acre	lbs/bu	%
700 thousand	3,450	47.6	9.8
1 million	3,445	46.8	9.8
Average	3,448	47.2	9.8
LSD 0.05	183.0		

Planted: October 2, 2015; harvested: July 18, 2016.

[1]Grain yields are adjusted to 12% moisture content.

Table 4.Agronomic performance of hybrid rye at Walsh, Colorado 2016.

Cultivar	Seeding Rate	Lodging[1]	Lodging Unharvestable[2]	Days to Heading	Days to Anthesis
	seeds/acre	%	%	no.	no.
Bono	1M	100	0	220	225
Bono	700K	100	0	220	225
Brasetto	1M	100	4	219	224
Brasetto	700K	100	0	219	224
Progas	1M	100	5	220	226
Progas	700K	100	8	220	226
Guttino	1M	100	0	221	226
Guttino	700K	100	3	220	226
Magnifico	1M	100	3	220	226
Magnifico	700K	100	5	221	226
Byrd (wheat)	1M	10	0	221	226
Byrd (wheat)[3]	700K	0	0	221	226
Average		84	2	220	225
LSD 0.05				0.9	0.8

Planted: October 2, 2015; harvested: July 18, 2016.

[1]All rye hybrids were lodged and necessitated harvesting unidirectionally.

[2]Small areas in some hybrids were lodged flat and could not be harvested.

[3]Byrd is a hard red winter wheat.

Strip Till and No Till Comparison for Dryland Grain Sorghum Production

Kevin Larson, Brett Pettinger and Perry Jones

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 April 26, 2016. For the no till treatment, we surface applied liquid 28-0-0 in streams 20 in. apart at 50 lb N/a on April 30, 2016 and seedrow applied 10-34-0 at 5 gal/a at planting. We planted Mycogen 1G557 at 35,000 seeds/a on June 15, 2016 with a John Deere vacuum planter with eight, 30 in. rows. For pre-emergence weed control we applied Metalochlor at 24 oz/a and atrazine at 1.0 lb/a, and for post emergence weed control, we applied: 2,4-D amine first and later Huskie at 16 oz/a and atrazine at 0.75 lb/a. We harvested the 60 ft. wide by 1200 ft. long grain sorghum plots on November 1, 2016 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 4.1 bu/a more than the strip till treatment and this yield difference was significant at the 0.20 alpha level. The cost of 50 lb/a of N fertilizer was $7.62/a less expensive for strip till using anhydrous N than for no till using liquid N (anhydrous cost was $570/ton and liquid 28-0-0 cost was $280/ton); however, custom application cost of strip till was $9/a more than boom application for no till ($15/a for strip till and $6/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, this equated to a marginal ($1.38/a) difference in total variable cost between the no till and strip till treatments. The variable net income of no till was $11.63/a more than strip till primarily due to the higher grain yield of no till (4.1 bu/a @ $2.50/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. This is the second year that no till produce higher dryland grain sorghum yields and variable net incomes 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, 2016.

Tillage Treatment	Flowering Date	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	11-Aug	70.2	Liquid (28-0-0)	25.00	6.00	31.00	144.50
Strip Till	14-Aug	66.1	Anhydrous (82-0-0)	17.38	15.00	32.38	132.87
Average	13-Aug	68.2		21.19	10.50	31.69	138.69
LSD (0.20)		3.96					

Strip till: anhydrous N applied April 26, 2016 on 30 in. row spacing at a depth of 6 in.
No till: surface applied liquid 28-0-0 on May 2, 2016 in streams 20 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: $570/ton; 28-0-0 cost $280/ton.
Grain sorghum price: $2.50/bu.
Planted Mycogen 1G557 on June 15 and harvested on November 1, 2016.

Dryland Grain Sorghum Seeding Rates, Walsh, 2016

Brett Pettinger, Kevin Larson and Perry Jones

Dryland seeding rates in Eastern Colorado vary greatly based on location, soil type and hybrid maturity. The goal of this study is to observe general trends of an early maturing hybrid in maturation and yield as seeding rate increases.

Materials and Methods

The plot location selected has a Wiley Loam soil profile that is nearly level in slope. Fertilizer inputs of 50 pounds nitrogen per acre via streaming 32-0-0 on 20 inch spacing and 5 gallons 10-34-0 per acre delivered in the seed trench at planting. Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The study was planted on June 16, 2016 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, 35.7, 44.4 and 53.7 seeds/a X 1000 were tested. Two randomized block replications were laid out using eight row strips of approximately 1275 feet in length. Tractor speed at planting was held to a constant 5.0 mph. Stand counts were taken using a 0.005 acre area on June 29, 2016. Tiller counts were taken on September 8, 2016. Two post emergence herbicide applications were applied, one using glyphosate via a hooded sprayer, the other using Huskie, atrazine and ammonium sulfate. The study was harvested on November 3, 2016.

Results and Discussion

The plot received 10.82 inches of moisture from June through October. 6.35" of precipitation in April and May provided ample submoisture. One significant hail event occurred on August 4th impacting the main culms at the boot to boot plus physiological stages. This hail event caused substantial vegetative damage to the plants by stripping leaves. The precipitation timing in the latter part of the growing season is certainly worth noting as only .19" of moisture fell from August 28th through the killing freeze date of October 7th. Yields in this study ranged from 61.4 to 70.9 bushels per acre (adjusted to 14% moisture). Results showed an increase in yield as seeding rate was increased. This pattern mirrors results of previous seeding rate studies performed in 2014 and 2015. (Pettinger and Larson 2014, 2015) See figure 1 for yield results of the 2016 study. In the three years of research regarding seeding rates, this is the first year in which tiller counts have been taken. These observations revealed average tillers per plant ranging from 2.23 at the 24,600 seeding rate to 0.73 tillers at the 53,700 seeds per acre rate. This observation, coupled with minimal late season moisture for tiller seed production, could certainly explain yield increases as seeding rate increased due to drought stress on tillers. Interestingly, when total head count at harvest was calculated, total head count per acre (main culm and tillers) were very similar across all seeding rates except the 24,600 seeds per acre category. See Figure 2. This observation suggests Mycogen 1G557, across nearly all seeding rates, was able to compensate tiller production based on the number of main culms, for a similar total head count at harvest. This observation will be taken in subsequent seeding rate studies in order to determine if there is a defined pattern of tiller production to a targeted total head count. If it can be determined that a grain sorghum variety exhibits these characteristics, this could be used as a more objective tool for producers when determining seeding rates.

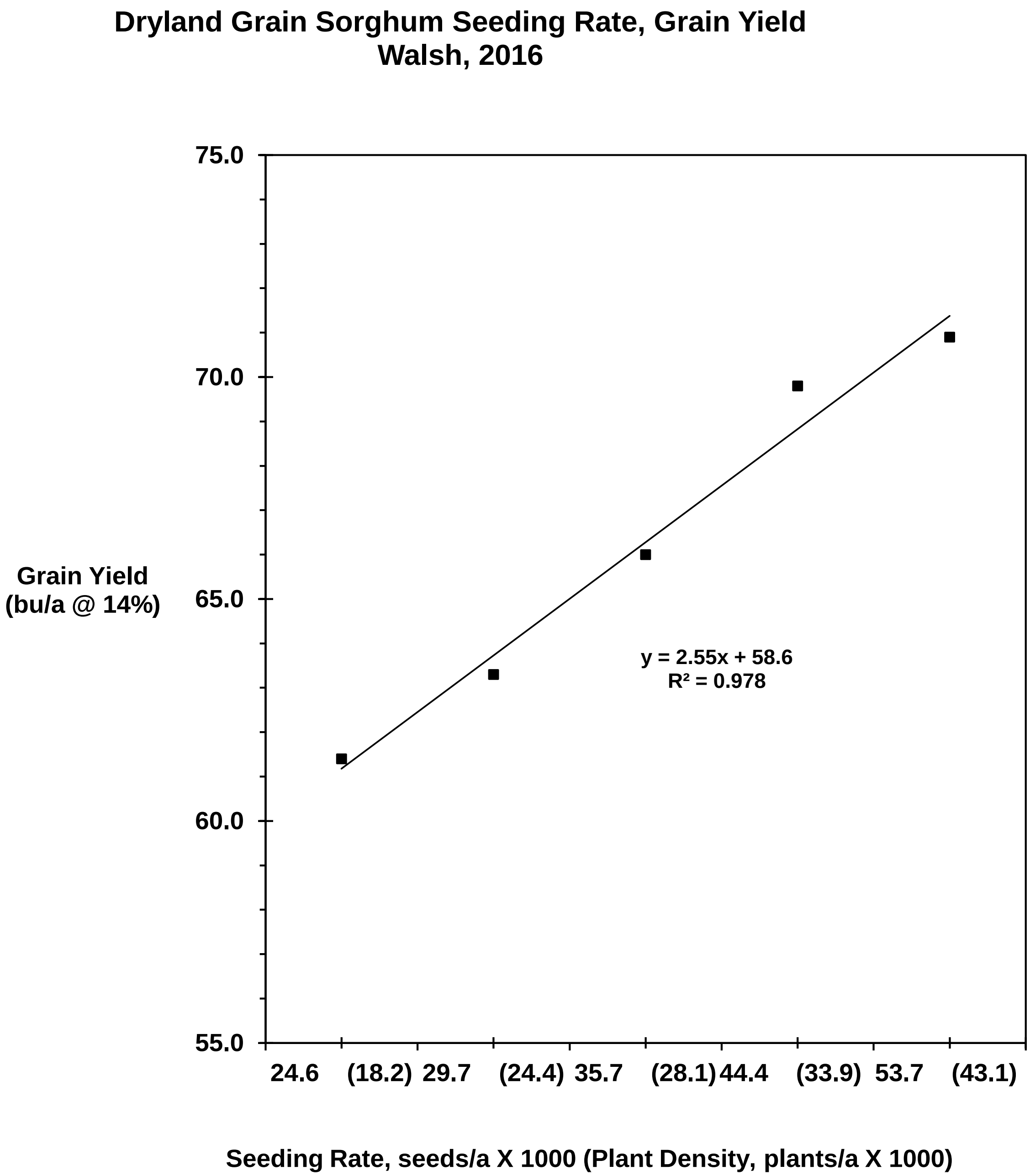


Figure 1-Yield relationship observed in dryland grain sorghum as seeding rate increased. The seeding rates were: 24.6, 29.7, 37.1, 44.4, and 53.7 seeds/acre X 1000. The grain sorghum hybrid was Mycogen 1G557.

Seeding Rate (Seeds Per Acre)	Main Culms (Per Acre)	Tillers (Per Acre)	Total Heads (Per Acre)	Tillers (Avg. Per Plant)
24,600	14400	31200	45600	2.23
29,700	20800	38800	59600	1.87
35,700	26000	36400	62400	1.4
44,400	28800	32400	61200	1.125
53,700	35600	25600	61200	0.73

Figure 2- Main culms and tillers observed on September 8, 2016.

Seeding Density (Seeds Per Acre)	Plant Stand (Plants Per Acre)	Emergence Percent
24600	18200	73.98%
29700	24400	82.15%
35700	28100	78.71%
44400	33900	76.35%
53700	43100	80.26%

Figure 3- Seeding Density and observed stand counts.

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.

Pettinger B., K. Larson. 2015. “Dryland Grain Sorghum Seeding Rates, Walsh, 2015.” Technical Report, TR-16-2. Colorado Agricultural Experiment Station, CSU.

Effects of Planting Speed on Dryland Grain Sorghum Production 2016

Brett Pettinger, Kevin Larson and Perry Jones

Purpose: To study the effects of vacuum seed meter performance and yield of John Deere and Precision Planting systems based upon planting speed. This is the third year conducting this study to help develop optimum planting speed recommendations for grain sorghum producers.

Materials and Methods

John Deere and Precision Eset vacuum meters were cleaned and calibrated on a Meter Max test stand using Channel 5B49 hybrid seed (11,500 seeds per pound) to determine optimum vacuum setting for each system. Specific plates used were a 45 cell sorghum plate for the John Deere meters and a 60 cell large sugar beet plate for Precision Eset meters. 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 was modified 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 1200 feet in length. Speed categories of 4.5, 5, 5.5, 6, 6.5 and 7 mph were tested. Field preparation consisted of streaming 50 pounds of nitrogen in March via 28-0-0 using nozzles at 20 inch spacing. Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The field was originally planted to grain sorghum on May 25, 2016 using a different variety for non-testing purposes. Due to soil crusting, the resulting stand was very poor and was terminated using glyphosate. The test plot was planted on June 19, 2016 with 5 gallon of 10-34-0 applied in the seed trench with Keeton seed firmers. 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 12 psi for Precision and 7.9 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 29,000 seeds/acre while John Deere averaged 26,800 seeds/acre. A Huskie, atrazine and ammonium sulfate mixture was applied for post emergence weed control. Due to operator error, we were unable to retrieve seed singulation data from the planter monitor.

Overview and Results

The plot received 10.82 inches of rainfall from June through October. April and May precipitation of 6.35 inches provided ample sub moisture. The entire study averaged 67.89 bushels per acre (all yields are represented at 14% moisture). Statistical analysis for both planting systems produced maximum yields at a planting speed of 5.5 mph (70.37 bushels per acre for John Deere and 70.5 bushels per acre for Precision Planting). This observation matches results for optimum speed found in 2014 and 2015 and suggests that the 5.5 mph planting speed is best for an early maturing hybrid with a similar seeded population. (Pettinger and Larson, 2014, 2015) The yield range for the John Deere Vacuum seed plates was 65.07 to 70.37 bushels per acre. Yield range for Precision Eset seed plates was 67.35 to 70.50 bushels per acre. Both planting systems exhibited a similar yield depression at 4.5 and 7.0 mph, however yields from the Precision Eset meters more closely followed the statistical bell curve (Precision R^2=0.646 versus Deere R^2=0.279). A trend can also be developed in three years of data that the yields from Precision Eset meters have more consistently followed this bell shaped curve with R^2 values ranging from 0.646 to 0.9819. The yields of the John Deere seed meters were much less consistent with R^2 values ranging from 0.279 to 0.927 for the three year study period.

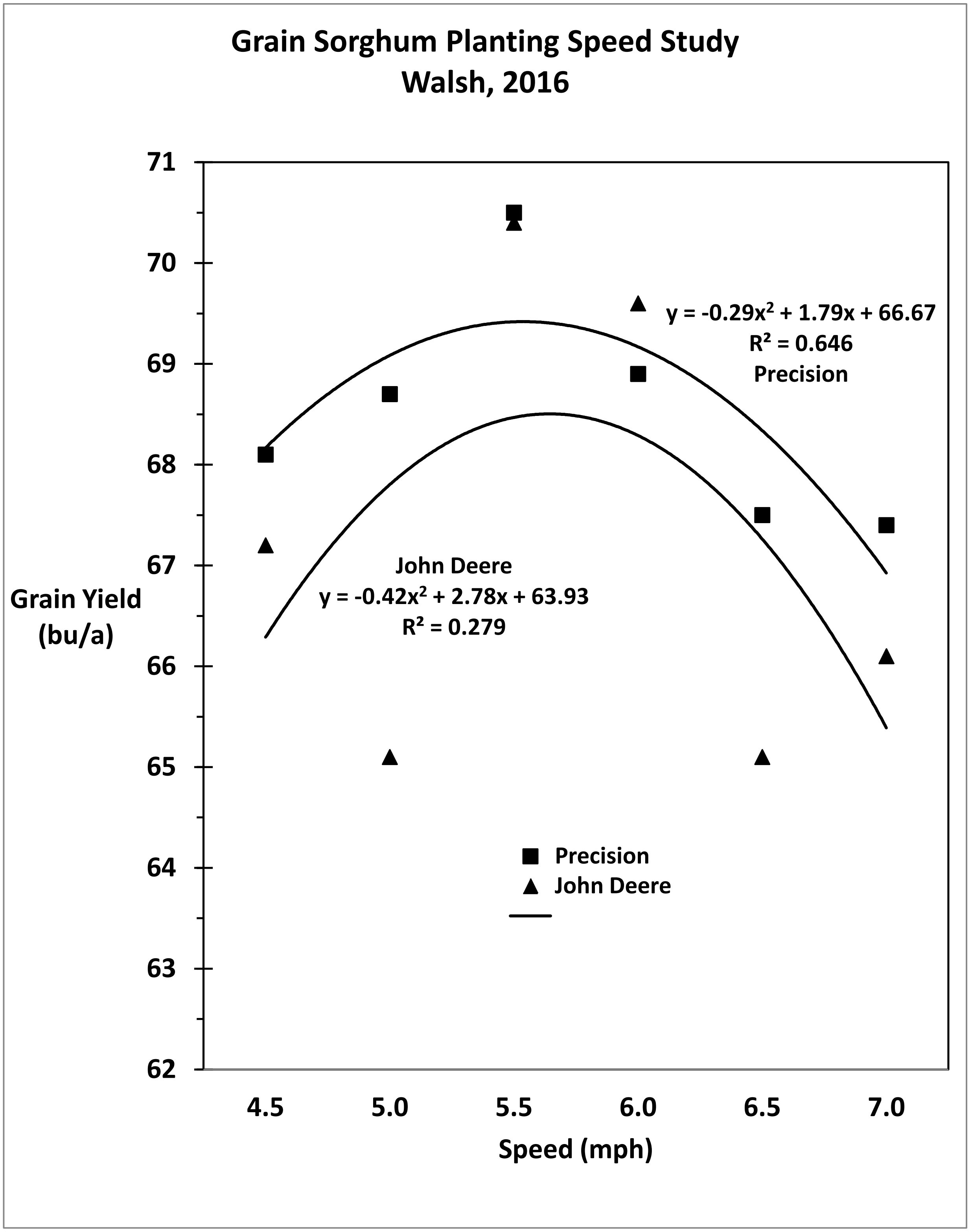
Discussion

Dryland test studies, because of variations in growing conditions, ordinarily take many years of repetition to accurately show trends in treatments. We have been pleasantly surprised that in all three years of this study that the 5.5 mph planting speed produced the highest yields. This data has been developed with a ground drive meter system and we are hoping that future testing of this concept will be done with hydraulic meter drive to more accurately mirror planter performance of area farmers.

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.

Pettinger,B., K. Larson. 2015 “Effects of Planting Speed on Dryland Grain Sorghum Production” Technical Report, TR-16-2. Colorado Agricultural Experiment Station, CSU.



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 Walsh, 2016

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 3000 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 6. HARVESTED: October 28 and 31.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 21 oz/a, Glyphosate, 32 oz/a; 2,4-D, 0.5 lb/a, Banvel 5 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: Transform for sugarcane aphids.

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	3.23	659	21	0	24
July	3.88	898	24	6	55
August	3.68	741	14	0	86
September	0.17	611	10	0	116
October	0.01	106	0	0	123
Total	10.97	3015	69	6	123

[a]Growing season from June 6 (planting) to October 7 (first freeze, 26 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 very good. Light infestation of sugarcane aphids, which were controlled by Transform. The growing season precipitation was above average. June, July and August were wet and September was dry. Hybrids at this site had to recover from minor hail damage. Grain yields and test weights were excellent.

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”	8.0	0.5	2.4	15	4.7	393	0.9	9.3
8”-24”				13				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization.

