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Agricultural Experiment Station

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

Colorado State University

Plainsman Research Center 2014 Research Reports

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

Kevin Larson, Superintendent and Research Scientist II

Plainsman Research Center

Box 477

42790 Hwy 160

Walsh, CO 81090

(719) 324-5643

Kevin.Larson@colostate.edu

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This Plainsman Research Center booklet is dedicated to:

Deborah Harn

Deb has been a loyal and conscientious Plainsman staff member for 25.5 years. We wish you well on your retirement and we know that you will enjoy the peace and serenity of your mountain retreat. Personally, I think that you are going to miss flagging in the wind and collecting plant samples for pest damage on those cold and blustery days (well, maybe not so much). When the wind is really whipping, who is going to listen when I say, “Well, it looks like it is time to do some flagging?”

This Plainsman Research Center booklet is also dedicated to:

Dean Sides

We wish you well on your retirement. You have been a dedicated Plainsman Agri-Search Board veteran for 35 years. That’s right 35 years! When Plainsman was expanding our wheat seed sales, you volunteered your sprinklers for irrigated production and only charged us market price for your wheat seed production. Thank you, for keeping Plainsman viable.

This Plainsman Research Center booklet is also dedicated to:

Max Smith

We know that this new opportunity was too great to pass up and it was time to move onward and upward, but we will surely miss you. It feels like our brother is moving away. We will miss you, not only as a 25-year member (and past president) of the Plainsman Agri-Search Board, but personally as my ‘go to guy’. Whenever my bosses on campus needed to evaluate me, I always suggested you as a Plainsman representative. I knew that you had my back. We will all miss you brother.

This Plainsman Research Center booklet is also dedicated to:

The Neill Foundation Board:

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

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

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

Plainsman Research Center, 2014 Research Reports

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2014 Plainsman Research Center Staff and Personnel with Projects

Kevin Larson (719) 324-5643	Superintendent and Research Scientist II, Plainsman Research Center, Agricultural Experiment Station, Colorado State University.
Brett Pettinger (719) 324-5643	Research Associate, Plainsman Research Center, Agricultural Experiment Station, Colorado State University.
Deborah Harn (719) 324-5643	Research Associate II, RWA Project, Plainsman Research Center, Agricultural Experiment Station, Colorado State University.
Jerry Johnson (970) 491-1454	Associate Professor and Extension Specialist, Soil and Crop Sciences Department, Colorado State University.
Scott Haley (970) 491-6483	Professor, Soil and Crop Sciences Department, Colorado State University.
Wilma Trujillo (719) 336-7734	Cropping System Specialist, Extension Southeast Area, Colorado State University.
Sally Sauer (970) 491-1914	Research Assistant/Crop Testing Program, Soil and Crop Sciences Department, Colorado State University.

PLAINSMAN AGRI-SEARCH FOUNDATION BOARD

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Paul Hinds (Vice President)
12785 Road 34
Campo, CO 81029