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

Yield Goal: 40 bu/a.
Actual Yield: 85 bu/a.

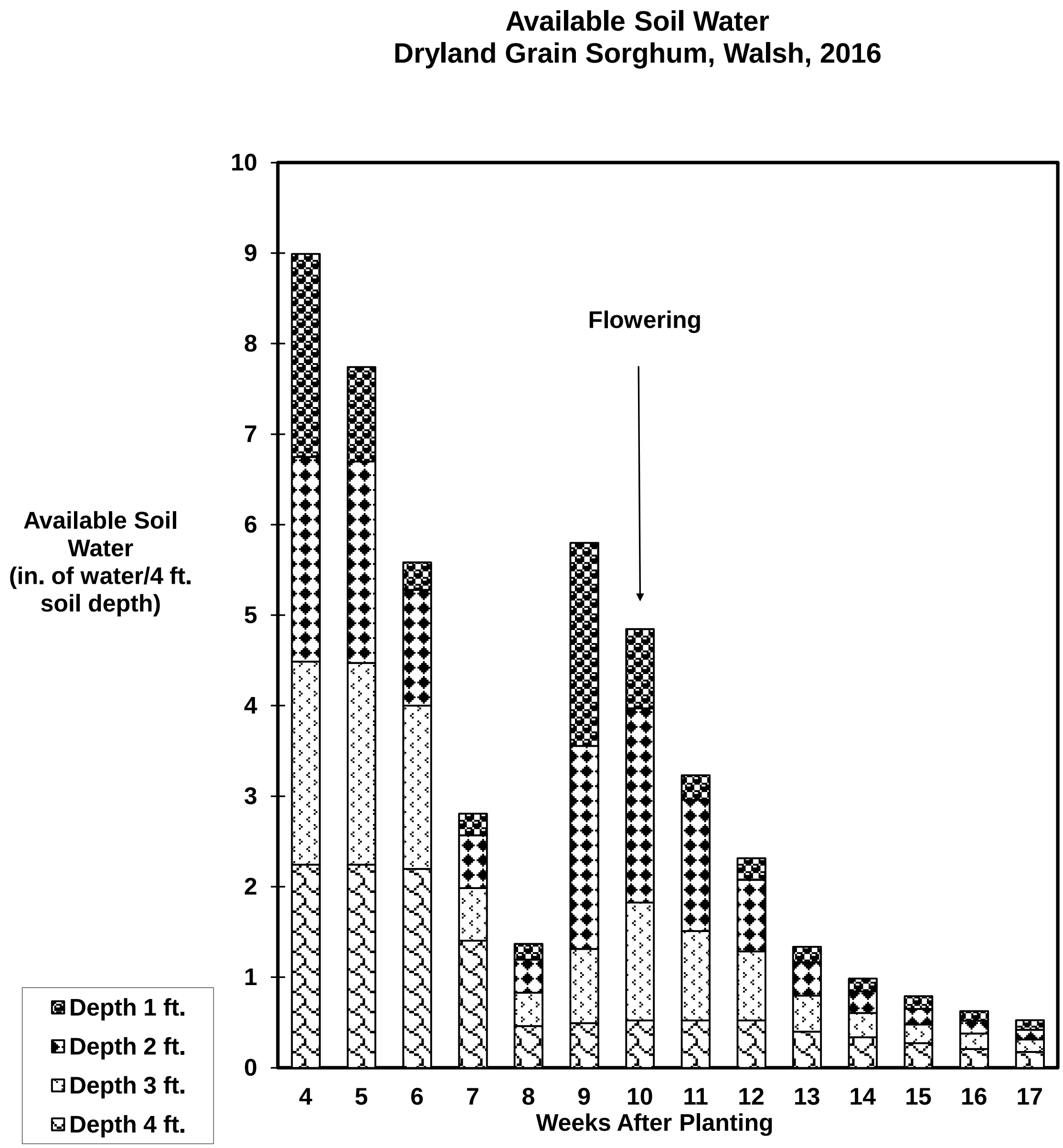


Fig. 1. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 10.97 in. Any increase in available soil water between weeks is from rain.

2016 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]	
Alta Seeds	AG1203	112.2	132	60.8	0	25,200	48	68	1914	112	ME
Heartland Genetics	HG44-R	103.2	121	59.7	0	28,700	42	67	1894	114	ME
Gayland Ward Seed	9135	102.5	120	60.6	1	25,900	46	71	1982	118	M
Dyna-Gro Seed	M60GB31	101.6	119	61.1	0	27,100	47	68	1914	114	ME
Gayland Ward Seed	8022	99.5	117	58.1	1	24,400	50	77	2119	123	ML
Gayland Ward Seed	9139	95.1	112	61.3	2	23,200	49	68	1914	113	ME
Gayland Ward Seed	8019	93.3	110	57.4	6	28,300	47	77	2119	121	ML
Sorghum Partners	KS585	92.7	109	61.0	0	29,800	45	73	2035	120	M
Dekalb	DKS29-28	91.7	108	60.8	0	26,700	39	60	1710	106	E
Dyna-Gro Seed	GX16667	89.6	105	58.5	2	30,200	52	76	2096	123	ML
Dyna-Gro Seed	GX16988	89.5	105	59.5	0	27,900	45	63	1780	107	ME
Gayland Ward Seed	9076	86.1	101	58.1	13	23,600	53	74	2063	119	M
Gayland Ward Seed	9059	85.8	101	59.8	0	27,500	50	67	1894	112	ME
Sorghum Partners	SP 34A19	85.6	101	58.7	0	35,600	41	65	1835	111	ME
Sorghum Partners	KS310	85.0	100	60.7	0	29,800	43	63	1780	109	ME
Dekalb	DKS28-05	84.8	100	59.9	0	31,400	43	60	1710	107	E
Gayland Ward Seed	9138	84.6	99	61.2	2	22,900	54	69	1936	115	ME
Heartland Genetics	HG23-R	84.0	99	60.8	0	30,600	40	62	1754	107	ME
Alta Seeds	AG2115	83.6	98	59.6	0	27,100	45	71	1982	118	M
Sorghum Partners	SP 31A15	80.5	95	59.6	0	23,600	42	64	1807	111	ME
Dyna-Gro Seed	M58GR24	80.1	94	59.9	5	23,600	48	60	1710	105	E
Dyna-Gro Seed	GX16957	79.9	94	60.8	0	27,100	35	59	1680	105	E
Alta Seeds	AG1201	77.7	91	59.3	0	24,800	37	62	1754	106	ME
Dyna-Gro Seed	M71GR75	77.5	91	56.2	6	28,300	61	79	2168	HD	ML
Sorghum Partners	SP 33S40	77.0	90	61.2	0	24,400	46	61	1732	107	E
Gayland Ward Seed	9134	76.6	90	60.7	10	25,200	52	73	2035	120	M
Sorghum Partners	Chrolo163	75.3	88	60.5	0	16,700	44	66	1867	113	ME
Alta Seeds	AG1101	64.9	76	60.2	0	24,800	33	56	1589	100	E
Heartland Genetics	HG18-R	64.6	76	60.8	0	25,200	39	58	1649	103	E
Sorghum Partners	SP 3303	49.7	58	60.4	1	19,800	42	61	1732	109	E
Average		**85.1**		**59.9**	**2**	**26,300**	**45**	**67**	**1872**	**112**	**ME**
[e]LSD (P<0.05)		11.7			3						
[e]LSD (P<0.20)		7.6			2						

[a]Yields adjusted to 14% moisture.

[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 or seed maturation. HD = hard dough.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is a 95% (at P<0.05) or 80% (at P<0.20) chance the difference is statistically significant.

Table 4. Summary: Dryland Grain Sorghum Hybrid Performance Trials at Walsh, 2014-2016.

			Grain Yield					Yield as % of Test Average				
Brand	Hybrid	Maturity Group[a]	2014	2015	2016	2-Year Avg	3-Year Avg	2014	2015	2016	2-Year Avg	3-Year Avg
Alta Seeds	AG1101	E	44	41	65	53	50	91	104	76	85	88
Alta Seeds	AG1201	ME	55	44	78	61	59	114	112	91	98	103
Alta Seeds	AG1203	ME	54	38	112	75	68	111	98	132	121	119
Alta Seeds	AG2115	M	--	42	84	63	--	--	107	98	101	--
Dekalb	DKS29-28	E	--	37	92	64	--	--	95	108	104	--
Dekalb	DKS28-05	E	--	34	85	59	--	142	130	130	96	--
Average			**48**	**39**	**85**	**62**	**57**					

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

Drip Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2016

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

PURPOSE: To identify high yielding hybrids under subsurface drip irrigated conditions with 3000 sorghum heat units in a silt loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 87,100 seed/a. PLANTED: June 7. HARVESTED: October 28.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 21 oz/a, Glyphosate, 32 oz/a; 2,4-D, 0.5 lb/a, Banvel 5 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: Transform for sugarcane aphids.

Irrigation: Eight subsurface drip irrigations, totaling 10.6 in/a.

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	3.23	640	21	0	23
July	3.88	898	24	6	54
August	3.68	741	14	0	85
September	0.17	611	10	0	115
October	0.01	106	0	0	122
Total	10.97	2996	69	6	122

[a]Growing season from June 7 (planting) to October 7 (first freeze, 26 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was good. Light infestation of sugarcane aphids, which were controlled by Transform. The growing season precipitation was above average. June, July and August were wet and September was dry. Hybrids at this site had to recover from severe hail damage. Grain yields and test weights were good.

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”	7.8	0.6	2.3	24	6.1	444	0.5	11.5
8”-24”				13				
Comment	Alka	VLo	VHi	VHi	Lo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	40	2	20
Applied	150	20	0.3	0

Yield Goal: 80 bu/a.
Actual Yield: 98 bu/a.

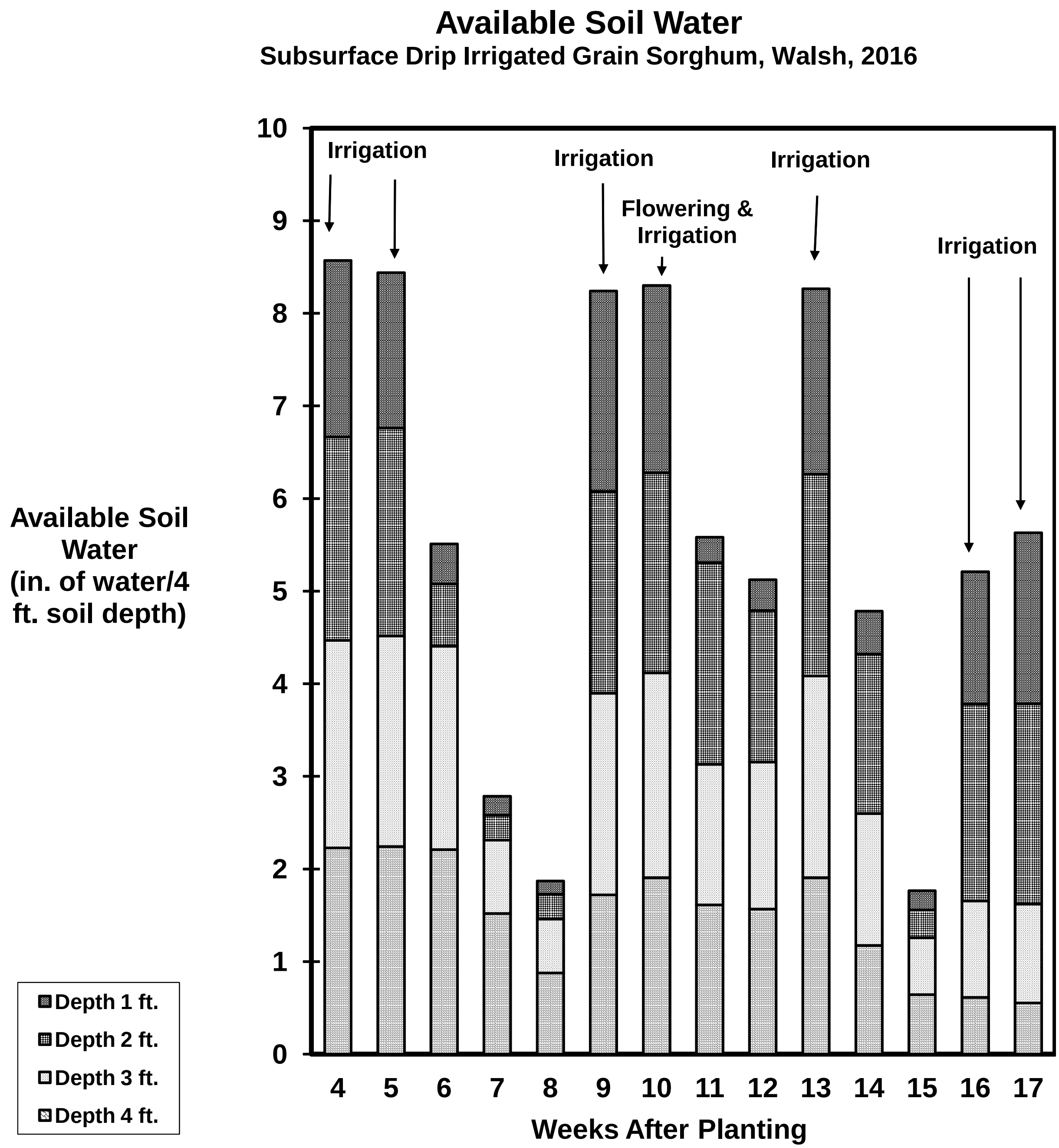


Fig. 2. Available soil water in drip irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 10.97 in. Any increase in available soil water between weeks not attributed to irrigation is from rain

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2016 Subsurface Drip Irrigated 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]	
Dyna-Gro Seed	GX16988	101.1	119	58.9	18	41,000	49	61	1754	106	E
Dyna-Gro Seed	GX16957	84.0	99	59.8	0	40,300	40	57	1649	103	E
Sorghum Partners	SP 33S40	70.6	83	60.0	3	32,900	46	61	1754	107	E
Sorghum Partners	SP 3303	59.0	69	60.0	8	33,700	41	59	1710	108	E
Alta Seeds	AG1203	120.1	141	61.0	5	41,400	48	66	1894	112	ME
Sorghum Partners	SP 34A19	104.6	123	58.7	9	42,200	44	63	1807	109	ME
Alta Seeds	AG1201	80.7	95	57.8	1	36,400	37	62	1780	108	ME
Sorghum Partners	KS585	117.6	138	61.6	12	38,000	48	69	1957	115	M
Dyna-Gro Seed	M60GB31	115.0	135	60.2	2	44,900	48	68	1936	115	M
Alta Seeds	AG2115	107.5	126	58.4	22	44,500	47	67	1914	113	M
Dekalb	DKS38-16	101.6	119	59.4	19	45,300	54	70	1983	117	M
Dekalb	DKS51-01	111.6	131	59.7	10	41,400	51	72	2035	119	ML
Dyna-Gro Seed	M71GR75	105.1	124	57.2	22	46,500	63	77	2142	HD	ML
Dyna-Gro Seed	GX16667	95.1	112	56.7	8	32,900	59	78	2168	HD	ML
Average		**98.1**		**59.2**	**10**	**40,100**	**48**	**66**	**1892**	**113**	**ME**
[e]LSD (P<0.05)		17.8			11						
[e]LSD (P<0.20)		11.4			7						

[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 or seed maturation. HD = hard dough.

[e]If the difference between two varieties yields equals or exceeds the LSD value, there is a 95% (at P<0.05) or 80% (at P<0.20) chance the difference is statistically significant.

Dryland Forage Sorghum Performance Trial at Walsh, 2016

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 6. HARVESTED: October 18.

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 5 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: Transform for sugarcane aphids.

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	3.23	659	21	0	24
July	3.88	898	24	6	55
August	3.68	741	14	0	86
September	0.17	611	10	0	116
October	0.01	106	0	0	123
Total	10.97	3015	69	6	123

[a]Growing season from June 6 (planting) to October 18 (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 very good. Light infestation of sugarcane aphids, which were controlled with an application of Transform. The growing season precipitation was above average. June, July and August were wet and September was dry. Hybrids at this site had to recover from minor hail damage. Forage yields were good.

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"	8.1	0.5	2.5	13	3.9	365	0.9	8.5
8"-24"				13				
Comment	Alka	VLo	VHi	Mod	Lo	VHi	Lo	Lo

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	100	20	2	20
Applied	50	20	0	0

Yield Goal: 8 tons/a.
Actual Yield: 11.6 tons/a.

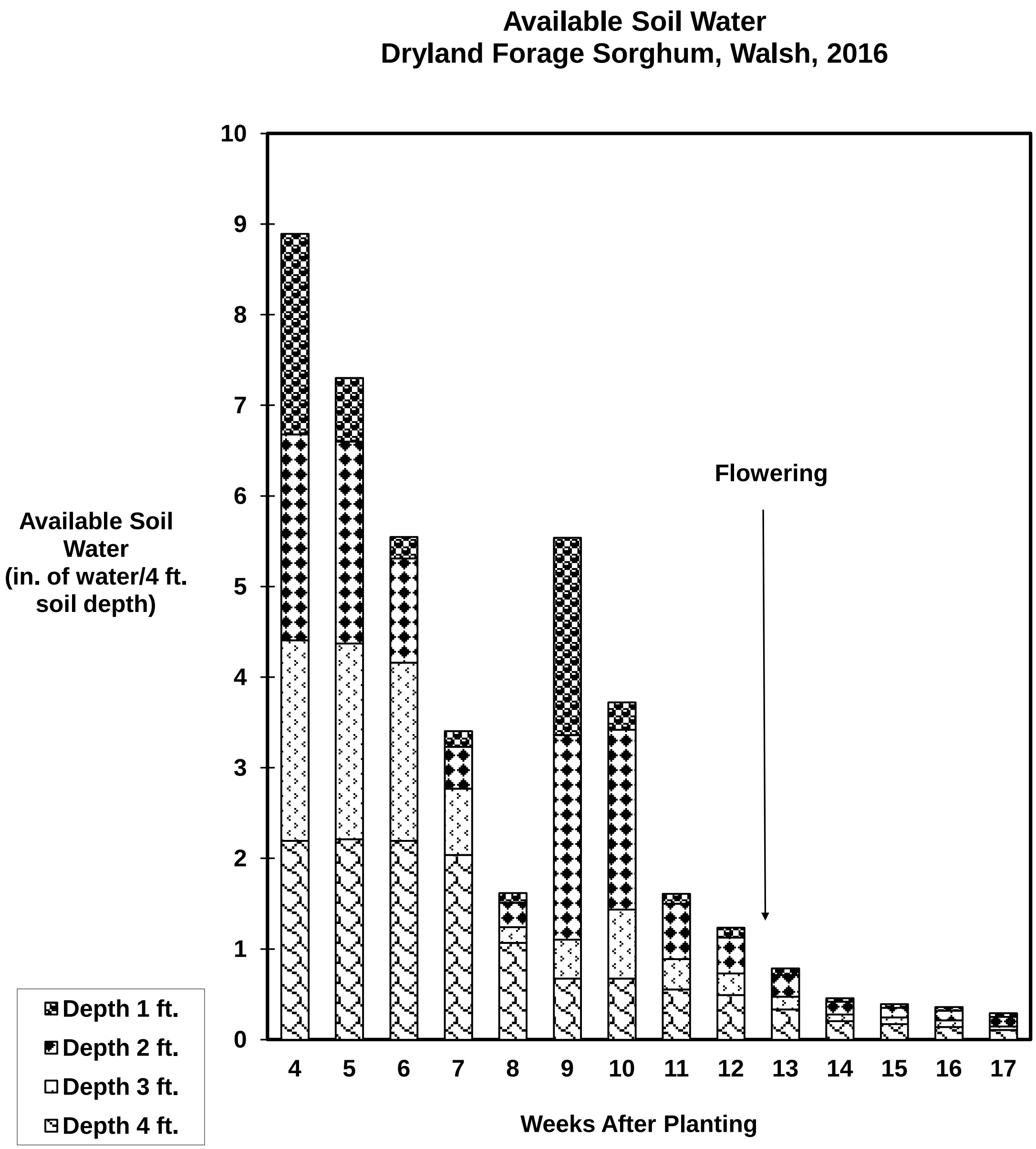

Fig. 3. Available soil water in dryland forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 10.97 in. Any increase in available soil water between weeks is from rain.

2016 Dryland Hybrid Forage Sorghum 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			
Blade	F4C207	15.7	135	11.0	34.5	86	8	73	M	FS	-
Sorghum Partners	Sordan Headless	14.3	123	11.9	38.7	99	0	Veg	PS	SS	-
Sudax	331 BMR	14.3	123	13.0	30.2	58	0	92	L	FS	BMR
Croplan	BMR 3411	14.2	122	15.5	29.0	97	0	84	ML	FS	BMR
Summer Select	FS 95 BMR BD	14.1	121	7.8	41.4	80	40	79	M	FS	BMR-6, BD
CHS, Inc.	HighYield	13.6	116	11.2	24.0	109	0	87	L	SS	-
Sorghum Partners	Hikane II	13.4	115	7.3	29.0	96	4	63	ME	FS	-
Sorghum Partners	SP1615	13.1	113	11.2	30.6	86	0	Veg	PS	FS	-
CHS, Inc.	HighYield BMR	12.2	105	12.2	29.8	95	1	95	L	SS	BMR
CHS, Inc.	HighYield BMR Dwarf	12.0	103	4.4	29.4	83	5	68	ME	SS	BMR
Sorghum Partners	SP4105	11.5	99	14.5	45.3	64	0	Veg	PS	SS	BMR
Sorghum Partners	Millex32	10.8	93	9.9	19.4	83	0	54	E	Millet	-
Blade	F4C204	10.6	91	17.7	34.5	93	1	64	ME	FS	-
Croplan	BMR 3561	10.5	91	12.3	34.9	85	0	73	M	FS	BMR
Croplan	BMR 3631	10.3	89	12.5	30.6	69	0	89	ML	FS	BMR
Blade	S4B230	10.2	87	7.8	31.0	107	0	64	ME	FS	BMR
Sudax	EXP1601	9.2	79	14.4	27.1	96	0	70	ME	FS	-
Mycogen Seeds	2V709 (corn)	8.3	71	10.6	21.7	78	0	64	ME	Corn	-
Sorghum Partners	SP4555	7.9	68	14.8	37.6	89	35	57	E	FS	-
Sorghum Partners	Millex BMR	6.5	56	11,1	7.4	85	0	79	M	Millet	BMR
Average		**11.6**		**11.6**	**30.3**	**87**	**5**	**74**			
[e]LSD (P<0.20)		1.4									

[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; Millet=hybrid pearl millet.

[d]Traits: BD=brachytic dwarf; BMR=brown mid-rib; BMR-6=one of the three main brown mid-rib genes.

[e]If the difference between two varieties yields equals or exceeds the LSD value, then they are significantly different with less than 20% probability that the difference is due to random error.

2016 Dryland Hybrid Forage Sorghum Performance Trial Feed Quality at Walsh

Brand	Hybrid[a]	Forage Type[b]	RFQ	CP	ADF	NDF	NDFD	IVTDMD	TDN	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				percent						MCal/lb		
Blade	F4C207	FS	147	11.8	32.6	62.3	62	74.6	65.4	0.68	0.41	0.67
Sorghum Partners	Sordan Headless	SS	146	7.7	30.1	54.3	63	76.4	68.2	0.72	0.44	0.71
Sudax	331 BMR	SS	149	11.0	32.4	61.6	63	75.2	65.7	0.68	0.41	0.68
Croplan	BMR 3411	FS	145	11.6	33.4	63.0	64	75.8	64.5	0.66	0.40	0.66
Summer Select	FS 95 BMR BD	FS	152	11.4	32.6	63.6	64	74.3	65.4	0.68	0.41	0.67
CHS, Inc.	HighYield	SS	140	10.4	34.6	62.6	57	70.2	63.1	0.64	0.38	0.65
Sorghum Partners	HiKane II	FS	162	12.8	29.8	58.7	64	77.0	68.6	0.72	0.45	0.71
Sorghum Partners	SP1615	FS	145	9.4	30.4	57.0	59	73.9	67.9	0.71	0.44	0.70
CHS, Inc.	HighYield BMR	SS	141	10.3	32.6	62.7	62	75.6	65.3	0.68	0.41	0.67
CHS, Inc.	HighYield BMR Dwarf	SS	142	12.1	33.4	64.8	62	74.7	64.5	0.66	0.40	0.66
Sorghum Partners	SP4105	SS	159	7.7	32.7	56.1	68	78.7	65.3	0.67	0.41	0.67
Sorghum Partners	Millex32	Mil	136	19.8	28.7	58.6	66	77.2	69.9	0.74	0.47	0.72
Blade	F4C204	FS	144	12.3	31.6	62.5	59	72.9	66.5	0.69	0.42	0.69
Croplan	BMR 3561	FS	156	14.5	31.3	59.8	68	78.3	66.8	0.70	0.43	0.69
Croplan	BMR 3631	FS	162	11.8	31.5	61.4	67	77.2	66.7	0.69	0.42	0.69
Blade	S4B230	SS	139	13.5	32.8	63.1	59	72.3	65.2	0.67	0.41	0.67
Sudax	EXP1601	SS	156	12.6	31.5	62.2	67	78.0	66.6	0.69	0.42	0.69
Mycogen Seeds	2V709 (corn)	Corn	132	14.5	32.2	63.3	61	74.4	65.8	0.68	0.41	0.68
Sorghum Partners	SP4555	FS	176	15.0	28.2	56.2	70	79.4	70.4	0.75	0.47	0.73
Sorghum Partners	Millex BMR	Mil	143	18.3	29.3	60.0	67	77.7	69.1	0.73	0.46	0.72
Average			**149**	**12.4**	**31.6**	**60.7**	**64**	**75.7**	**66.5**	**0.69**	**0.42**	**0.69**

[a]Hybrids ranked according to relative feed quality score (RFQ)

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

RFQ=relative forage 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 Hybrid Comparisons, Walsh 2016

Kevin Larson, Brett Pettinger and Perry Jones

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

MATERIALS AND METHODS: We tested 22 corn hybrids and 19 grain sorghum hybrids under sprinkler irrigation. We planted the corn study on May 4 at 26,500 seeds/a, and the grain sorghum study on June 7 at 44,000 seeds/a. We fertilized both studies using a strip-till implement with 175 lb N/a to the corn and 125 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 10.75 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 a hailstorm on August 4. The damage from hail was less severe at this study location than other study sites on the Plainsman farm. A few hybrids had moderate plant lodging. This lodging appeared to be from Charcoal Rot. Timely rains contributed to high yields and test weights of these studies. September and October were dry and the dry harvest weather is reflected in the low seed moisture of the corn study.

DISCUSSION: Production was very good for both the irrigated corn and grain sorghum studies. Typical yield goals for these studies are 150 bu/a for corn and 90 bu/a for grain sorghum. To exceed our yield goal by more than 20 bu/a for both studies is quite good. Overall rainfall for the season was above average. June, July and August were wet, but September was dry. Generally, the rain events were well timed, which contributed to the high yields.

Sprinkler Irrigated Grain Sorghum Hybrid Comparisons Study at Walsh, 2016

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

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

RESULTS: The 19 grain sorghum hybrids tested averaged 126 bu/a. The yield ranged from 111 bu/a for Mycogen Seeds 627 to 136 bu/a for Channel Seed 7B65. Medium early and later maturing hybrids produced the highest yields.

PLOT: Four rows with 30 in. row spacing, at least 600 ft. long. SEEDING DENSITY: 44,000 seeds/a. PLANTED: June 7. HARVESTED: November 8 & 9.

IRRIGATION: Sprinkler applied 10.75 acre-in/a.
PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, Sharpen 2.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Huskie 16 oz/a; Atrazine 0.75 lb/a.
INSECTICIDE: Transform for sugarcane aphids.
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	3.23	0.00	635	21	0	23
July	3.88	2.75	898	24	6	54
August	3.68	4.00	741	14	0	85
September	0.17	4.00	611	10	0	115
October	0.01	0.00	106	0	0	122
Total	10.97	10.75	2991	69	6	122

\1 Growing season from June 7 (planting) to October 7 (freeze, 26F).
\2 Total in-season water from irrigation and precipitation was 21.72 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. June, July and August were wet and September was dry. A hailstorm on August 4 stripped leaves. Yields and test weights were good despite the minor hail damage.

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	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.1	0.6	2.4	15	4.1	458	1.1	12.8
8”-24”				11				
Comment	Alka	VLoVHi	VHi	Mod	Lo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	25	20	1	10
Applied	125	40	0.4	0

Yield Goal: 100 bu/a.
Actual Yield: 126 bu/a.

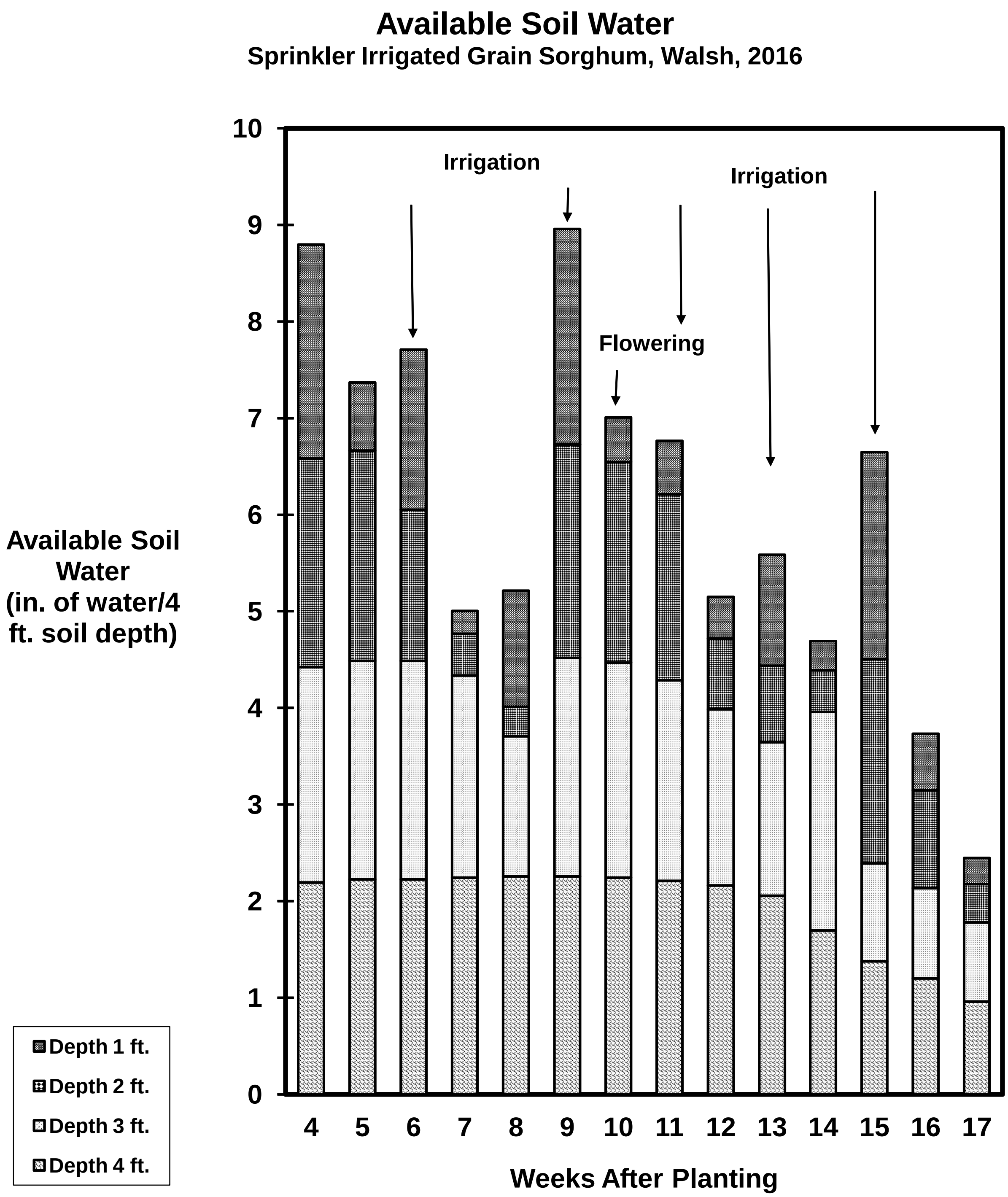

Fig. . Available soil water in limited sprinkler irrigation grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 10.97 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigated Grain Sorghum, Plainsman Research Center, Walsh, 2016.

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		
Channel Seed	7B65	136	13.5	60	35.6	51	8/14	9/30
Channel Seed	6B60	135	13.6	60	32.4	54	8/12	10/3
Alta Seeds	AG3201	134	13.7	59	32.8	51	8/16	10/7
Dyna-Gro Seed	M60GB31	133	13.8	60	32.8	53	8/13	9/27
Alta Seeds	XG2118	132	14.6	60	34.8	54	8/13	10/3
Alta Seeds	AG1203	131	13.7	60	32.8	53	8/12	9/26
Golden Acres	3960B	128	14.2	61	35.6	54	8/13	9/27
Golden Acres	2990C	126	14.0	59	30.0	50	8/15	10/7
Channel Seed	7B30	125	14.0	60	34.4	54	8/13	10/2
Golden Acres	3545	125	13.9	59	34.8	51	8/14	10/7
Dyna-Gro Seed	DG766B	125	14.3	59	32.0	52	8/12	9/26
Golden Acres	H-390W	124	13.3	58	35.2	47	8/14	10/1
Mycogen Seeds	1G588	124	13.2	60	37.6	50	8/8	9/21
Dyna-Gro Seed	M75GR47	123	14.7	59	31.6	51	8/14	10/4
Alta Seeds	AG1301	121	13.6	58	34.4	47	8/14	10/1
Golden Acres	5613	121	14.1	60	34.0	52	8/11	9/24
Mycogen Seeds	1G600	121	14.0	58	35.2	51	8/14	10/1
Alta Seeds	XG2117	120	14.2	59	33.2	53	8/15	10/6
Mycogen Seeds	627	111	13.9	59	32.0	49	8/11	9/27
Average		126	13.9	59	33.7	51	8/13	9/30
LSD 0.20		4.7						

Planted: June 7; Harvested: November 8 and 9, 2016.
50% Flowering Date: minimum date on which a hybrid flowers on half of its population.
50% Maturity Date.
Sprinkler irrigated grain sorghum received 10.75 acre-in of applied water.
Yields are adjusted to 14.0% seed moisture content.

Sprinkler Irrigation Corn Hybrid Comparisons Study at Walsh, 2016

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

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

RESULTS: The average yield for all 22 hybrids tested was 173 bu/a. All six seed firms (Channel, Dyna-Gro, Golden Acres, 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: May 4. HARVESTED: October 20 & 21.

PEST CONTROL: Preemergence Herbicides: Balance 1.75 oz/a, Glyphosate 32 oz/a, Sharpen 2.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Glyphosate 32 oz/a, Dicamba 8 oz/a. CULTIVATION: None. INSECTICIDE: Comite 52 oz/a, Brigade 6.4 oz/a for mites.

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

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--------			
May	1.42	2.00	364	0	0	27
June	3.23	4.00	757	21	0	57
July	3.88	4.00	898	24	6	88
August	3.68	4.00	741	14	0	119
September	0.17	4.00	611	10	0	149
October	0.01	0.00	106	0	0	156
Total	12.39	18.00	3477	69	6	156

\1 Growing season from May 4 (planting) to October 7 (freeze, 26F).
\2 Total in-season water from irrigation and precipitation was 30.39 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination and stand establishment. Weed control was good. The growing season precipitation was above average. June, July and August were wet and September was dry. A hailstorm on August 4 stripped leaves. Grain yields and test weights were good despite the damage from the minor hailstorm. 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	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.1	0.6	2.9	12	4.0	411	1.1	19.7
8”-24”				10				
Comment	Alka	VLo	VHi	Mod	Lo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	70	20	1	10
Applied	175	40	0.4	0

Yield Goal: 150 bu/a.
Actual Yield: 173 bu/a.

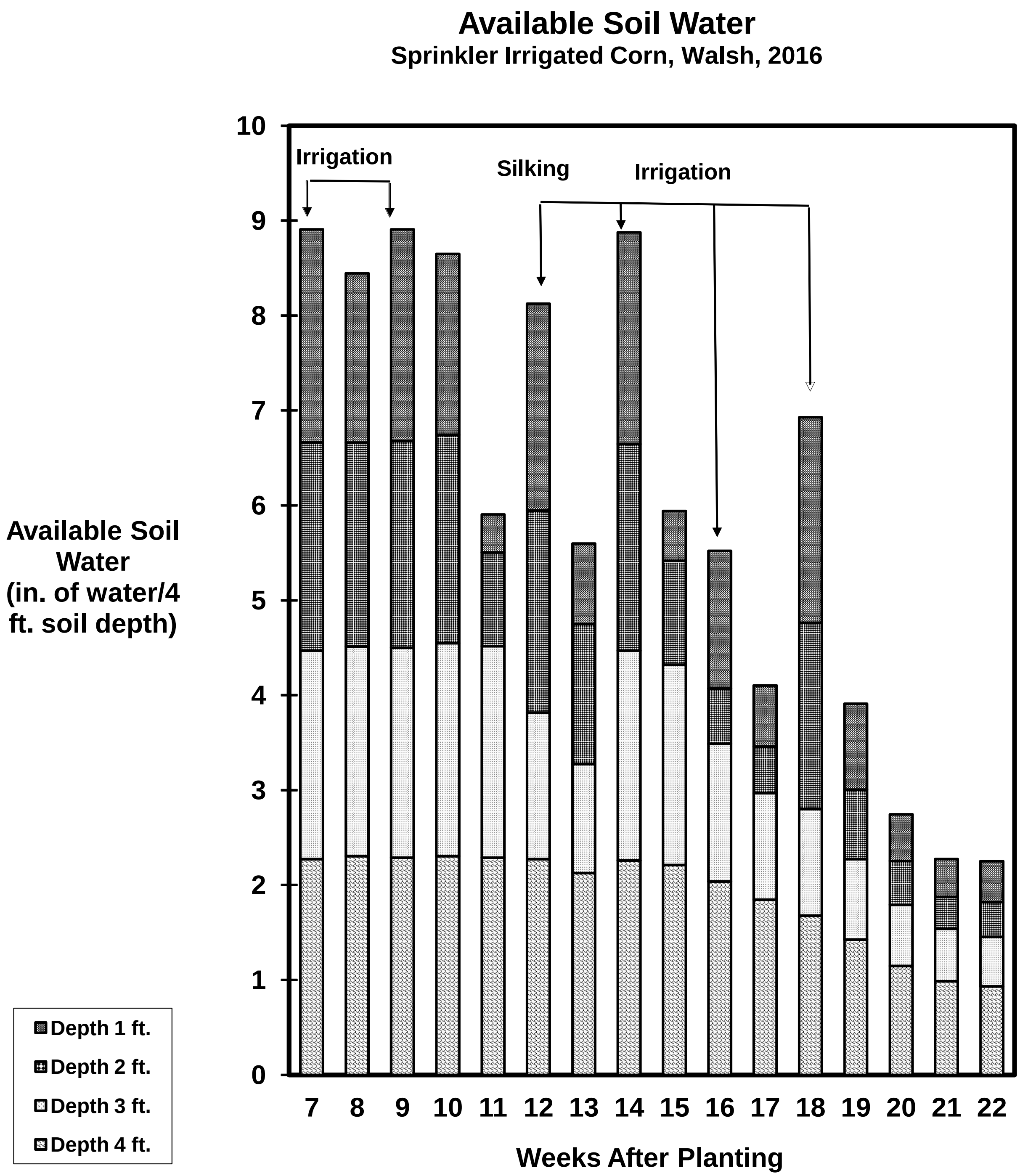

Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 12.39 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Sprinkler Irrigated Corn, Plainsman Research Center, 2016.