James Hume
21491 Road 55
Walsh, CO 81090

Brian Brooks
19511 Road 36
Walsh, CO 81090

Don Wood
36663 Road UU
Two Buttes, CO 81084

Lyndell Herron
Box 64
Manter, KS 67862

Truman Wright (Secretary/Treasurer)
19625 Road 50
Walsh, CO 81090

2014

Max Smith
21715 Road 51
Walsh, CO 81090

Bill Brooks
37701 Road V
Walsh, CO 81090

Perry Jones
342 N. Nevada
Walsh, CO 81090

Calvin Melcher
300 N. Main
Holly, CO 81047

Matt Tedder
20923 Road 49
Walsh, CO 81090

Todd Randolph (President)
53766 Road GG
Walsh, CO 81090

2015

Dean Sides
49681 Road X
Walsh, CO 81090

Kim Wood
721 Barkley
Springfield, CO 81073

Jack Walker
30780 Road 51
Walsh, CO 81090

Ron Batterton
1550 Hwy 89
Holly, CO 81047

Robert Wood
721 Barkley
Springfield, CO 81073

Douglas Melcher
12845 Hwy 89
Holly, CO 81047

2014 Climatological Summary
Plainsman Research Center, Walsh, Colorado

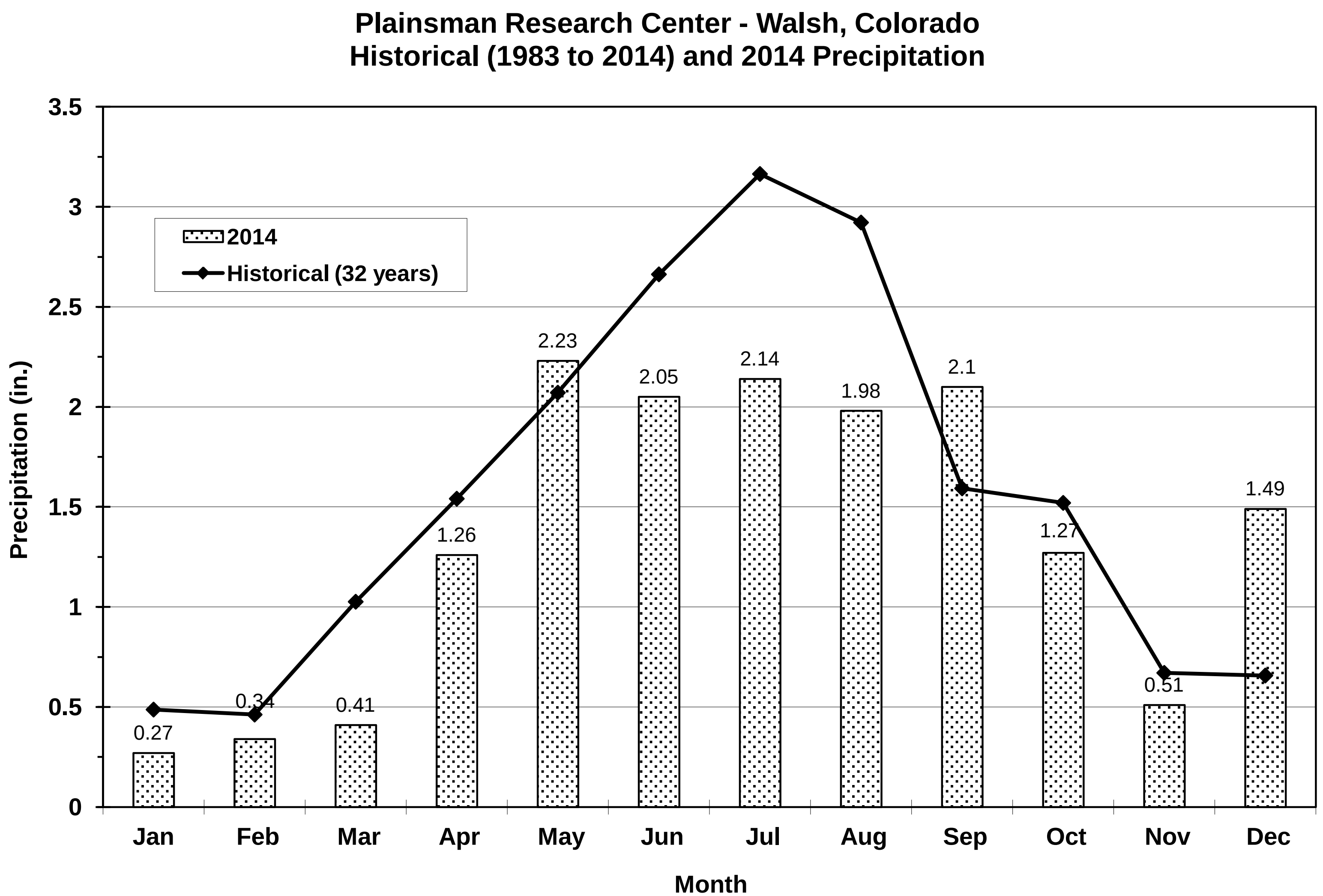
Month	Temperature Max. F	Min. F	Max. Mean F	Min. Mean F	Precip. In.	Greatest Day of Precip-atation	Snow-Fall In.	Greatest Snow Depth In.	Average Soil Temp F	Evapor-ation In.
Jan.	67	-10	47.9	16.4	0.27	0.16	4.10	2.00	30.84	
Feb.	72	-7	46.2	18.2	0.34	0.16	4.30	2.00	33.25	
Mar.	77	-4	58.9	26.3	0.41	0.23	5.30	2.50	39.94	
Apr.	88	22	67.6	37.5	1.26	0.36	3.50	3.50	50.53	4.63
May	95	30	78.6	46.1	2.23	1.12	0.00	0.00	59.74	11.20
Jun.	100	41	87.7	57.8	2.05	0.73	0.00	0.00	69.07	12.62
Jul.	107	53	92.6	61.1	2.14	1.30	0.00	0.00	76.77	13.97
Aug.	101	53	92.1	61.6	1.98	1.06	0.00	0.00	74.35	12.77
Sep.	101	37	82.1	53.8	2.10	1.20	0.00	0.00	66.77	8.27
Oct.	88	29	72.8	42.2	1.27	0.93	0.00	0.00	55.87	3.22
Nov.	80	0	54.7	25.5	0.51	0.36	4.30	4.00	40.20	
Dec.	65	-8	46.0	21.1	1.49	0.52	4.00	3.00	34.74	
Total Annual			**68.9**	**39.0**	**16.05**		**25.50**			**66.68**