Firm	Hybrid	Grain Yield	Seed Moisture	Test Weight	Plant Density	50% Silking Date
		bu/a	%	lb/bu	plants/a (X 1000)	
LG Seeds	LG5630 VT3RIB	190	10.7	59	24.6	20-Jul
Mycogen Seeds	MY13M87RA	189	11.5	61	26.0	18-Jul
Dyna-Gro Seed	D52SS91	185	10.5	62	24.6	20-Jul
Dyna-Gro Seed	D49VC39	185	9.9	59	25.2	19-Jul
Mycogen Seeds	X14730VH	181	11.3	60	24.8	24-Jul
Producers Hybrids	7493 VT2RIB	180	11.0	62	25.4	20-Jul
Channel Seed	213-19 STXRIB	177	10.3	61	26.2	23-Jul
Golden Acres	G4678 DG	177	10.8	60	25.6	23-Jul
LG Seeds	LG5618 STXRIB	177	10.8	61	26.0	19-Jul
Golden Acres	G2778 VT2RIB	177	10.2	62	26.6	18-Jul
Dyna-Gro Seed	D54DC94	177	11.4	60	25.2	22-Jul
Mycogen Seeds	MY13K77RA	176	10.6	59	24.8	23-Jul
LG Seeds	LG5548 STXRIB	176	9.1	60	25.8	17-Jul
LG Seeds	LG5565 STXRIB	175	9.2	61	25.2	18-Jul
Mycogen Seeds	2V709	172	11.4	60	27.8	20-Jul
Channel Seed	208-23 STXRIB	168	9.7	60	25.0	18-Jul
Mycogen Seeds	X13745VH	168	11.1	58	24.0	19-Jul
Channel Seed	211-97R (non Bt)	165	9.9	61	24.8	17-Jul
Golden Acres	4173A-3111	162	10.7	59	24.0	20-Jul
Producers Hybrids	7068 STXRIB	156	9.5	60	25.0	18-Jul
Channel Seed	217-41 STXRIB	153	10.4	61	25.7	23-Jul
LG Seeds	LG5499 STXRIB	137	9.2	60	24.6	17-Jul
Average		173	10.4	60	25.3	19-Jul
LSD 0.20		13.2				

Planted: May 4; Harvested: October 20 and 21, 2016.
Grain Yield adjusted to 15.5% moisture content.
This corn trial received a total of 18 acre-in./acre of irrigation.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2016

Kevin Larson, Brett Pettinger and Perry Jones

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

RESULTS: There were no first corn borer shot holes, or second generation corn borer stalk holes, or second generation corn borer lodging. Some hybrids had moderate lodging not attributed to corn borer. Grain yields were good, averaging 173 bu/a.

DISCUSSION: This is the first year that we recorded no first or second generation corn borer damage. First generation corn borer damage has been quite low for years, but this is the first year that we recorded no shot holes. The lack of second generation corn borer damage was probably due to including Brigade with the Comite to control mites. Since there was no corn borer damage, all 22 hybrids tested (including the non-Bt hybrid) showed excellent resistance to first generation corn borer. The inclusion of Brigade controlled the second generation corn borers; therefore, no second generation corn borer resistance could be evaluated. In previous years, the low level of corn borer damage was attributable to our region’s extensive use of corn borer resistant hybrids. Even though we could not evaluated second generation damage, 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, 2016.

Firm	Hybrid	Grain Yield	Test Wt.	1st Gen. Shot Holes	2nd Gen. Plants Lodged	Non Corn Borer Plant Lodging	50% Silking Date
		bu/a	lb/bu	----------plants/a-----------			
LG Seeds	LG5630 VT3RIB	190	59	0	0	5	20-Jul
Mycogen Seeds	MY13M87RA	189	61	0	0	0	18-Jul
Dyna-Gro Seed	D52SS91	185	62	0	0	5	20-Jul
Dyna-Gro Seed	D49VC39	185	59	0	0	0	19-Jul
Mycogen Seeds	X14730VH	181	60	0	0	8	24-Jul
Producers Hybrids	7493 VT2RIB	180	62	0	0	0	20-Jul
Channel Seed	213-19 STXRIB	177	61	0	0	0	23-Jul
Golden Acres	G4678 DG	177	60	0	0	3	23-Jul
LG Seeds	LG5618 STXRIB	177	61	0	0	23	19-Jul
Golden Acres	G2778 VT2RIB	177	62	0	0	0	18-Jul
Dyna-Gro Seed	D54DC94	177	60	0	0	0	22-Jul
Mycogen Seeds	MY13K77RA	176	59	0	0	25	23-Jul
LG Seeds	LG5548 STXRIB	176	60	0	0	8	17-Jul
LG Seeds	LG5565 STXRIB	175	61	0	0	0	18-Jul
Mycogen Seeds	2V709	172	60	0	0	0	20-Jul
Channel Seed	208-23 STXRIB	168	60	0	0	0	18-Jul
Mycogen Seeds	X13745VH	168	58	0	0	15	19-Jul
Channel Seed	211-97R (non Bt)	165	61	0	0	3	17-Jul
Golden Acres	4173A-3111	162	59	0	0	5	20-Jul
Producers Hybrids	7068 STXRIB	156	60	0	0	0	18-Jul
Channel Seed	217-41 STXRIB	153	61	0	0	15	23-Jul
LG Seeds	LG5499 STXRIB	137	60	0	0	10	17-Jul
Average		173	60	0.0	0.0	6	19-Jul
LSD 0.20		6.6				5.2	

Planted: May 4; Harvested: October 20 and 21, 2016.
Grain Yield adjusted to 15.5% moisture content.
Sprinkler irrigated corn received a total of 18 in./acre of applied water.

Bio K Fertilizer Solutions Applied in Strip Tilled Rows for Sprinkler Irrigated Corn Production

Kevin Larson and Brett Pettinger

Soil tests reveal that most soils in Southeastern Colorado have very high potassium levels. Some agronomists argue that even though K is high in our soils, it is bound too tightly to clay particles to be available to high K requiring crops. This lack of K availability is most notable for young plants with newly developing root systems. Relatively small amounts of potash fertilizer banded in the seedrows may remedy this early season lack of K availability. We evaluated Bio K solutions, applied in the strip till rows, to determine if these K fertilizers would increase sprinkler irrigated corn grain yields in a high K soil.

Materials and Methods

We conducted this sprinkler irrigated corn study at the Plainsman Research Center on a pivot in which the previous crop was grain sorghum. The study site was disked then strip tilled with anhydrous N at 175 lb N/a and 10-34-0 at 5 gal/a using an eight row strip till implement to a depth of 6 in. on April 25, 2016. To apply the K treatments, we used a John Deere planter equipped with seed row fertilizer tubes to band the K treatments in the strip rows to a depth of 3 in. prior to planting. The seedrow K treatments were: 1) Control 10-34-0 at 5 gal/a and Zn chelate at 0.38 lb/a, 2) KFuel (0-0-24) at 1.5 gal/a plus control, 3) KFuel (0-0-24) at 0.5 gal/a and RhizoLink at 1.0 gal/a plus control, and 4) KCL (0-0-15) at 2 gal/a plus control. We planted Mycogen 2V709 at 26,500 seeds/a on May 6, 2016 with the same John Deere vacuum planter that we used to apply the K treatments. For pre-emergence weed control we disked and applied Balance 1.75 oz/a, Atrazine at 1.0 lb/a, Sharpen 2.0 oz/a, and Glyphosate 32 oz/a, and for post emergence weed control, we applied Glyphosate 32 oz/a and dicamba 8 oz/a. Total irrigation applied was 18 in./a. We harvested the 20 ft. wide by, at least, 1200 ft. long corn plots on October 25, 2016 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 15.5% seed moisture content.

Results and Discussion

Grain yields for all the K treatments were very high, averaging 193.6 bu/a. The K control (no applied K) had the highest yield, 195.9 bu/a, of the four K treatments tested; however, there was no significant difference (at alpha 0.10) between any of the K treatments.

The soil test analysis by the CSU soil testing laboratory showed a very high K level of 412 ppm of K. The CSU soil laboratory recommended that no additional K fertilizer was needed for our corn yield goal of 150 bu/a. Since there were no significant grain yield differences between the no K control and the K treatments, indicates that the application of small amounts of K in the seedrow may not increase corn yields in high K soils. This sprinkler irrigated corn study, testing small amounts of seedrow applied K fertilizers, counters the theory that there is insufficient K availability in the high K soils of Southeastern Colorado for high grain yields.

SOIL: Wiley 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	S
		mmhos/cm	%	----------------	----------------	ppm	----------------	
0-8"	8.1	0.6	2.9	12	4.0	411	1.1	19.7
8"-24"				10				
Comment	Alka	VLo	VHi	Mod	Lo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	----------------	lb/a	----------------	
Recommended	70	20	1	10
Applied	175	40	0.4	0

Yield Goal: 150 bu/a.
Actual Yield: 194 bu/a.

Table .-Bio K Fertilizer Solutions Appied in Strip Tilled Rows for Sprinkler Irrigated Corn Production, Walsh, 2016.

Treatment	Product	Product Dosage	Seed Moisture	Test Weight	Grain Yield
			%	lb/bu	bu/a
1 Control	10-34-0	5 gal/a	11.0	60.0	195.9
	Zn chelate	0.25 lb/a			
2 KFuel	KFuel (0-0-24)	1.5 gal/a	11.0	59.8	190.5
3 KFuel +	KFuel (0-0-24)	0.5 gal/a	11.0	60.3	194.8
3 RhizoLink	RhizoLink	1.0 gal/a			
4 KCl	KCl (0-0-15)	2.0 gal/a	11.1	60.0	193.0
Average			11.0	60.0	193.6
LSD 0.10					6.72

Planted: May 6; Harvested: October 25, 2016.
Corn hybrid: Mycogen 2V709, 26,500 seeds/a.
Strip tilled: anhydrous 175 lb N/a, 5 gal/a 10-34-0, Zn chelate 0.25 lb/a with rows spaced 30 in. apart on April 25, 2016.
Bio K and K controls applied with the planter in strip tilled rows. on May 5, 2016.
Grain yields were adjusted to 15.5% seed moisture content.
The study site was sprinkler irrigated with 18 in./a of water.

Dragonline Precision Mobile Drip Irrigation and Long Drop Spray Nozzle Comparison of Sprinkler Irrigated Corn 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 corn 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 corn, Mycogen 2V709, at 26,500 seeds/a on May 6, 2016 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 175 lb N/a and 5 gal/a of 10-34-0 to the site. For pre-emergence weed control we disked and applied Balance 1.75 oz/a, Atrazine at 1.0 lb/a, Sharpen 2.0 oz/a, and Glyphosate 32 oz/a, and for post emergence weed control, we applied Glyphosate 32 oz/a and dicamba 8 oz/a. We did not cultivate. The entire pivot was irrigated with LDSNs until June 23 before reactivation 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 14, 2.0 in/a irrigations were applied every other week through the Dragonlines and spray nozzles. The corn crop received 18 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 20 ft. wide by, at least, 1200 ft. long corn plots on October 24, 2016 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 15.5% seed moisture content.

Results and Discussion

The Dragonlines planted in circular rows produced the highest yield of 191.9 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 corn plants 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, particularly at the critical silking stage, 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.

Last year we conducted this same study comparing Dragonline PDMI to Long Drop Spray Nozzles, but last year the crop was grain sorghum instead of corn. With grain sorghum instead of corn, we reported similar results: 1) there were no significant yield differences between Dragonlines and LDSNs when planted in circular rows; and 2) Dragonlines produced significantly more yield that LDSNs when planted in straight rows.

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 Corn at Walsh, 2016.

Treatment	Grain Yield		Test Weight	Moisture
	bu/a		lb/bu	%
Circular Rows				
Dragonline	191.9	a	60.2	11.1
Long Drop Spray Nozzle	189.1	a	60.5	10.8
Straight Rows				
Dragonline	181.2	b	60.3	10.3
Long Drop Spray Nozzle	174.8	c	60.6	10.3
LSD 0.05	6.13			
Average	**184.3**		**60.4**	**10.6**

Planted: May 5; Harvested: October 24 and 25, 2016.
The entire pivot was irrigated with LDSNs until
June 23 before reactivation of the driplines.
From June 23 to September 14, 2.0 in./a irrigations
were applied every other week.
The study received 18 in. of total irrigation.

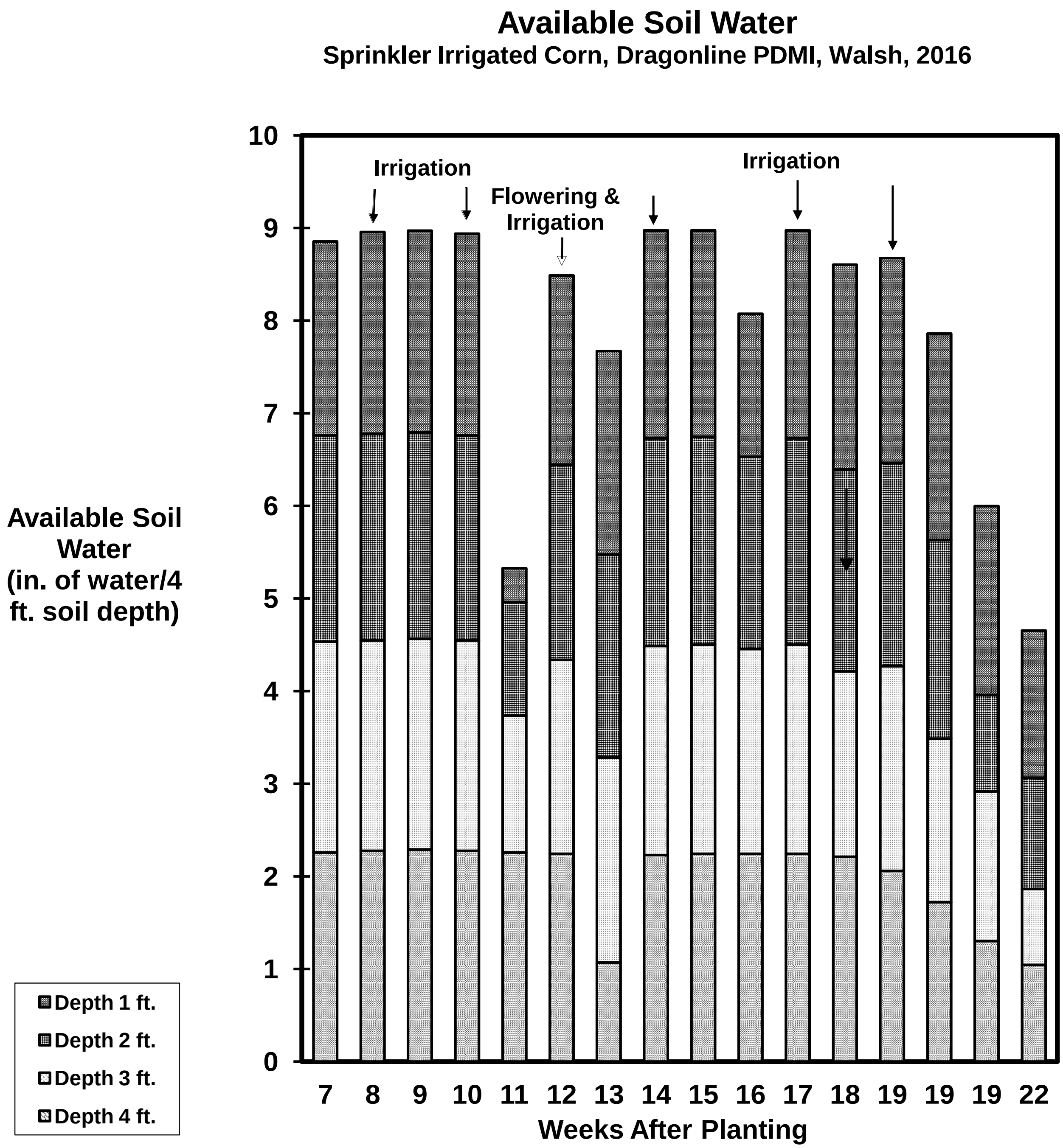

Fig. . Available soil water in sprinkler irrigation corn using Dragonline PDMI at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 12.39 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

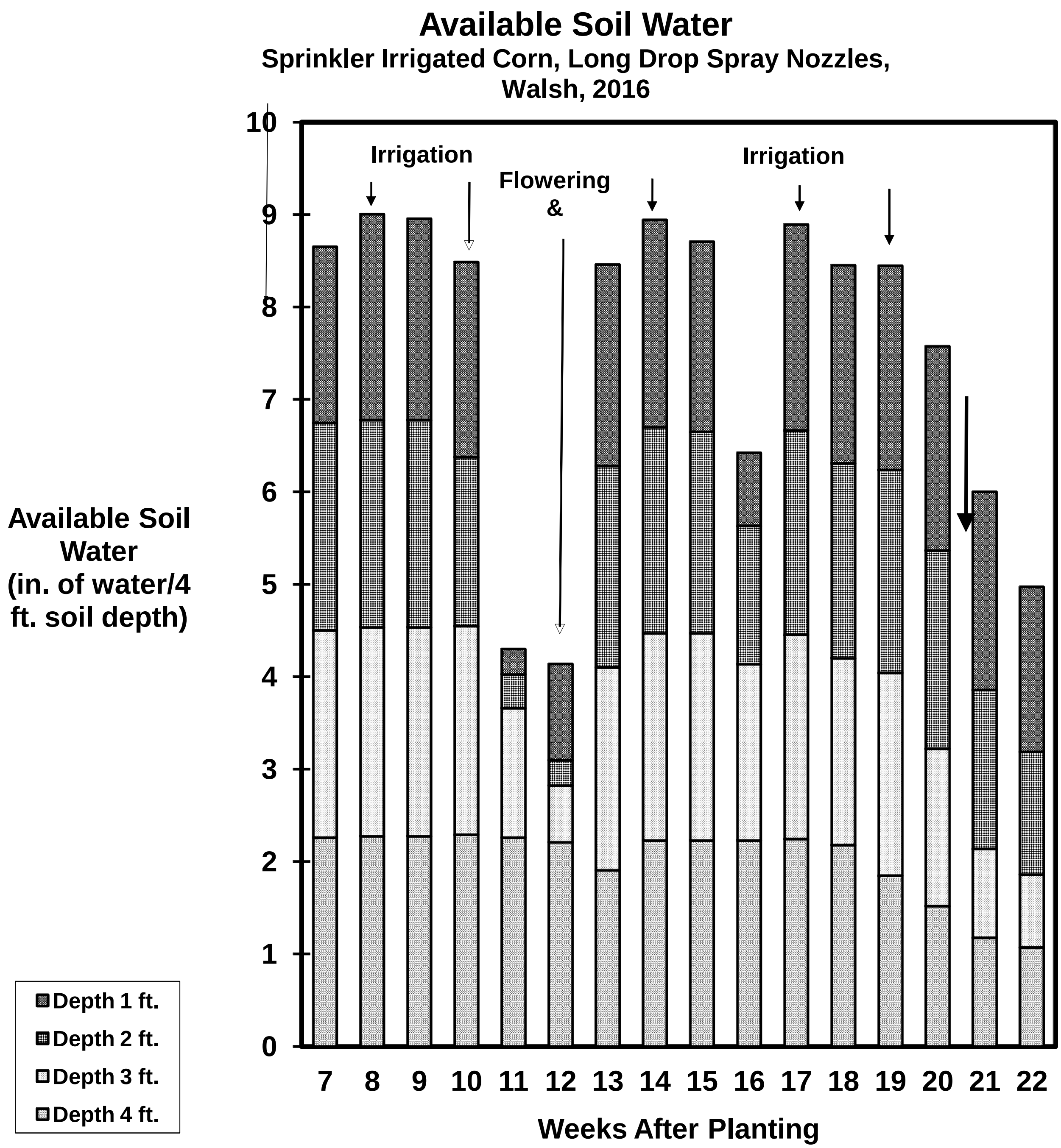

Fig. . Available soil water in sprinkler irrigation corn using Long Drop Spray Nozzles at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 12.39 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Long-Term N Effects on Irrigated Sunflower-Corn Rotation at Walsh, 2016

Kevin Larson, Brett Pettinger and Perry Jones

Purpose: To study the long-term N fertilizer effects on irrigated Sunflower-Corn and Corn-Corn (continuous corn) rotations where N rates 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 2K757, on May 6 at 22,000 seeds/a, and sunflower, Mycogen 8H456CL, on June 24 at 21,500 seeds/a. 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. We disked both the corn and sunflower plots and for pre-emergence weed control we applied glyphosate 32 oz/a to both sites. The corn also received pre-emergence Balance Flexx 5 oz/a, Sharpen 2.0 oz/a, Atrazine 1.0 lb/a, and HSMSO 64 oz/100 gal of water, AMS 8.5 lb/100 gal of water. For post emergence weed control in the corn, we applied two applications of glyphosate at 32 oz/a and one application of dicamba at 6 oz/a. For weed control in the sunflower, we applied pre-emergence Spartan 2 oz/a. For post emergence grass control in the sunflower, we applied Select 8 oz/a. Puncture vine severely infested the sunflowers and we applied glyphosate 32 oz/a with a hooded sprayer to control them. The corn received approximately 15 in/a of irrigation and the sunflower received 8 in./a of irrigation. We harvested two replications of the 20 ft. by 650 ft. plots of corn on October 19 and we harvested the sunflowers on November 11 with a self-propelled combine and weighed them in a digital weigh cart. Corn yields were adjusted to 15.5% and the sunflowers were adjusted to 10% seed moisture content.

Results and Discussion: Grain yield in the continuous corn rotation increased linearly with increasing N rates. This linear response with increasing N rates for continuous corn has occurred multiple years for this study. Typically, continuous corn requires high rates of N for high grain yields and this year we recorded this expected result. The corn in Sunflower-Corn rotation produced a higher yield range, 162 to 173 bu/a, than the continuous corn rotation, 140 to 152 bu/a; however, unlike the continuous corn rotation, yields reached an optimum yield at the 150 lb N/a rate for the Sunflower-Corn rotation. This yield optimum is unlike the no or low N response we reported in previous years of N response to increasing N rates for the Sunflower-Corn rotation.

Sunflower following corn decreased yield with increasing N rates. This declining yield response aligns well with our previous reports no or declining sunflower yield with increasing 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 156 bu/a, and the yield goal for the sunflowers was 2000 lb/a, our actual average seed yield was 1150 lb/a or 466 lb/a oil yield. Typically we have reported oil percentages decreasing with increasing N rates. This year, the oil percentages peaked at the 150 lb N/a rate. We have no explanation for this oil percentage response. The oil percentages were: 40.2, 41.0, and 40.4, respectively for 100, 150, and 200 lb N/a.

Table .-Soil Analysis.

Depth	pH	Salts mmhos/cm	OM %	N	P	K	Zn	Fe	S
				ppm					
0-8”	7.8	0.6	2.3	24	3.2	444	0.5	1.8	8.3
8-24”				13					

This is the eleventh 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 20.9 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.

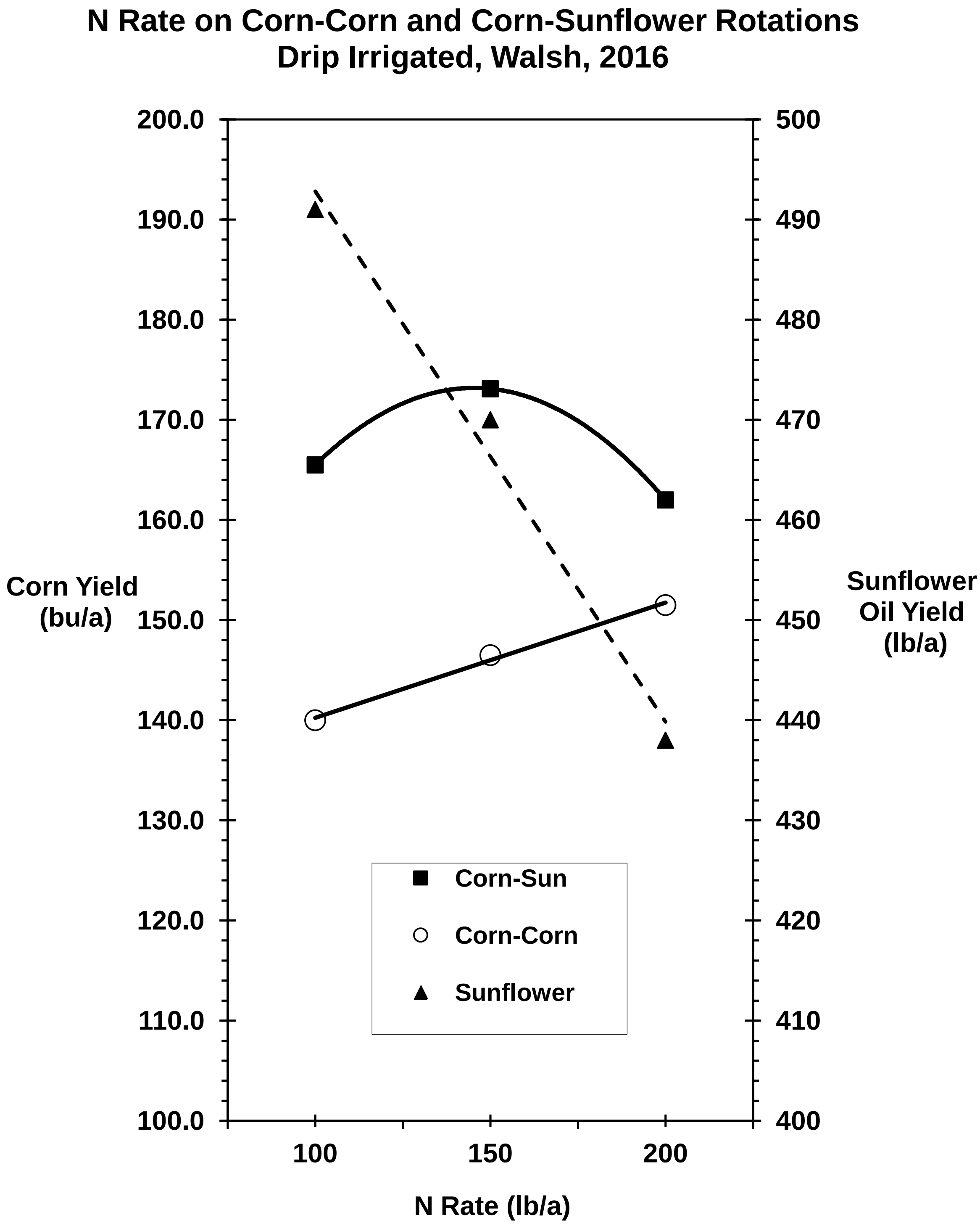

Fig. . N rate on drip irrigated sunflower and corn in Sunflower-Corn rotations at Walsh. The N rates were 100, 150, and 200 lb N/a as 28-0-0. The sunflower hybrid was Mycogen 8H456CL planted at 21,500 seeds/a. The corn hybrid was Mycogen 2K757 planted at 22,000 seeds/a.

Dryland Crop Rotation Study

Kevin Larson and Brett Pettinger

This is the twelfth 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. In 2015, we changed the Wheat-Sunflower-Fallow to Wheat-Corn-Fallow because the sunflower crops failed too often.

Materials and Methods

This is our tenth 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. Last 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 6, 2015; Proso millet, Huntsman, at 12 lb/a on June 30; grain sorghum, Mycogen 1G557, at 35,000 seeds/a on June 7; and corn, Mycogen 2K757, at 12,500 seeds/a on May 9, 2016. 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, dicamba 2 oz/a and Penetrate II 8 oz/a; millet, glyphosate 32 oz/a; grain sorghum, atrazine 0.75 lb/a, Sharpen 2.0 oz/a, Huskie 16 oz/a, atrazine 0.75 lb/a; corn, atrazine 0.75 lb/a, Sharpen 2.0 oz/a, Balance 1.75 oz/a, glyphosate 32 oz/a. For fallow, we applied glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D ester 10.7 oz/a two time, and one of these application we included Stare Down 6.4 oz/a to all the fallow plots to control glyphosate-resistant kochia. We harvested the crops with a self-propelled combine equipped with a digital scale: wheat, June 24; grain sorghum, November 2; and corn, October 14. The millet crop was not harvest because of a poor stand. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

The W-S-F rotation produced the highest annual rotation production of 2587 lb/a, but it was only 111 lb/a higher than the W-C-F rotation. The W-S-F and W-C-F rotations had relatively high yields for both grain sorghum, corn and wheat. This year the M/W-F and S/M rotations produced much less production because the millet crop had a poor stand and was not harvested, therefore the two rotations with millet suffered yield and revenue losses. The rotation with the second highest annual rotation production of 2476 lb/a was W-C-F, which was changed last year from Wheat-Sunflower-Fallow to Wheat-Corn-Fallow.

Along with the highest annual rotation production, the W-S-F rotation also returned the highest annual rotation variable net income of $89.46/a for 2016; nonetheless, the W-S-F and the W-C-F rotations were essentially tied for the highest annual rotation income. The two-year rotations, S-M and M/W-F, produced considerably less income than the three-year rotations because the millet crops in the two-year 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 2016 total production for the W-S-F rotation was 7760 lb/a. The crop rotational phases were: wheat, 3246 lb/a; grain sorghum, 4514 lb/a; and, of course, no production for fallow. The annual rotation production would be 2587 lb/a, which is one-third the total production because the W-S-F rotation takes three years to complete one rotation cycle.

This year the S/M and M/W-F rotations produced the least variable net income because millet, one of their two crop phases, failed.

The long term annual rotational income, after the last seven harvest years, favors the S-M rotation with $115.05/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 $80.74/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 five 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. With no millet crop, rotations containing grain sorghum, wheat 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, 2016.

	Crop Production						
	--------------------------2016 Crop--------------------------					2016 Total	Annual
Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow	Rotation Production	Rotation Production
	------------------------------------lb/a--------------------------------						
S-M		3461	0			3461	1731
W-S-F	3246	4514			0	7760	2587
M/W-F	3504		0		0	3504	1752
W-C-F	3324			4105	0	7429	2476
Average	3358	3988	0	4105	0	5539	2136
LSD 0.20	309.0	1276.8	--				

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The millet failed to make a stand and was not harvested.
This is the second year of W-C-F, previously it was W-Sunflower-F.

Table .-Dryland Crop Rotation Study, Variable Net Income, 2016.

						2016	Annual
	-------------------------2016 Crop-------------------------					Total	Rotation
		Grain				Crop	Variable
Rotation	Wheat	Sorghum	Millet	Corn	Fallow	Net Income	Net Income
	--$/a--						
S-M		114.23	-13.20			101.03	50.52
W-S-F	138.56	161.23			-31.41	268.38	89.46
M/W-F	151.46		-13.20		-31.41	106.85	53.43
W-C-F	142.46			132.42	-31.41	243.47	81.16
Average	144.16	137.73	-13.20	132.42	-31.41	179.93	68.64

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 millet crop failed to make a stand and was not harvested.

Table .-Dryland Crop Rotation Study, Walsh, 2016.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		---------------------------	---------------------------$/a	---------------------------	---------------------------	---------------------------	---------------------------
Wheat	50 lb	7.08	16.66	56.0 bu	3.00/bu	167.90	144.16
M/W-F				58.4	3.00	175.20	151.46
W-C-F				55.4	3.00	166.20	142.46
W-S-F				54.1	3.00	162.30	138.56
Millet	12 lb	4.20	9.00	0 bu	2.80/bu	0.00	-13.20
S-M				0.0	2.80	0.00	-13.20
M/W-F				0.0	2.80	0.00	-13.20
Grain Sorghum	35,000 seeds	5.25	35.02	71.2 bu	2.50/bu	178.00	137.73
S-M				61.8	2.50	154.50	114.23
W-S-F				80.6	2.50	201.50	161.23
Corn	12,500 seeds	52.80	34.62	73.3 bu	3.00/bu	219.90	132.48
W-C-F				73.3	3.00	219.90	132.48
Fallow	---	---	31.41	---	---	-31.41	-31.41
Average			25.34			106.88	73.95

Planted: Grain Sorghum, Mycogen 1G557 at 35,000 seeds/a on June 7; Millet, Huntsman at 12 lb/a on June 30; and Corn, Mycogen 2K757 at 12,500 seeds/a on May 9;
Wheat, Byrd at 50 lb/a on October 6, 2015.
Harvested: Wheat, June 24; Grain Sorghum, November 2; Corn, October 14.
Millet was not harvested due to poor stand.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .-Dryland Crop Rotation Study, Annual Rotation Income, 2009 to 2016.

Rotation	Annual Rotation Variable Net Income 2009	2010	2012	2013	2014	2015	2016	Total Crop Net Income	Average Annual Rotation Variable Net Income
	$/a								
S-M	141.76	262.97	98.38	27.79	105.98	117.98	50.52	805.37	115.05
W-S-F	105.16	198.75	39.81	56.60	56.59	18.81	89.46	565.18	80.74
M/W-F	143.26	135.55	52.97	41.67	-21.87	-2.02	53.43	403.00	57.57
W-Sun-F	27.69	99.95	-32.88	8.17	-32.93	--	--	70.00	14.00
W-C-F						18.09	81.16	99.25	49.63
Average	104.47	174.31	39.57	33.55	26.94	38.21	68.64	485.70	79.25

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.
The 2016 millet crop was not harvested because of poor stand.
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, Brett Pettinger and Perry Jones

This was the tenth 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 nineth 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 October 6, 2015 and Proso millet, Huntsman, at 12 lb/a on June 30, 2016. 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 applied Sharpen 2.0 oz/a once to 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, dicamba 2.0 oz/a and Penetrant II 8 oz/a; millet, Staredown 6.4 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 October 11 and the wheat on July 8 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.

Results and Discussion

Wheat yields were very good, averaging 49.5 bu/a, but the proso millet yields were very poor, averaging 1.5 bu/a. This is the first time in many years that the wheat was not damaged by hail. The low millet yields were due to the late June planting date, which produced poor plant stands and subsequently high weed pressures. 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 failed to produce a stand and was not harvested. The planting date of the grain sorghum was June 6 (near the optimum planting date); whereas, the June 30 planting date of the millet was beyond its optimum planting date. This year, five of the six rotations produced positive annual rotation variable net incomes, only the M-M rotation lost income. This year the W/M-F rotation produced the highest wheat yield and generated the highest amount of income, $61.89/a. However, the continuous wheat (W-W) rotation provided the highest average net return of $35.29/a for the past seven harvest years.

For the ten 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, wheat yields were very good, but millet yields were reduced by a late planting date. 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 $35.29/a and $26.83/a, respectively. The four other rotations provided around $9/a to $23/a in average annual rotation variable net income after seven harvest years. In 2015, both wheat and millet yields were low. The wheat yields were low because a hailstorm caused considerable lodging and seed shattering. The millet yields were low because of a late planting date. 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, 2016.

Rotation	-----------2016 Crop---------- Wheat	Millet	Fallow	2016 Total Rotation Production	Annual Rotation Production
	-------------------------lb/a----------------------------				
W-F	3420			3420	1710
W-W	1596			1596	1596
W-M-F	3414	66		3480	1160
M/W-F	2562	130		2692	1346
W/M-F	3864	49		3913	1957
M-M		94		94	94
Average	2971	85		2533	1310
LSD 0.20	474.0	35.7			

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.

Table .Dryland Millet-Wheat Rotation, Variable Net Income, 2016.

Rotation	-----------2016 Crop---------- Wheat	Millet	Fallow	2016 Total Crop Net Income	Annual Rotation Variable Net Income
	-------------------------$/a----------------------------				
W-F	147.26		-31.42	115.84	57.92
W-W	56.06			56.06	56.06
W-M-F	146.96	-13.42	-31.42	102.12	34.04
M/W-F	95.36	-10.34	-31.42	53.60	26.80
W/M-F	169.46	-14.26	-31.42	123.78	61.89
M-M		-12.02		-12.02	-12.02
Average	123.02	-12.51	-31.42	73.23	37.45

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.