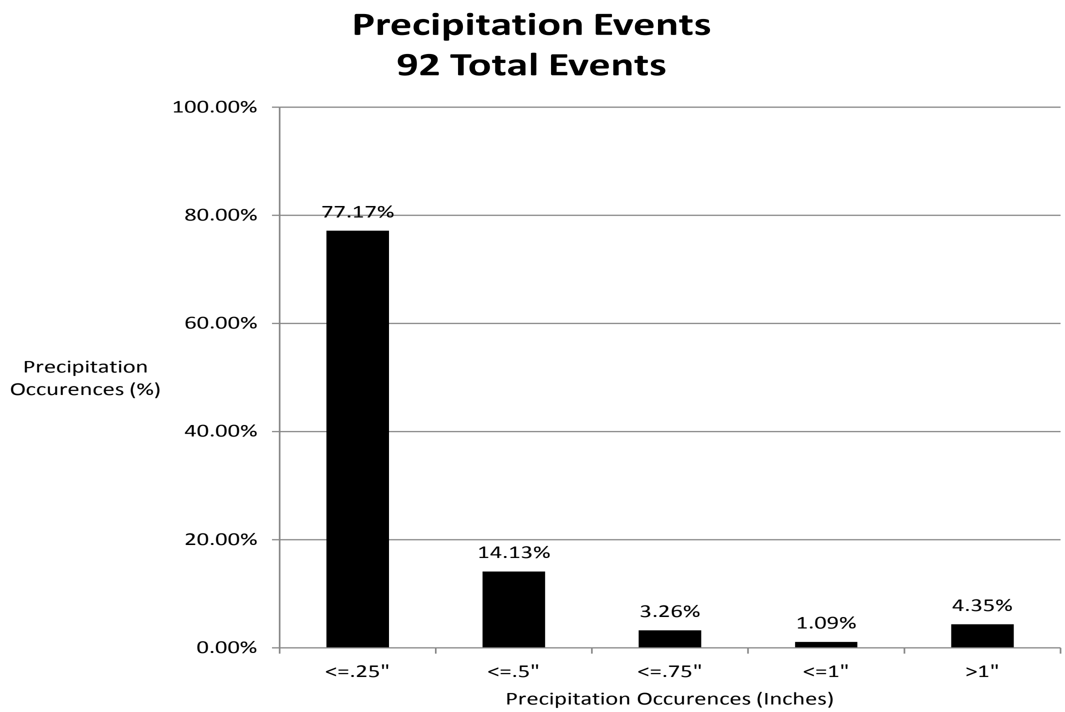
*** NOTE: Evaporation read April 15th through October 15th.
Wind velocity is recorded at two feet above ground level.
Total evaporation from a four foot diameter pan for the period indicated.

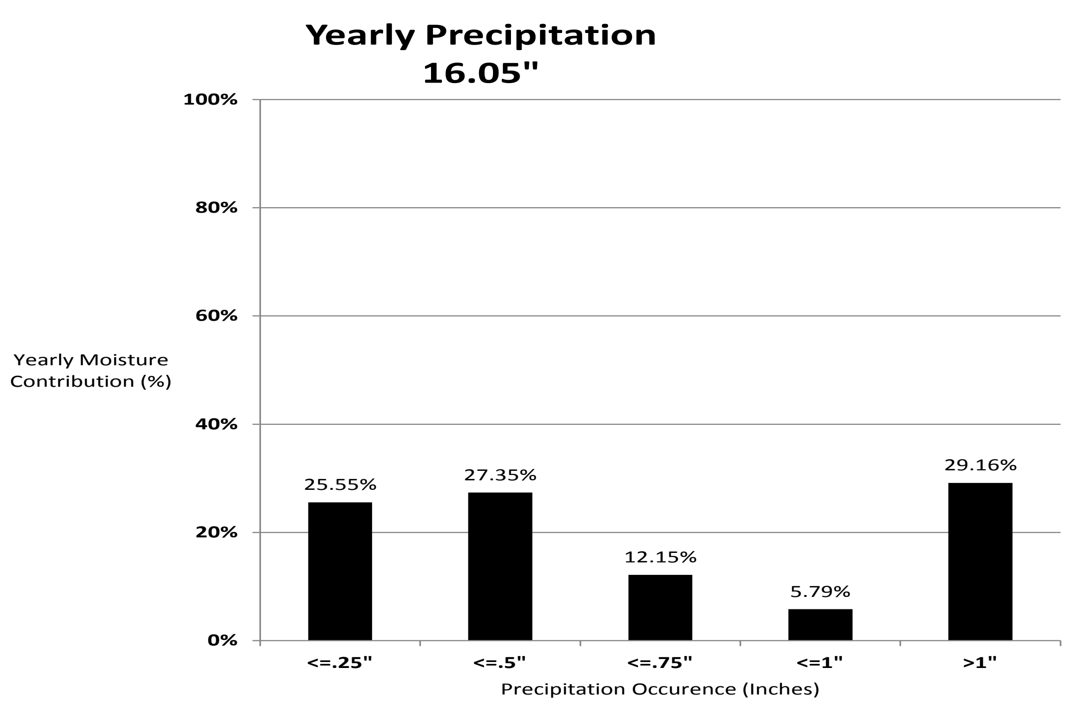
	2014	2013
Highest Temperature:	107 F on July 26	107 F on June 11 & 12
Lowest Temperature:	-10 F on January 6	0 F on December 9
Last freeze in spring:	32 F on May 14	30 F on May 6
First freeze in fall:	32 F on October 29	32 F on October 5
Frost free season:	168 frost free days	152 frost free days
Avg. Prec. for 31 years	18.78 inches	