Table .-Dryland Millet and Wheat Rotation Study, Walsh, 2016.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
	lb/a	$/a	$/a	bu/a	$/bu	$/a	$/a
Wheat							
W-F	50	7.08	16.66	57.0	3.00	171.00	147.26
W-W	50	7.08	16.66	26.6	3.00	79.80	56.06
W-M-F	50	7.08	16.66	56.9	3.00	170.70	146.96
M/W-F	50	7.08	25.66	42.7	3.00	128.10	95.36
W/M-F	50	7.08	16.66	64.4	3.00	193.20	169.46
Wheat Average	**50**	**7.08**	**18.46**	**49.5**	3.00	**148.56**	**123.02**
Millet							
M-M	12	4.20	12.58	1.7	2.80	4.76	-12.02
W-M-F	12	4.20	12.58	1.2	2.80	3.36	-13.42
M/W-F	12	4.20	12.58	2.3	2.80	6.44	-10.34
W/M-F	12	4.20	12.58	0.9	2.80	2.52	-14.26
Millet Average	**12**	**4.20**	**12.58**	**1.5**	2.80	**4.27**	**-12.51**
Fallow	---	---	31.42	---	---	0.00	-31.42
Average			15.85			148.56	26.36

Planted: Millet, Huntsman at 12 lb/a on June 30; Wheat, Byrd at 50 lb/a on October 6, 2015.
Harvested: Millet on October 11; Wheat on July 8.
Wheat herbicides: Express 0.33 oz/a, 2,4-D 0.38 lb/a, dicamba 2 oz/a, Penetrant II 8 oz/a;
Wheat herbicide cost: $10.66/a
Millet herbicides: Staredown 6.4 oz/a, 2,4-D ester 6 oz/a: Millet herbicide cost: $6.58/a
Fallow herbicides: glyphosate 32 oz/a, 2,4-D 0.5 lb/a, dicamba 6 oz/a;
Fallow herbicide cost: $9.71/a per application (two applications, $6.00/a per application)
Applied Sharpen 2.0 oz/a to control kochia. Kochia control cost: $10.94/a
Wheat in M/W-F additional herbicide: glyphosate 32 oz/a cost $3/a.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .Millet-Wheat Rotation, Annual Rotation Income, 2010 to 2016.

Rotation	2010	2011	2012	2013	2014	2015	2016	Total Crop Net Income	Average Annual Rotation Variable Net Income
	Annual Rotation Variable Net Income								
	$/a								
W-W	170.76	78.46	-19.04	-26.02	-25.42	12.23	56.06	247.03	35.29
W-M-F	116.42	37.05	-1.65	12.05	-21.12	11.033	34.04	187.83	26.83
W/M-F	118.77	59.48	-21.47	-23.58	-12.48	-24.78	61.89	157.84	22.55
W-F	112.08	63.66	-21.47	-27.93	-15.78	-13.01	57.92	155.47	22.21
M-M	93.66	-23.30	47.39	-0.56	-23.09	4.21	-12.02	86.29	12.33
M/W-F	123.45	-34.96	-25.79	-1.95	-24.21	-2.00	26.80	61.36	8.77
Average	122.52	30.07	-7.00	-11.33	-20.35	-2.05	37.45	149.30	21.33

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 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). 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 inserted gypsum blocks at 6 in., 18 in., and 30 in. depths to measure soil water use by the cover crops.

This is the first year that the winter and spring cover crops survived and we were able to harvest both grain sorghum and wheat crops. In previous years, either the cover crops did not survive, or the wheat crop was lost to hail or was winterkilled. We planted the W-F winter cover crops on August 29, 2014 after wheat harvest. We sprayed a mix of glyphosate, 2,4-D and dicamba to terminate the cover crops and control weeds in the N plots on March 27, 2015. For the wheat phase of the W-S-F rotation, we planted the spring cover crops in the W-S-F rotation on March 31, 2015 during the fallow period after sorghum harvest. On June 27, 2015, we terminated the spring cover crops and controlled weeds in the N plots with an application of glyphosate, 2,4-D, dicamba and Comet (for kochia control). We planted both the W-S-F and the W-F wheat on October 6, 2015 with Byrd at 50 lb/a and seedrow applied 10-34-0 at 5 gal/a at planting. To control weeds in the wheat, we applied Express, 2,4-D, dicamba and surfactant after tillering. We planted the winter cover crops prior to sorghum planting in the W-S-F rotation on August 24, 2015 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 April 4, 2016. We planted Mycogen 1G557 at 35,000 seeds/a on June 7, 2016 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, atrazine, AMS and surfactant.

We harvested the W-S-F grain sorghum on November 7, 2016, and the W-F and W-S-F wheat on July 12, 2016 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14.0% seed moisture content for grain sorghum and 12% seed moisture content for wheat.

Results and Discussion

Grain Sorghum Phase, W-S-F Rotation

Precipitation from planting to termination of the winter cover crops (seven months, September 2015 through March 2016) for the grain sorghum phase of the W-S-F rotation was 6.88 in. After seven months of growth, the average dry matter production of the cover crops was 2469 lb/a. The cover crops forage yields ranged from 2186 lb/a for triticale to 2596 lb/a for rapeseed. 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 preceding the grain sorghum had these changes in available soil water (at termination minus at planting): +1.22 in. for triticale, +0.50 in. for rapeseed, +.093 in. for hairy vetch, and -0.54 in. for Winter N Mix of soil water to a depth of three feet. The fallow 0N check (at termination minus at planting) had +4.18 in. more 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: 2.96 in. for triticale, 3.68 in. for rapeseed, 3.25 in. for hairy vetch, and 4.72 in. for Winter N Mix. Triticale had the lowest water use of the cover crops tested.

The treatment with the highest grain sorghum yield was hairy vetch with 76.6 bu/a, which was significantly higher than triticale for the cover crop tested. The grain yield from two of the cover crops, hairy vetch and Winter N Mix, were significantly higher than any of the N treatments. The 50 lb N/a treatment had the lowest grain yield and it was significantly lower than any of the cover crop yields. There were no significant grain yield differences between the N treatments.

The rapeseed treatment produced the highest variable net income, $148.50, because it had high grain yield and the second lowest treatment cost. All the cover crop treatments, expect hairy vetch, had higher incomes than N treatments. The lowest variable net income, $93.00/a, was from the 50 lb N/a treatment, which had the lowest yield and above average treatment cost. The higher grain sorghum production of the cover crops compared to the N treatments may be due to the 23.89 inches of precipitation that occurred from cover crop planting to sorghum maturation (September 2015 through September 2016). John Holman, KSU research scientist studying cover crops for the Central Great Plains, stated that cover crops may work in our semi-arid environment with precipitation greater than 25 inches (Four States Ag Expo Summit, March 18, 2016).

<u>Wheat, W-F Rotation</u>

Precipitation from planting to termination of the winter cover crops (seven months, September 2014 through March 2015) for wheat in the W-F rotation was 7.72 in. After seven months of growth, the average dry matter production of the cover crops was 3768 lb/a. The cover crops forage yields ranged from 3381 lb/a for hairy vetch to 4217 lb/a for rapeseed. 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 preceding wheat planting had these changes in available soil water (at termination minus at planting): +5.19 in. for triticale, +3.47 in. for rapeseed, +.6.27 in. for hairy vetch, and +4.09 in. for Winter N Mix of soil water to a depth of three feet. The fallow 0N check (at termination minus at planting) used 0.47 in. in soil water to a depth of three feet during the same seven month period. During the seven months of cover crop growth, all the cover crops stored more available soil water than the fallow 0N check. Therefore, subtracting soil water stored by the cover crops from soil water used during no-till fallow equals the water use cost of cover crops. The water use cost (stored) to a soil water depth of three feet was: +5.66 in. for triticale, +3.94 in. for rapeseed, +6.74 in. for hairy vetch, and +4.56 in. for Winter N Mix. This is the first time that we have recorded available soil water storage in excess of water use for the cover crops.

The treatment with the highest wheat grain yield was hairy vetch with 50.9 bu/a, which was not significantly higher than any of the cover crop tested. Grain yields were not significantly different between any of the cover crop or N treatments. The triticale cover had the lowest grain yield, 42.1 bu/a.

All of the N treatments had higher variable net incomes than the cover crops. The 0 lb N/a treatment produced the highest variable net income, $137.25, because it had average grain yield, but no treatment cost. The lowest variable net income of $85.51/a was from the Winter N Mix treatment, which had the second lowest yield and second highest treatment cost. The high wheat production of the cover crops, which averaged 45.0 bu/a, may be due to the 24.13 inches of precipitation that occurred from cover crop planting to wheat planting (September 2014 through August 2015). David Nielsen, ARS research scientist at the Central Great Plains Station at Akron, Colorado, studying dryland soil moisture management, stated that cover crops may succeed when wheat yields are greater than 50 bu/a (Four States Ag Expo Summit, March 18, 2016).

<u>Wheat Phase, W-S-F Rotation</u>

Precipitation from planting to termination of the spring cover crops (three months, April 2015 through June 2015) for the wheat phase of the W-S-F rotation was 8.16 in. This high precipitation amount for the three month period was due mainly to the 5.64 inches of rain that occurred in May. After three months of growth, the average dry matter production of the cover crops was 1916 lb/a. The cover crops dry matter yields ranged from 485 lb/a for hairy vetch to 2879 lb/a for oats and the forage yield difference between oats and hairy vetch was significant at the 0.20 alpha level.

When terminated after three months of growth, the cover crops preceding wheat planting used: 4.81 in. for oats, 4.38 in. for rapeseed, 4.41 in. for hairy vetch, and 4.65 in. for Spring N Mix of available soil water (at termination minus at planting) to a depth of three feet. The fallow 0N check (at termination minus at planting) stored 2.53 in. in soil water to a depth of three feet during the same three month period. During the three months of cover crop growth, all the cover crops used more available soil water than the fallow 0N check. Therefore, subtracting soil water used by the cover crops from soil water stored 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: 7.34 in. for oats, 6.91 in. for rapeseed, 6.94 in. for hairy vetch, and 7.18 in. for Winter N Mix.

The treatment with the highest wheat grain yield was the 25 lb N/a treatment with 53.6 bu/a, which was significantly higher than all of the cover crop tested, except oats. The oat treatment produced significantly higher grain yield than the other cover crops tested. The rapeseed treatment had the lowest grain yield of 37.7 bu/a.

The 0 lb N/a and the 25 lb N/a treatments had higher variable net incomes than the cover crops. The 0 lb N/a treatment produced the highest variable net income, $152.50, because it had the second highest wheat grain yield and no treatment cost. The hairy vetch treatment had the lowest variable net income of $53.61/a because it had the third lowest yield and the highest treatment cost. Wheat production of the cover crops averaged 41.1 bu/a, which was less than expect considering that 29.61 inches of precipitation occurred from cover crop planting to wheat maturity (April 2015 through May 2016). The N treatments averaged 50.1 bu/a and the grain yield difference between the N treatments and cover crops was 9.0 bu/a. Since the wheat phase of the W-S-F rotation exceeded the 25 inch precipitation level suggested for cover crop success, but the cover crops only averaged 41 bu/a, and the N treatments produced 9.0 bu/a more than the cover crops treatments, it appears that the 50 bu/a wheat yield level for cover crop success may be a more applicable threshold.

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Table .-Cover Crop Study, Grain Sorghum (W-S-F) after Winter Cover Crop, Walsh, 2016.

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	66.1	57.5	2596	75.0		16.75		148.50
Triticale	63.6	59.1	2186	71.0		28.80		130.20
Hairy Vetch	76.6	58.7	2869	84.9	13.9	69.00	6.95	129.45
Winter N Mix	70.6	58.1	2223	63.6		46.25		130.25
0 N	51.9	57.1				0.00		129.75
25 N	56.1	57.2				18.50		121.75
50 N	49.6	57.2				31.00		93.00
Average	62.1	58	2469	73.6		30.04		126.13
LSD 0.20	11.6		1051					

Cover crops planted: August 24, 2015.
Cover crops terminated: April 4, 2016.
Grain sorghum planted: June 7; Harvested: November 7, 2016.
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, $0.50/lb.
Treatment application cost: cover crop planting, $12/a; N application, $6/a.
Grain sorghum price: $2.50/a.

Table .-Cover Crop Study, Wheat (W-F) after Winter Cover Crop, Walsh, 2016.

Treatment	Wheat 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	43.6	53.7	4217	98.5		16.75		116.23
Triticale	42.1	53.4	3872	159.8		28.80		99.61
Hairy Vetch	50.9	53.3	3381	130.9	32.4	69.00	16.20	102.45
Winter N Mix	43.2	53.4	3602	158.5	60.0	46.25	30.00	115.51
0 N	45.0	54.7				0.00		137.25
25 N	47.6	54.6				18.50		126.68
50 N	48.7	55.5				31.00		117.54
Average	45.9	54	3768	136.9		30.04		116.47
LSD 0.20	9.4		1058					

Cover crops planted: August 29, 2014.
Cover crops terminated: March 27, 2015.
Wheat planted: October 6, 2015; harvested: July 12, 2016.
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, $0.50/lb.
Treatment application cost: cover crop planting, $12/a; N application, $6/a.
Wheat price: $3.05/a.

Table .-Cover Crop Study, Wheat (W-S-F) after Spring Cover Crop, Walsh, 2016.

Treatment	Wheat Yield	Test Weight	Cover Dry Matter	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	$/a	$/a
Oats	47.9	53.4	2879	24.60	121.50
Rapeseed	37.7	54.4	1927	16.75	98.24
Spring N Mix	38.6	53.3	2372	41.65	76.08
Hairy Vetch	40.2	53.0	485	69.00	53.61
0 N	50.0	54.0		0.00	152.50
25 N	53.6	54.1		18.50	144.98
50 N	46.6	52.9		31.00	111.13
Average	44.9	53.6	1916	28.79	108.29
LSD 0.20	7.03		557.8		

Spring cover crops planted: March 31, 2015, spring cover for wheat in W-S-F; spring cover terminated: June 27, 2015.
Wheat planted: October 6, 2015; harvested: July 12, 2016.
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, $0.50/lb.
Treatment application cost: cover crop planting, $12/a; N application, $6/a.
Wheat price: $3.05/a.

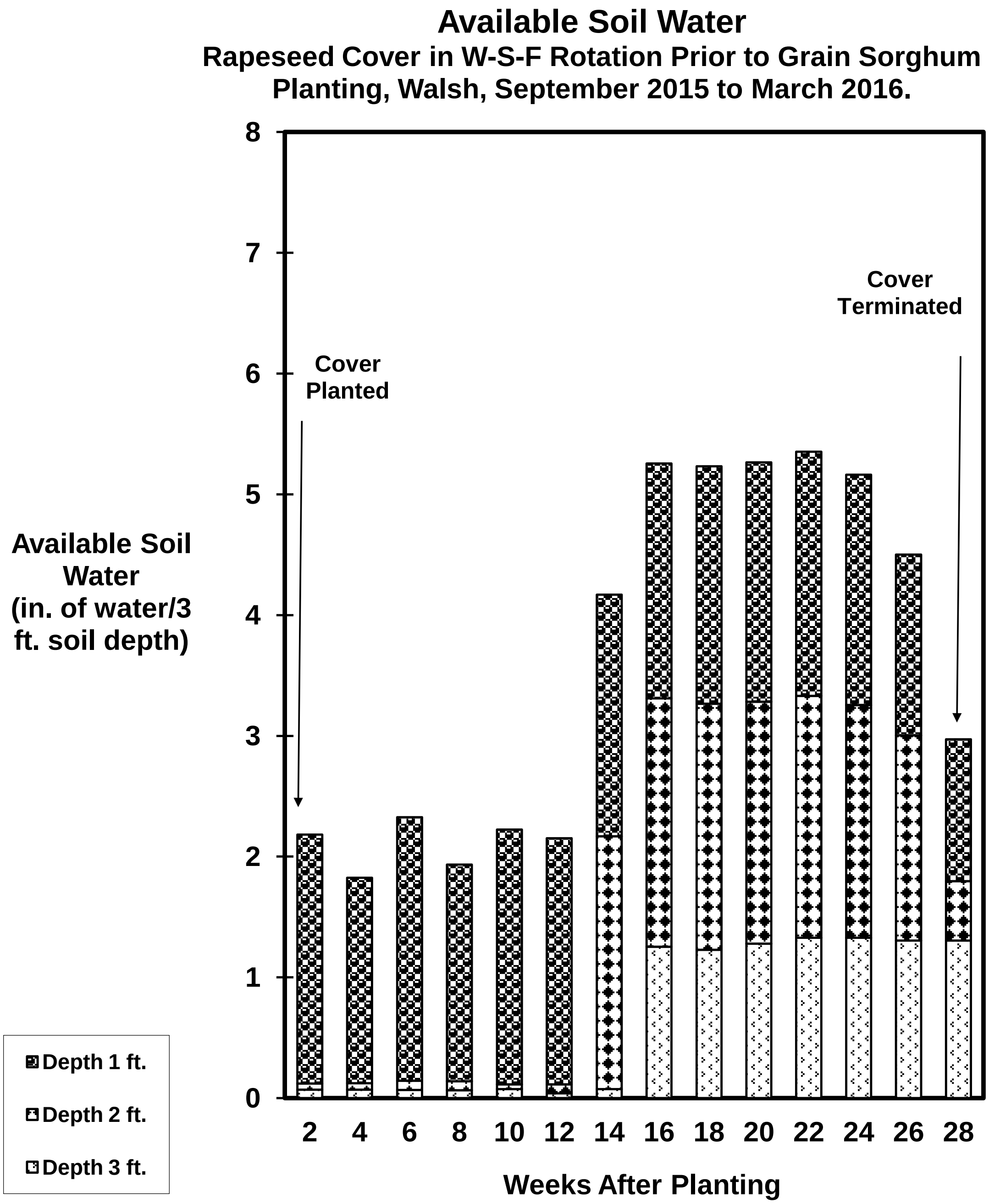

Fig. . Available soil water of rapeseed cover in W-S-F Rotation prior to grain sorghum planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 6.88 in. Any increase in available soil water between weeks is from rain.

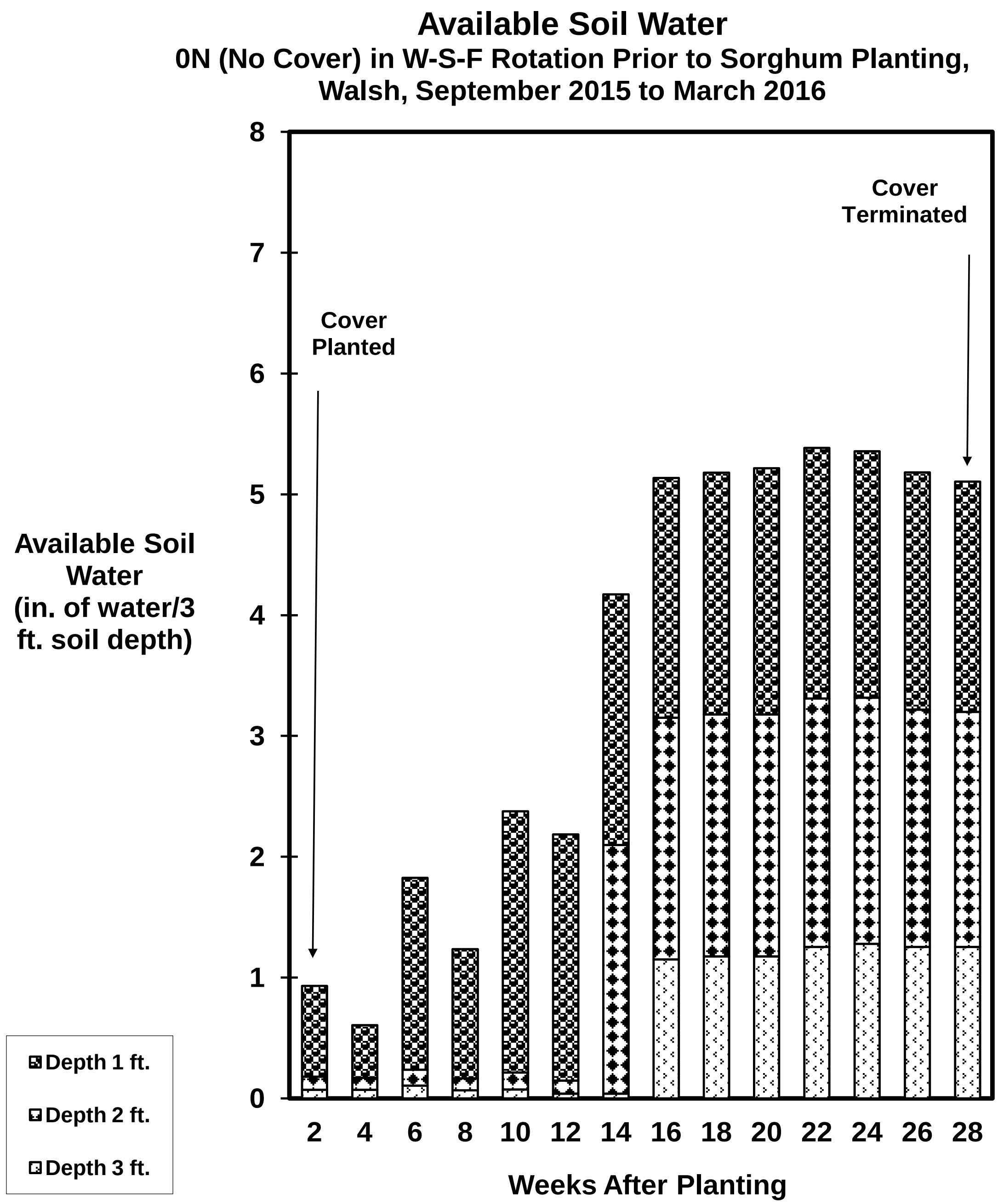

Fig. . Available soil water of 0N (no cover) in W-S-F rotation prior to grain sorghum planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 6.88 in. Any increase in available soil water between weeks is from rain.

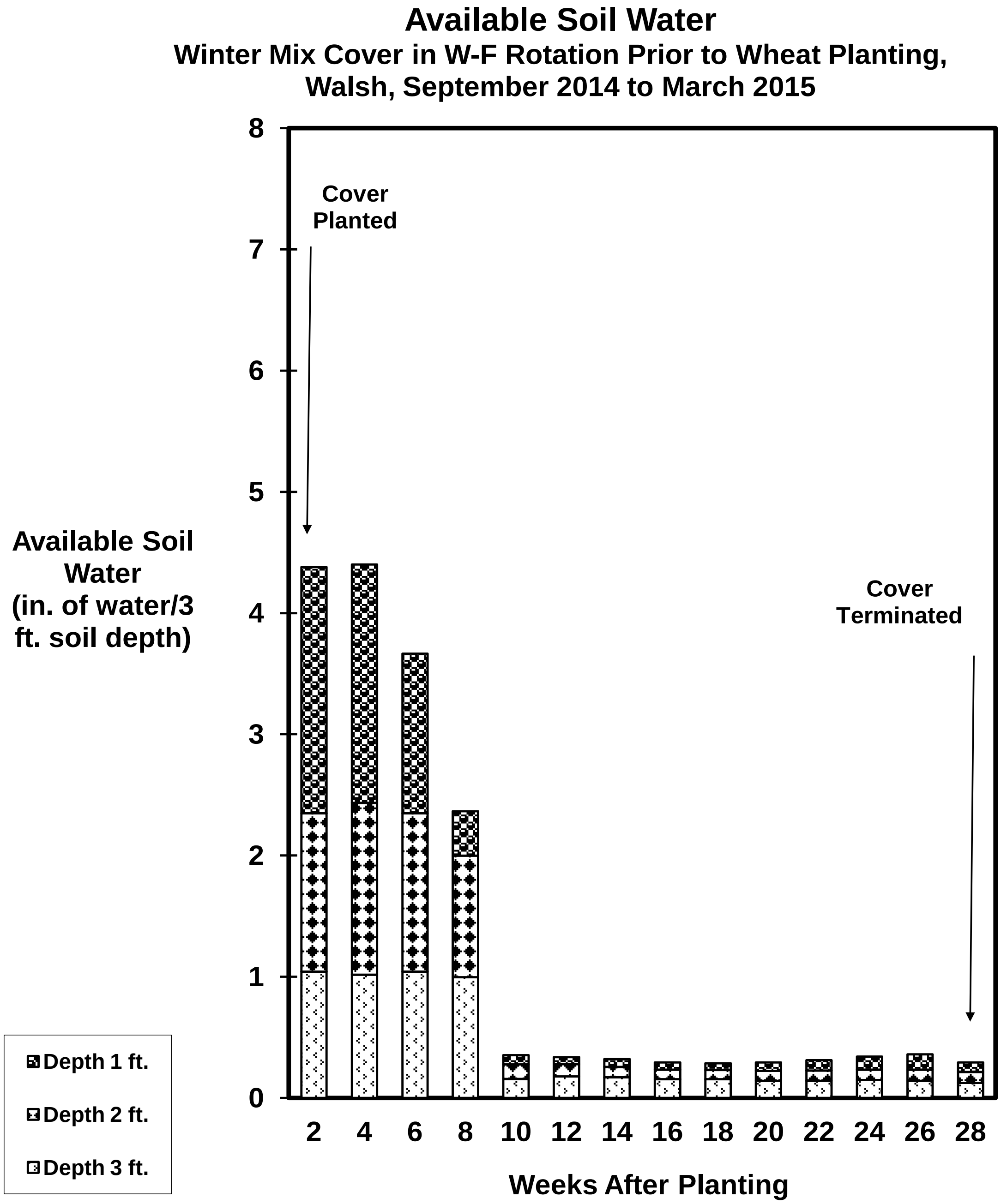

Fig. . Available soil water of winter mix cover in W-F Rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.72 in. Any increase in available soil water between weeks is from rain.

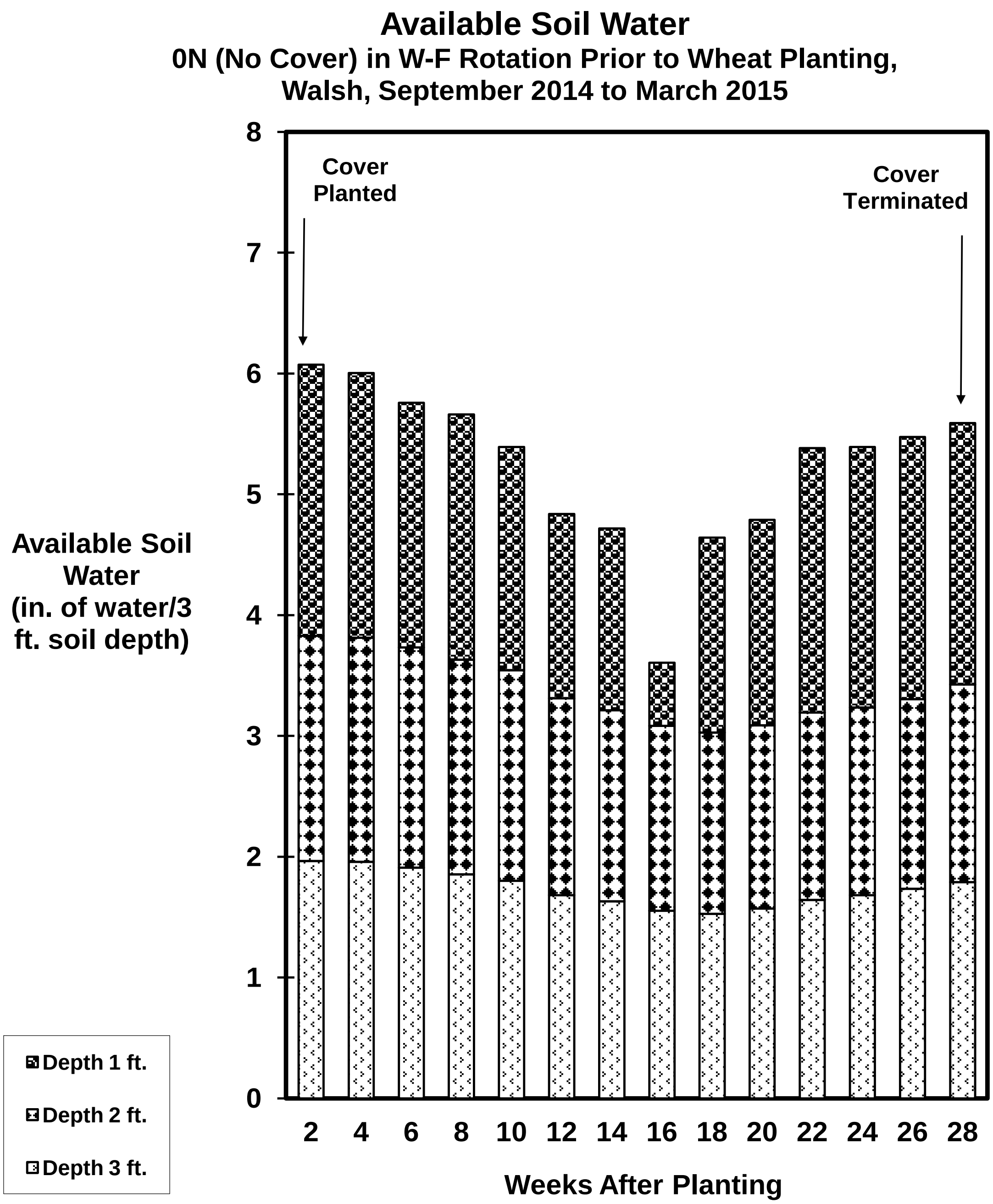

Fig.   . Available soil water of 0N (no cover) in W-F Rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.72 in. Any increase in available soil water between weeks is from rain.

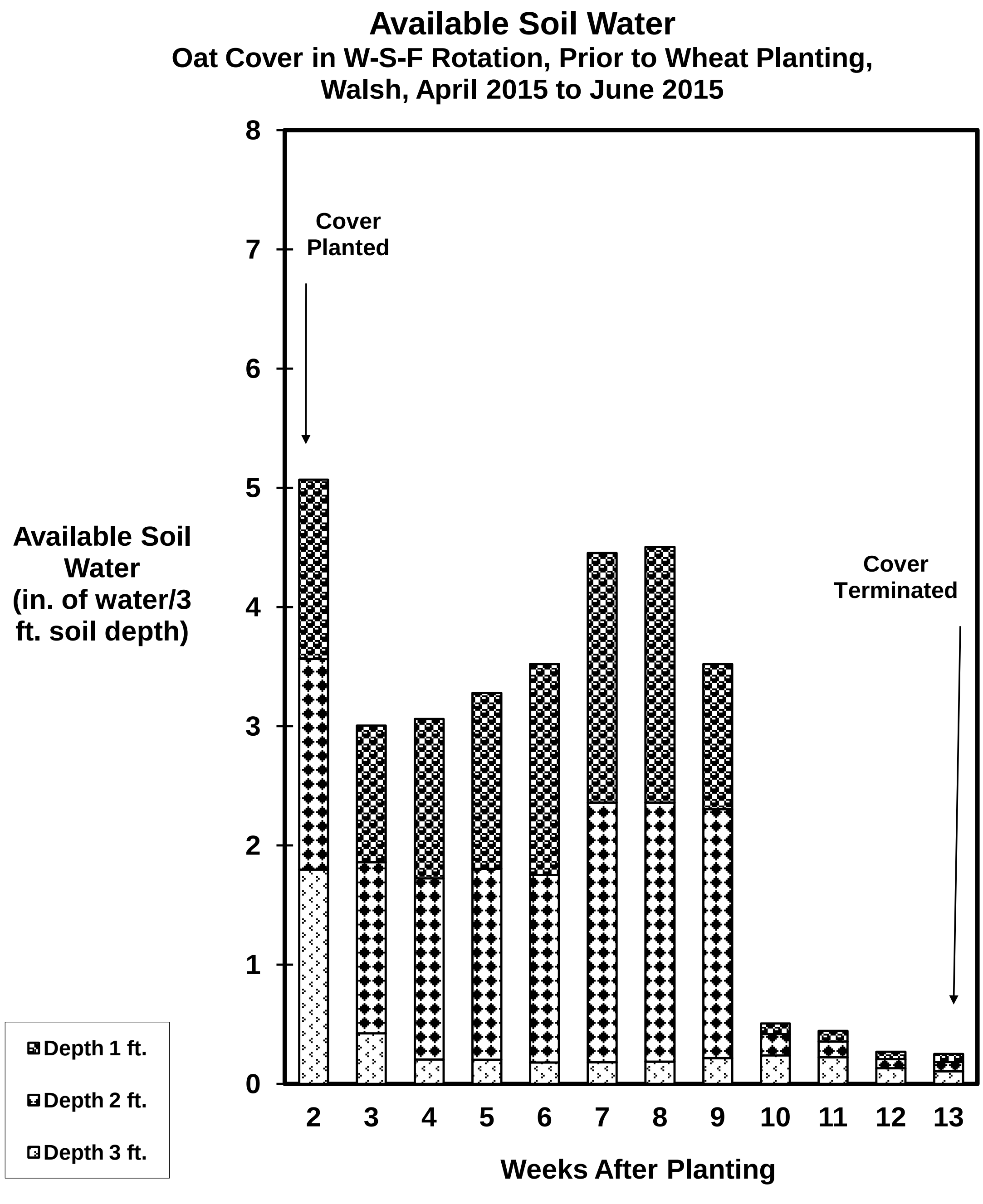

Fig. . Available soil water of oats cover in W-S-F rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 8.16 in. Any increase in available soil water between weeks is from rain.

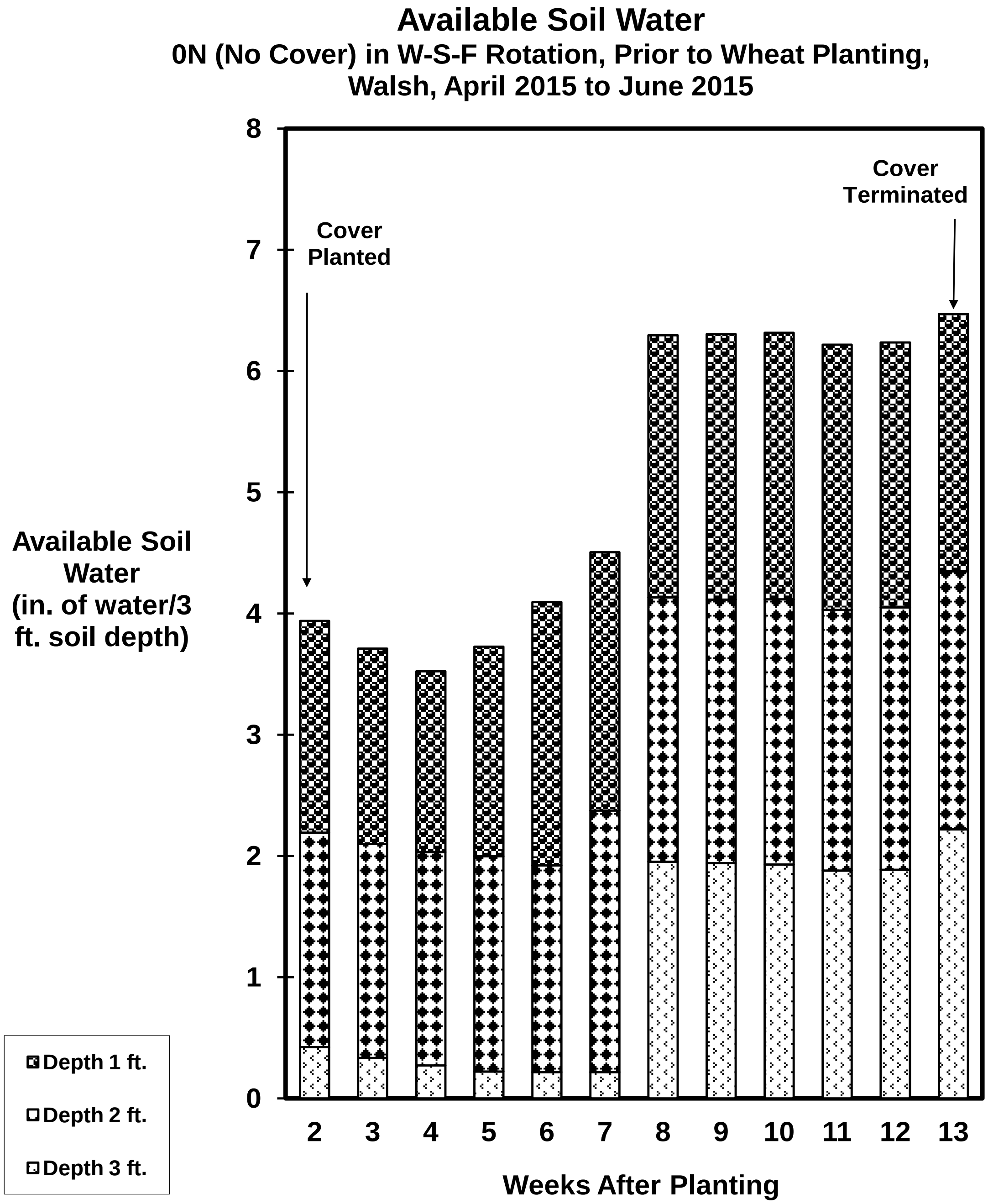

Fig. . Available soil water of 0N (no cover) in W-S-F rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 8.16 in. Any increase in available soil water between weeks is 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 fifth cropping season, we treated both the chemical and tillage treatments the same starting in March, 2015. 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 for the W-S-F rotation and five times for the W-F rotation. For in-season broadleaf weed control in the grain sorghum crop, we applied a tank mix of Huskie 16 oz/a, atrazine 0.75 lb/a, Penetrant II 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, dicamba 2 oz/a, Penetrant II 8oz/a. For N fertilization, we streamed 28-0-0 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 6, 2015. For the sorghum crop, we planted Mycogen 1G557 at 35,000 seeds/a on June 7, 2016 and seedrow applied 5 gal 10-34-0/a at planting. We harvested the wheat on June 24, 2016. We harvested the grain sorghum on November 1, 2016 with a self-propelled combine equipped with a digital scale. Yields were adjusted to 14% seed moisture content for grain sorghum and 12% seed moisture content for wheat..

Results and Discussion

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, this is only the second time that we have harvested a wheat crop, but this is our fifth harvested grain sorghum crop. The first wheat crop, following our initial burn down or tillage to control the perennial grasses, had been our only other wheat harvest until this year.