Maximum Wind:

Jan.	43 mph on 13th	July.	37 mph on 8th
Feb.	46 mph on 20th	Aug.	30 mph on 15th
Mar.	54 mph on 19th	Sept.	35 mph on 30th
Apr.	54 mph on 30th	Oct.	38 mph on 13th
May	44 mph on 23rd	Nov.	38 mph on 25th
Jun.	46 mph on 23rd	Dec.	52 mph on 24th


Plainsman Research Center - Walsh, Colorado
Historical (1983 to 2014) and 2014 Precipitation
Precipitation (in.)
3.5
3
2.5
2
1.5
1
0.5
0
2014
Historical (32 years)
0.27
0.34
0.41
1.26
2.23
2.05
2.14
1.98
2.1
1.27
0.51
1.49
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Month


Precipitation Events
92 Total Events
100.00%
80.00%
60.00%
40.00%
20.00%
0.00%
Precipitation Occurences (%)
77.17%
14.13%
3.26%
1.09%
4.35%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurences (Inches)


Yearly Precipitation
16.05"
100%
80%
60%
40%
20%
0%
Yearly Moisture Contribution (%)
25.55%
27.35%
12.15%
5.79%
29.16%
<=.25"
<=.5"
<=.75"
<=1"
>1"
Precipitation Occurence (Inches)

Variety Performance in the 2014 Eastern Colorado Winter Wheat Trials

Jerry Johnson and Scott Haley

The Colorado State University Crops Testing and Wheat Breeding and Genetics programs provide current, reliable, and unbiased wheat variety information as quickly as possible to Colorado producers for making better variety decisions. CSU has an excellent research faculty and staff, a focused breeding program, graduate and undergraduate students, and dedicated agricultural extension specialists. Wheat improvement in Colorado would not be possible without the support and cooperation of the entire Colorado wheat industry. Strong producer support for our programs is critical for sustained public variety development and testing.
Our wheat variety performance trials and Collaborative On-Farm Tests (COFT) represent the final stages of a wheat breeding program where promising and newly released experimental lines are tested under an increasingly broad range of environmental conditions.

There were 44 entries in the dryland performance trials (UVPT) and 28 entries in the irrigated performance trials (IVPT). All 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 (Syngenta), AgriPro (Monsanto), Limagrain, AGSECO, and Watley Seed Company. There were entries from four marketing organizations, PlainsGold (Colorado), Husker Genetics (Nebraska), the Crop Research Foundation of Wyoming, 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 viable seeds per acre for dryland trials and 1.2 million viable seeds per acre for irrigated trials. Yields were corrected to 12% moisture. Test weight information was obtained from an air blower-cleaned sample of the first replication or from a combine equipped with a Harvest Master measuring system.

2014 Dryland Variety Performance Trials – Southeast locations

Walsh – Planted 10/2/2013. September precipitation and good emergence. Freezing events, but not too bad. Dry conditions from planting until May 2014. Blowing between the rows. Jointing was later than normal. Brown wheat mites were present around the trial. On May 23, the site received 1.5 inches of rain. In early June it received another 1.5 inches. The trial average yield of 33.3 bushels/acre was better than expected given an October date of planting.

Lamar – Planted 9/23/13. Brown wheat mites bad in April. Soil probe to 3”, very dry. Very small plants in June (average plant height at harvest was 18 inches). Soil was very dry. Brown wheat mites damaged plants and drought led to dry plants. Trial was highly variable for plant height (minimum 13 inches, maximum 24 inches). No weeds were present. Visit to trial by Tony Frank, president of CSU. The nearest weather station showed 8 inches of precipitation from September 2013 through June 2014. Another 6.5 inches fell in July. Average trial yield was 24.8 bushels/acre.