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.

Early in the process of establishing the crop rotations, we were able, in 2013, to create 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.

Last 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. There were fewer chemical and tillage operations, resulting in $4.52/a higher chemical treatment cost. However, 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.

This year, we were able to harvest both the wheat and the grain sorghum crops. This is only the second time that we have harvested wheat for this study. We suspended the tillage operations for the tillage treatment and treated both chemical and tillage treatments using the same no-till methods. We suspended tillage operations to determine the length of the recovery period required for the tillage treatment to produce yields equivalent to the chemical treatment. The tillage treatment produce higher grain sorghum yield than the chemical treatment, although the 2.7 bu/a yield difference was not significant. Likewise, the W-F tillage treatment produced significantly higher wheat yield, 7.4 bu/a more than the chemical treatment. The greater production for the tillage treatment did not hold true for the wheat yield in the W-S-F rotation, where the chemical treatment produced 3.5 bu/a more yield than the tillage treatment. It appears that the length of recovery period for the tillage treatment to produce at a similar yield level as the chemical treatment was only one season without tillage.

Total rotational variable net income (rotational income minus CRP conversion cost and treatment maintenance cost) for the first five years of this study (2012 to 2016) produced negative incomes for the W-F rotation, -$37/a for the chemical treatment and -$21/a for the tillage treatment. The negative incomes for the W-F rotation are due to harvesting only two wheat crops in five years. 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 2016, $103/a for chemical treatment and $79/a for tillage treatment. For the first five years of this CRP crop conversion study, the chemical treatment produced an average of $62/a more than the tillage treatment.

Reference Cited

USDA, FSA. December 30, 2011. Conservation Reserve Program - Monthly CRP Acreage Report, Summary of Active and Expiring CRP Acres by State. Accessed: January 12, 2012. ftp://ftp.fsa.usda.gov/crpstorpt/RMEPEGG/MEPEGGR1.HTM

Table .Long Term CRP Conversion After Using Tillage or Chemical, Fifth Season, Wheat-Sorghum-Fallow, Grain Sorghum Crop, Walsh, 2016.

CRP Conversion	Rotation	Test Weight	Grain Sorghum Yield	Gross Income	Treatment Cost	Variable Net Income
		lb/bu	bu/a	$/a	$/a	$/a
Tillage	W-S-F	58.5	71.7	179.25	54.24	125.01
Chemical	W-S-F	59.1	69.0	172.50	54.24	118.26
Average		58.8	70.4	175.88	54.24	121.64
LSD 0.20			14.47			

Chemical: glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2lb/a applied four times.
Chemical cost: $7.56/a and $6.00/a for each application.
Tillage and no till treated the same.
N fertilizer applied at 50 lb/a as 28-0-0.
Grain sorghum, Mycogen 1G557, planted at 35,000 seeds/a and seedrow applied 5 gal 10-34-0/a at planting.
Grain sorghum planted on June 7; harvested on November 1, 2016.
Grain sorghum price: $2.50/bu.
Variable Net Income is Gross Income minus Treatment Cost.

Table .Long Term CRP Conversion Using Tillage or Chemical, Fifth Season, Wheat-Sorghum-Fallow & Wheat-Fallow, Wheat Crop, Walsh, 2016.

CRP Conversion	Rotation	Test Weight	Wheat Yield	Gross Income	Treatment Cost	Variable Net Income
		lb/bu	bu/a	$/a	$/a	$/a
Tillage	W-F	56.7	60.3	180.90	67.80	113.10
Chemical	W-F	54.1	52.9	158.70	67.80	90.90
Tillage	W-S-F	53.8	50.9	152.70	67.80	84.90
Chemical	W-S-F	51.9	54.4	163.20	67.80	95.40
Average		54.1	54.6	163.88	67.80	96.08
LSD 0.20			2.51			

Chemical: glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2lb/a applied five times.
Chemical cost: $7.56/a and $6.00/a for each application.
Tillage and no till treated the same.
N fertilizer applied at 50 lb/a as 28-0-0.
Wheat , Hatcher, 50 lb seeds/a, 5 gal 10-34-0/a.
seedrow applied 5 gal 10-34-0/a at planting.
Wheat planted on October 6, 2015; harvested on June 24, 2016.
wheat price: $3.00/bu.
Variable Net Income is Gross Income minus Conversion Cost.

Table .-CRP Conversion, Chemical and Tillage Comparison, Annual Rotational Income, 2012 to 2016.

Rotation & Conv. Treatment	Conver-sion Cost	Variable Net Income 2012	2013	2014	2015	2016	2012-2016 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	213.66	512.95	102.59
W-F	113.10	--	-102.23	-80.80	-57.04	90.90	-149.17	-37.29
Tillage								
W-S-F	84.00	-34.63	50.50	149.63	19.63	209.91	395.04	79.01
W-F	84.00	--	-97.88	-60.00	-40.52	113.10	-85.30	-21.33
Average		-34.72	-15.89	52.24	-7.50	156.89	168.38	30.74

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, 2016

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

PURPOSE: To identify high yielding hybrids under irrigated conditions with 2500 heat units in a silty loam soil.

RESULTS: Of the 2 hybrids tested, Mycogen 8H456CL had the highest seed yield, 635 lb/a (261 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: 21,050 seeds/a. PLANTED: June 24. HARVESTED: November 14, 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; Glyphosate 32 oz/a applied with hooded sprayer. 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	2.24	164	6	0	6
July	3.88	898	24	6	37
August	3.68	741	14	0	68
September	0.17	611	10	0	98
October	0.01	106	0	0	105
Total	9.98	2520	54	6	105

[a]Growing season from June 24 (planting) to October 7 (first freeze, 26 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

FIELD HISTORY: Last Crop: Grain sorghum. FIELD PREPARATION: Disked.

COMMENTS: Planted in adequate soil moisture. Weed control was good, except for a partially controlled infestation of puncture vine. The growing season precipitation was above average with a wet April and a dry September. Seed yields and oil percentages were poor because of poor plant stands and damage from herbicide drift.

SOIL: Wiley 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	0.6	2.3	24	3.2	444	0.5	8.3
8”-24”				13				
Comment	Alka	Vlo	VHi	Hi	VLo	VHi	Lo	Lo

Iron was low.

Summary: Fertilization for Drip Site.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	40	2	20
Applied	100	0	0	0

Yield Goal: 2000 lb/a.
Actual Yield: 541 lb/a.

Drip Irrigated Sunflower, Mid and High Oleic Variety Trial, PRC, Walsh, 2016.

Firm	Hybrid	Mid or High Oleic	Plant Height	Test Weight	Oil	Seed Yield	Oil Yield
			in	lb/bu	%	lb/a	lb/a
MYCOGEN	8H456CL	high	47	30.1	41.1	635	261
MYCOGEN	8H449CLDM	high	39	28.8	39.3	446	175
Average			43	29.5	40.2	541	218
LSD 0.20						480.2	

Planted: June 24; Harvested: November 14, 2016.
Seed Yield adjusted to 10% seed moisture content.
Total water applied was 6 in./a of drip irrigation.

National Winter Canola Variety Performance and Great Plains Trials, Walsh 2016

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, canola's narrow planting window (late August to mid-September) is frequently too short for sufficient rain to occur. We had good fall moisture and all of the varieties and lines had very good plant stands. The winter temperatures were mild and winter survival rates were very high. Most varieties and lines had good plant stands, except for Wichita and Sumner, which had very poor plant stands because old seed was used for planting (personal communication with Dr. Stamm). We had a very wet April. We expected high seed yields, but yields were less than anticipated, averaging 896 lb/acre for both trials. The lower than expected yields may be attributed to a severe infestation of false cinch bugs feeding on the pods during seed filling.

Materials and Methods

We planted 45 winter canola hybrids, varieties and lines for the National Winter Canola Trial, and we planted 36 winter canola varieties and lines for the Great Plains Winter Canola Trial on September 9, 2015. 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. We harvested on July 20 and 21, 2016 using a self propelled combine equipped with a digital scale.

National Winter Canola Hybrid Trial at Walsh, Colorado, 2016.

Hybrid (Line)	Stand (0-10)	Winter Survival (0-10)	Flowering Date	Plant Height in.	Seed Shattering %	Seed Yield lb/acre
DK Severnyi	8.5	10.0	15-Apr	35	0	1898
DK Sensei	7.7	10.0	17-Apr	36	4	1568
Hornet	9.1	10.0	21-Apr	38	4	1526
DL Imistar CL	8.9	10.0	15-Apr	36	5	1436
Inspiration	9.1	10.0	21-Apr	35	5	1353
PX112	8.3	10.0	18-Apr	35	6	1295
MH12AQ37	9.2	10.0	23-Apr	35	13	1171
Edimax CL	8.8	10.0	22-Apr	35	13	1147
46W94	8.7	10.0	24-Apr	36	4	1114
WRH458	6.6	10.0	21-Apr	36	26	1114
DK Imiron CL	7.2	10.0	22-Apr	33	5	1089
Popular	7.7	10.0	22-Apr	35	15	1073
Mercedes	8.3	10.0	20-Apr	38	22	1056
Thure	8.0	10.0	22-Apr	39	10	1056
Exp1302	9.0	10.0	23-Apr	35	22	990
Reflex CL	8.4	10.0	22-Apr	36	12	924
Helix	9.1	10.0	27-Apr	39	8	908
Hekip	9.1	10.0	28-Apr	31	19	891
Einstein	7.6	10.0	20-Apr	34	17	809
DL14001RR	5.2	10.0	23-Apr	36	17	784
MH11J41	8.8	10.0	30-Apr	32	16	759
MH12AY27	9.1	9.9	23-Apr	34	14	701
MH12AX37	8.1	9.9	22-Apr	32	15	668
MH12AC17	8.5	10.0	29-Apr	33	27	479
Mean	8.3	10.0	22-Apr	35	12	1075
LSD 0.05	1.61	0.57	1.7		15.6	498.4

Planted: September 9, 2015; Harvested: July 20 and 21, 2016

National Winter Canola Open Pollenated Trial at Walsh, Colorado, 2016.

Variety (Line)	Stand (0-10)	Winter Survival (0-10)	Flowering Date	Plant Height in.	Seed Shattering %	Seed Yield lb/acre
DKW47-15	8.7	10.0	15-Apr	37	5	1048
DKW45-25	8.0	10.0	14-Apr	35	13	982
Kadore	8.5	9.9	16-Apr	37	5	932
Claremore	8.3	10.0	16-Apr	36	2	907
15.UI.WC.1	8.9	10.0	14-Apr	37	7	866
15.UI.WC.05633	9.7	9.9	14-Apr	38	3	858
KSUR1211	9.7	10.0	12-Apr	38	9	809
HyCLASS220W	8.7	10.0	16-Apr	34	14	776
DKW46-15	8.5	9.9	13-Apr	33	11	767
KS4506	8.1	10.0	14-Apr	32	6	751
HyCLASS125W	9.7	10.0	14-Apr	34	12	702
KSR07363	9.5	10.0	13-Apr	38	12	668
HyCLASS225W	7.5	10.0	14-Apr	32	13	602
Quartz	8.5	10.0	23-Apr	34	11	570
Riley	4.7	9.9	17-Apr	37	7	512
Star 915W	9.0	9.9	15-Apr	35	7	495
HyCLASS115W	9.8	10.0	12-Apr	35	12	470
DKW41-10	8.3	9.9	18-Apr	31	33	396
DKW44-10	9.2	10.0	15-Apr	33	25	388
Wichita	1.5	9.5	22-Apr	34	13	223
Sumner	1.0	10.0	X	X	X	X
Mean	7.9	9.9	15-Apr	35	11	686
LSD 0.05	1.10	1.82	0.8		4.6	366.0

Planted: September 9, 2015; Harvested: July 20 and 21, 2016.

Great Plains Canola Variety Trial at Walsh, Colorado, 2016.

Variety (Line)	Stand (0-10)	Winter Survival (0-10)	Flowering Date	Plant Height in.	Seed Shattering %	Seed Yield lb/acre
KS4630	8.4	10.0	14-Apr	34	3	1296
KS4658	8.2	10.0	17-Apr	35	5	1246
KS4574	7.4	10.0	17-Apr	34	5	1221
KS4594	8.5	10.0	17-Apr	36	14	1197
KS4623	8.3	10.0	15-Apr	34	12	1196
KSNT149	8.4	10.0	20-Apr	34	8	1196
KS4656	8.7	10.0	16-Apr	35	5	1097
KS4659	7.6	10.0	18-Apr	35	11	1081
KSUR18	8.3	10.0	15-Apr	37	9	1081
KS4583	9.1	10.0	13-Apr	38	9	1065
KS4593	9.1	10.0	15-Apr	33	7	999
KSUR1219	8.9	10.0	15-Apr	39	8	990
KS4645	8.7	10.0	18-Apr	36	2	982
KS4675	8.0	10.0	14-Apr	33	12	957
KS4576	8.4	10.0	15-Apr	34	11	949
KS4517	9.1	10.0	15-Apr	37	11	924
KS4613	9.3	10.0	14-Apr	325	10	924
KS4657	9.1	10.0	20-Apr	35	2	908
KS4518	8.5	10.0	16-Apr	34	14	899
KS4498	8.3	10.0	15-Apr	35	14	891
KSUR1209	8.8	10.0	15-Apr	34	7	891
KS4616	8.9	10.0	16-Apr	35	9	883
KSNT127	8.5	10.0	15-Apr	36	11	875
Sumner	8.2	10.0	17-Apr	35	11	875
KS4629	9.1	10.0	15-Apr	34	9	850
KS4430	8.8	10.0	16-Apr	37	6	809
KS4612	9.5	10.0	17-Apr	33	11	809
KS4682	8.7	10.0	21-Apr	36	17	809
KS4524	8.1	10.0	15-Apr	39	13	759
KSUR1210	8.4	10.0	17-Apr	34	17	759
KS4636	9.6	10.0	15-Apr	34	5	751
KS4719	9.0	10.0	21-Apr	35	1	743
KS4686	9.2	10.0	15-Apr	37	26	726
Riley	6.8	9.8	17-Apr	34	14	677
Safran	6.6	9.5	27-Apr	32	3	520
Wichita	3.6	9.5	18-Apr	36	14	520
Mean	8.4	10.0	16-Apr	43	10	927
LSD 0.05	1.40	0.20	1.6		9.0	373.8

Planted: September 9, 2015; Harvested: July 20 and 21, 2016.

Herbicide and Single Tillage Control of Kochia in Wheat-Sorghum-Fallow Rotation

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Kochia (*Kochia scoparia*) is an introduced plant that was originally grown as a ornamental, but has become a pervasive weed in many cultivated fields. Soon after ALSs were first registered for long term broadleaf control in cereals, kochia developed resistant to these sulfonureals. In recent years, some kochia populations have become resistant to glyphosate. Continual dependence on glyphosate for broad spectrum weed control has lead to kochia becoming resistant. Since kochia has become difficult to control with glyphosate, we conducted this study to investigate alternative kochia controlling herbicides and practices.

Materials and Methods

We conducted this dryland Wheat-Sorghum-Fallow rotation study at the Plainsman Research Center in which the previous crop rotation was Wheat-Sunflower-Fallow rotation. The kochia population on this site became glyphosate resistant after extensive reliance on glyphosate for weed control for the 10-year duration of the no till Wheat-Sunflower-Fallow rotation study. The kochia controlling treatments were: 1) Valor 2.5 oz/a, glyphosate 32 oz/a, HSMSO 8 oz/a; 2) dicamba 16 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a; 3) dicamba 6 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a; and 4) dicamba 6 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a, plus a single sweep plow tillage operation. The application dates for the treatments were: March 20, 2016 for treatment 1; March 25, 2016 for the 2, 3 and 4 herbicide treatments; and May 26, 2016 for the sweep plow tillage portion of treatment 4. A rescue weed control application consisting of Sharpen 2.0 oz/a, Staredown 6.4 oz/a, glyphosate 32 oz/a, HSMSO 64 oz/100 gal of water, AMS 15 lb/100 gal of water was applied on June 10, 2016 to treatments 2 and 3. We planted Mycogen 1G557 at 35,000 seeds/a on June 18, 2016. A post emergence application of Huskie 16 oz/a, atrazine 0.75 lb/a, AMS 2 lb/a was applied to all plots. We harvested the 20 ft. wide by 1000 ft. long grain sorghum plots on November 3, 2016 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 14.0% seed moisture content.

Results and Discussion

Valor at 2.5 oz/a remained nearly kochia free through sorghum planting. The treatments containing dicamba, even at the high 16 oz/a rate of dicamba, had poor kochia control and a kochia controlling rescue application was necessary. The single sweep plow tillage operation provided very good control of the kochia.

The Valor treatment had the highest grain sorghum yield, but it was not significantly higher than the other treatments ($P>0.20$). Grain sorghum yields ranged from 60 to 64 bu/a. The Valor treatment had the highest variable net income of $138/a, which was more than $10/a more than the second highest treatment, the treatment that included the single sweep plow tillage operation.

Table .--Herbicide and Single Tillage Control of Kochia in W-S-F Rotation, Grain Sorghum Crop, Walsh, 2016.

Treatment	Product Dosage	Dosage Unit	Application Date	Seed Moisture %	Test Weight lb/bu	Grain Yield bu/a	Treatment Cost $/a	Rescue Treatment Cost $/a	Variable Net Income $/a
1 Valor	2.5	oz/a	3/20/2016	10.9	61.7	64.0	22.23		137.77
1 Glyphosate	32	oz/a	"						
1 HSMSO	8	oz/a	"						
2 Dicamba	16	oz/a	3/25/2016	10.7	62.5	61.2	16.42	27.94	108.64
2 Glyphosate	32	oz/a	"						
2 2,4-D ester	0.5	lb/a	"						
3 Dicamba	6	oz/a	3/25/2016	10.9	62.3	61.8	12.92	27.94	113.64
3 Glyphosate	32	oz/a	"						
3 2,4-D ester	0.5	lb/a	"						
4 Tillage (sweep plow)			5/26/2016	10.5	62.3	60.1	22.92		127.33
4 Dicamba	6	oz/a	3/25/2016						
4 Glyphosate	32	lb/a	"						
4 2,4-D ester	0.5	lb/a	"						
Average				10.8	62.2	61.8	18.62	27.94	121.85
LSD 0.20						7.00			

Planted: June 18, 2016, grain sorghum hybrid: Mycogen 1G557 at 35,000 seeds/a.
Treatments applied: 20 ft. by 1000 ft. with 2 replications, prior to kochia emergence.
Treatment cost is herbicide cost plus application cost at $6/a. Sweep plow cost is $10/a.
Rescue treatment applied June 10, 2016 to treatments 2 and 3 (dicamba 6 and 16 oz/a treatments).
The rescue treatment was: Sharpen 2.0 oz/a, Staredown 6.4 oz/a, Glyphosate 32 oz/a, HSMSO 64 oz per 100 gal. water, AMS 15 lb per 100 gal. of water. Rescue treatment herbicide cost, $21.94/a.
Variable Net Income: gross income (grain yield x $2.50/bu) minus treatment cost.
Grain sorghum price: $2.50/bu.