Sheridan Lake – Planted 9/19/13 into good soil moisture conditions that led to good stands. By April, soil was very dry and frost damage was evident. In June the leaves were rolled from drought. There were no insect or disease pests. According to the nearest weather station, only 6.3 inches of rain fell from September 2013 through June 2014. Another 2.8 inches fell in July. Trial average yield was 41.4 bushels/acre. Given the low precipitation, yields were exceptionally high.

General Wheat Growing Conditions in Southeast Colorado - Wilma Trujillo

Wheat producers in the southeastern area of the state planted into some of the best soil moisture conditions that they have seen in several years. Rains in mid-August and early September restored farmers' hope after losses from drought in recent years. The good moisture conditions led to an increase in the number of wheat acres that were planted compared to 2012. The favorable conditions also resulted in good stands going into winter. During the winter months temperatures were colder than normal. The majority of the southeastern corner was still under severe and extreme drought conditions. Lack of moisture combined with high wind conditions (gusts reaching 60 miles-per-hour) produced dust storms and blow-out of wheat fields.

As wheat fields started to green up in the spring, some concerns continued regarding winterkill due to extremely cold temperatures. Cool temperatures experienced in March and April delayed crop development and it was one to two weeks behind normal. Record low-temperatures with little or no snow cover caused some damage to the wheat crop in mid-April. Fortunately, the wheat was not jointed yet and only minor freeze damage occurred. In mid-May, temperatures were in the mid- to low-20s, which was low enough to damage wheat in more advanced growth stages. At this time, more fields were in the jointing and pre-boot stage than the freeze in April. Soil moisture conditions were still short. In mid- to late-May, rain and the return of more seasonably warm weather helped wheat survive.

Accumulated precipitation was 4.45 inches from October 1, 2013 to June 30, 2014 at the CoAgMet weather station south of Lamar. During the spring and early summer, precipitation was largely isolated and insufficient, with no significant improvement in moisture supplies noted. In mid- to late-June, the area saw a fair amount of hail, ranging from light hail events to more major damage.

2014 Dryland Winter Wheat Variety Performance Trial at Walsh

Variety	Yield bu/ac	Test Weight lb/bu	Plant Height in
CO09W009	42.8	61.2	18
CO11D174	41.0	59.3	20
LCS Mint	40.3	61.6	18
Settler CL	39.2	59.4	17
Hatcher	38.8	60.4	19
CSU Blend13	36.9	60.0	19
Denali	36.9	61.4	16
Cowboy	36.5	61.0	23
Byrd	35.7	59.6	17
Bill Brown	35.4	61.1	20
Antero	35.3	59.6	20
Above	35.1	60.3	23
Clara CL	35.0	60.4	22
CO09W040-F1	34.8	60.5	19
TAM 113	34.3	59.1	20
Akron	34.0	59.2	19
Ripper	33.7	58.1	17
Oakley CL	33.7	60.5	24
Brawl CL Plus	33.7	59.8	19
Gallagher	33.2	59.6	18
Bond CL	33.1	59.0	20
WB-Grainfield	32.8	60.0	20
Bearpaw	32.8	59.4	20
CO11D446	32.6	59.2	19
SY Monument	32.6	59.6	21
Robidoux	32.6	59.5	18
TAM 111	32.5	60.4	22
CO11D346	32.1	60.6	20
LCH11-1130	31.9	57.6	19
Snowmass	31.3	58.6	16
Winterhawk	31.2	61.5	20
Prairie Red	31.1	58.9	17
1863	31.1	59.2	21
Yumar	31.1	60.2	21
TAM 112	30.8	60.0	18
Iba	30.5	61.8	20
LCH11-1064	30.3	59.7	19
T158	29.7	58.5	16
CO09W293	28.6	58.2	16
KS10HW78-1	26.6	60.0	20
KS030887K-6	26.6	60.2	18
Warhorse	25.3	57.8	19
Freeman	21.0	58.1	20
Average	**33.3**	**59.8**	**19**
LSD (P<0.30)	3.8		

2014 Dryland Winter Wheat Variety Performance Trial at Lamar

Variety	Yield	Plant Height
	bu/ac	in
Hatcher	30.3	19
Brawl CL Plus	29.2	21
Oakley CL	28.9	19
Antero	28.8	19
CSU Blend13	28.7	16
Winterhawk	27.8	22
LCS Mint	27.8	19
WB-Grainfield	27.3	22
Settler CL	27.2	19
CO09W293	26.7	12
Prairie Red	26.6	18
Ripper	26.3	17
SY Monument	26.1	15
Byrd	26.1	16
Gallagher	26.0	16
CO11D346	25.6	22
CO11D174	25.5	16
Bond CL	25.3	19
Yumar	25.0	16
Iba	24.8	17
TAM 112	24.7	19
TAM 113	24.4	20
Cowboy	24.2	17
CO09W040-F1	24.0	17
LCH11-1130	23.9	15
T158	23.8	17
Denali	23.6	17
Snowmass	23.5	22
KS030887K-6	23.1	17
Akron	23.0	18
Bearpaw	22.9	20
CO09W009	22.8	15
Robidoux	22.8	13
Bill Brown	22.7	13
Warhorse	22.5	22
Clara CL	22.2	15
Above	22.1	16
KS10HW78-1	22.1	15
CO11D446	21.7	17
LCH11-1064	21.7	14
1863	21.2	18
Freeman	21.1	17
TAM 111	20.8	24
Average	**24.8**	**18**
LSD (P<0.30)	2.5	

2014 Dryland Winter Wheat Variety Performance Trial at Sheridan Lake

Variety	Yield	Test Weight	Plant Height
	bu/ac	lb/bu	in
LCS Mint	48.6	58.4	24
Winterhawk	46.5	61.9	24
CO09W009	46.5	58.9	19
CO11D174	45.4	61.2	21
Bill Brown	45.3	59.4	23
Oakley CL	44.9	55.4	21
Byrd	44.8	60.4	23
SY Monument	44.5	58.9	23
Gallagher	44.4	54.2	18
Antero	44.3	56.7	22
CO11D346	44.3	61.0	23
WB-Grainfield	44.2	58.7	22
TAM 113	44.1	54.3	22
KS030887K-6	44.1	60.4	20
Cowboy	44.0	61.8	23
Ripper	43.4	59.4	22
Denali	43.1	61.1	26
CO09W293	43.0	57.2	21
TAM 112	42.5	60.4	22
Above	41.6	58.7	21
Yumar	41.4	56.5	19
LCH11-1130	41.0	57.0	18
T158	40.8	59.4	20
Prairie Red	40.4	60.7	19
Hatcher	40.4	56.7	20
1863	40.1	54.4	19
Settler CL	39.9	55.4	18
TAM 111	39.8	59.7	22
Brawl CL Plus	39.7	59.0	22
CO11D446	39.6	61.6	19
Bond CL	39.3	48.9	19
CO09W040-F1	39.2	58.6	19
Clara CL	39.1	57.0	19
CSU Blend13	38.9	56.3	20
Snowmass	38.9	59.2	21
Bearpaw	38.5	57.7	21
Iba	38.5	56.7	21
Robidoux	38.2	58.8	18
KS10HW78-1	37.2	54.9	18
Akron	36.7	58.8	22
Freeman	36.6	60.6	17
Warhorse	33.2	59.8	19
LCH11-1064	32.9	60.1	16
Average	**41.4**	**58.3**	**20**
LSD (P<0.30)	3.2		

Summary of 2-Year (2013-2014) Southeast Colorado Dryland Variety Performance Results

Variety[a]	Brand/Source	Market Class[b]	Yield bu/ac	Yield % trial average	Test Weight lb/bu	Plant Height in
			--------------2-Year Average[c]	-------------		
LCS Mint	Limagrain	HRW	35.0	120%	60.0	20
Antero	PlainsGold	**HWW**	32.0	110%	58.1	20
Oakley CL	KS Wheat Alliance	HRW	31.8	109%	57.9	21
Settler CL	Husker Genetics	HRW	31.7	109%	57.4	18
Byrd	PlainsGold	HRW	31.5	108%	60.0	19
WB-Grainfield	WestBred Monsanto	HRW	30.7	105%	59.3	21
Winterhawk	WestBred Monsanto	HRW	30.5	105%	61.7	22
Hatcher	PlainsGold	HRW	30.2	103%	58.5	19
Bill Brown	PlainsGold	HRW	29.9	103%	60.3	18
Ripper	PlainsGold	HRW	29.9	102%	58.7	19
Brawl CL Plus	PlainsGold	HRW	29.8	102%	59.4	21
Gallagher	Oklahoma Genetics	HRW	29.6	102%	56.9	17
Denali	PlainsGold	HRW	29.5	101%	61.2	19
TAM 113	AGSECO	HRW	29.5	101%	56.7	21
Clara CL	KS Wheat Alliance	**HWW**	29.2	100%	58.7	19
Above	PlainsGold	HRW	29.0	100%	59.5	20
TAM 112	Watley Seed	HRW	28.7	98%	60.2	20
Iba	Oklahoma Genetics	HRW	27.8	95%	59.3	19
Robidoux	Husker Genetics	HRW	27.7	95%	59.1	16
T158	Limagrain	HRW	27.4	94%	59.0	18
Bond CL	PlainsGold	HRW	27.4	94%	53.9	19
1863	KS Wheat Alliance	HRW	27.0	92%	56.8	19
Bearpaw	Montana State Univ.	HRW	26.7	91%	58.6	20
TAM 111	AgriPro Syngenta	HRW	26.6	91%	60.0	23
Snowmass	PlainsGold	**HWW**	26.0	89%	58.9	20
Freeman	Husker Genetics	HRW	23.4	80%	59.4	18
Average			**29.2**		**58.8**	**19**

[a]Varieties ranked according to average 2-year yield.
[b]Market class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.
[c]The 2-year average yield is based on three 2014 trials and one 2013 trial, test weights are based on two 2014 trials, and plant heights are based on three 2014 trials in southeast Colorado.

Summary of 3-Year (2012-2014) Southeast Colorado Dryland Variety Performance Results

Variety[a]	Brand/Source	Market Class[b]	3-Year Average[c] Yield bu/ac	Yield % trial average	Test Weight lb/ac	Plant Height in
Byrd	PlainsGold	HRW	37.5	116%	60.8	22
Antero	PlainsGold	**HWW**	34.6	107%	60.6	22
Ripper	PlainsGold	HRW	34.2	106%	59.7	21
Hatcher	PlainsGold	HRW	33.5	104%	60.1	20
Settler CL	Husker Genetics	HRW	33.1	102%	59.8	20
TAM 113	AGSECO	HRW	32.9	102%	59.7	23
TAM 112	Watley Seed	HRW	32.9	102%	61.4	22
Winterhawk	WestBred Monsanto	HRW	32.8	101%	62.1	24
Brawl CL Plus	PlainsGold	HRW	32.7	101%	61.1	22
Bill Brown	PlainsGold	HRW	32.5	101%	61.6	19
Denali	PlainsGold	HRW	31.8	98%	61.8	21
Above	PlainsGold	HRW	31.7	98%	60.6	22
Robidoux	Husker Genetics	HRW	31.6	98%	60.5	20
Clara CL	KS Wheat Alliance	**HWW**	31.3	97%	60.9	21
T158	Limagrain	HRW	30.8	95%	60.4	23
TAM 111	AgriPro Syngenta	HRW	30.5	94%	61.1	25
Snowmass	PlainsGold	**HWW**	30.4	94%	60.2	23
Bond CL	PlainsGold	HRW	30.3	94%	56.7	21
1863	KS Wheat Alliance	HRW	29.3	91%	58.0	23
Average			**32.3**		**60.4**	**22**

aVarieties ranked according to average 3-year yield.
bMarket class: HRW=hard red winter wheat; **HWW**=hard white winter wheat.
cThe 3-year average yield is based on three 2014 trials, one 2013 trial, and three 2012 trials in southeast Colorado. Test weights are based on two 2014 trials and two 2012 trials, and plant heights are based on three 2014 trials and two 2012 trials in southeast Colorado.

Dryland Wheat Strips for Forage and Grain Yield at Walsh, 2014

Kevin Larson, Brett Pettinger, and Deborah Harn

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

MATERIALS AND METHODS: Thirteen wheat varieties were planted on October 9, 2013 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 Extra 0.4 oz/a, 2,4-D ester 0.38 lb/a and dicamba 1.5 oz/a was sprayed for weed control. Two 2 ft. by 2.5 ft. forage samples were taken at jointing (April 9) and at boot (May 5). We measure the forage for fresh weight, oven-dried the samples, and recorded dry weight at 15% moisture content. Russian Wheat Aphid did not reach the critical threshold and the field was not sprayed. We harvested the plots on July 3 and 4 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 good, especially considering that the October planting date caused other studies to winterkill. The trial averaged 33 bu/a. About 9 bu/a separated the highest yielding variety, Byrd, from the lowest yielding variety, Bond CL. TAM 111 had the highest forage yield at jointing, but only 8 lb/a or less separated it from TAM 112 and Antero. TAM 112 had the highest forage yield at boot. Three varieties (Antero, Byrd and Denali) had above average two-year averages than the other wheat tested. Hatcher and Bill Brown produced above average three-year average yields.

DISCUSSION: This year I choose Byrd and Antero as the best overall dual-purpose wheat varieties of the 13 wheat varieties tested. Byrd produced the highest grain yield, the fourth highest forage yield at jointing and the second highest forage yield at boot. Antero produced the third highest grain yield and was tied for second in forage yield at jointing and had the fourth highest forage boot yield. This is the second consecutive year that Antero was honored with best overall dual-purpose wheat variety.

Grain yield averages for this trial during the last three harvest years have been near the long-term Baca County average for 2011, (the wheat was hailed out in 2012), below the Baca County average for 2013, and above the Baca County average for 2014. None of the wheat varieties tested had at least average grain yields each of the last three production seasons. Producing average yields in response our wide-ranging seasonal conditions suggests that none of the wheat varieties can handle all of our weather extremes. Some varieties are better adapted to our environment than others, but none produce well under all conditions. Therefore, plant multiple varieties to spread your yield and income risk.

Table .Dryland Wheat Strips, Forage and Grain Yield at Walsh, 2014.

Variety	Jointing		Boot		Plant	Test	Grain	Grain
	Fresh Wt.	Dry Wt.	Fresh Wt.	Dry Wt.	Height	Weight	Protein	Yield
	------------------------lb/a------------------------				in	lb/bu	%	bu/a
Byrd	4147	1354	12952	4484	23	63	12.94	37.0
Bill Brown	3324	1160	10294	3685	22	63	12.78	36.4
Antero	4535	1546	11192	4035	22	63	12.31	35.1
Denali	3362	1208	9847	3412	24	64	12.55	35.0
Hatcher	4114	1403	10522	3675	23	63	13.00	33.6
TAM 112	4494	1548	12680	4545	24	64	13.76	33.2
TAM 111	4244	1554	11222	3926	26	64	13.04	32.9
TAM 113	3797	1389	10529	3794	25	63	13.51	32.4
WB-Grainfield	3149	1254	10038	3784	22	63	13.03	32.3
Snowmass	3359	1168	9485	3168	24	62	13.12	31.8
Winterhawk	3485	1218	11622	3842	24	63	12.84	31.1
Brawl CL Plus	3140	1183	12082	4270	25	64	13.64	30.4
Bond CL	3451	1196	10251	3732	25	62	12.26	28.3
Average	3739	1322	10978	3873	24	63	12.98	33.0
LSD 0.05	1715.8	454.6	4721.8	1611.7				4.26

Planted: October 9, 2013; 50 lb seed/a; 5 gal/a 10-34-0.
Harvested: July 3 and 4, 2014.
Jointing sample taken April 9, 2014.
Boot sample taken May 5, 2014.
Wet Weight is reported at field moisture.
Dry Weight is adjusted to 15% moisture content.
Grain yields are adjusted to 12% moisture content.

Table .--Summary: Dryland Wheat Strips Variety Performance Tests at Walsh, 2011-2014.

		Grain Yield					Yield as % of Trial Average				
Firm	Variety	2011	2013	2014	2-Year Avg	3-Year Avg	2011	2013	2014	2-Year Avg	3-Year Avg
AgriPro	TAM 111	21	13	33	23	22	88	108	100	100	97
Colorado State	Antero	--	15	34	25	--	--	125	103	107	--
Colorado State	Byrd	--	13	37	25	--	--	108	112	109	--
Colorado State	Hatcher	26	11	34	23	24	108	92	103	98	103
Colorado State	Bond CL	20	9	28	19	19	83	75	85	80	83
Colorado State	Brawl CL+	--	14	30	22	--	--	117	91	96	--
Colorado State	Bill Brown	26	10	36	23	24	108	83	109	100	104
Colorado State	Snowmass	26	11	32	22	23	108	92	97	93	100
Colorado State	Denali	--	14	35	25	--	--	117	106	107	--
Westbred	Winterhawk	24	12	31	22	22	100	100	94	93	97
Average		24	12	33	23	23					

Grain Yields were adjusted to 12.0 % seed moisture content.

No wheat yields recorded for 2012 due to hail.

Dryland Winter Barley Variety Performance Trial, Walsh, 2014

COOPERATORS: Rubisco Seeds; Kevin Larson, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To evaluate winter barley varieties under dryland conditions in Southeastern Colorado.

RESULTS: Of the five winter barley varieties tested, only three produced measureable yields. Winter survival rates ranged from 22% to 61%. The two varieties that were not harvested for grain had winter survival rates of 22% to 26%. Two of the three winter barley varieties that were harvested had significant head drop, ranging from 14% for PST WB 8 to 30% for PST WB 8493. The winter barley variety with the highest grain yield was PST WB 8493, which produced 9.0 bu/a. The average grain yield of the three harvested winter barley varieties was 8.3 bu/a. As a comparison, the winter wheat yield from an adjacent variety trial, planted one day earlier than this barley study, averaged 33 bu/a.

PLOT: Twelve rows with 12 in. row spacing, 35 ft. long with 4 replications. SEEDING DENSITY: 58 lb/a. PLANTED: October 4, 2013. HARVESTED: July 7, 2014.
SITE PEST CONTROL: Ally Extra 0.4 oz/a, 2,4-D ester 0.38 lb/a, dicamba 1.5 oz/a, Activator 90 4 oz/a. INSECTICIDE: Lorsban for brown mites.
FIELD HISTORY: Last Crop: Wheat (Wheat-Fallow rotation).
FIELD PREPARATION: Sweep plow.

COMMENTS: Planted in adequate soil moisture for seed germination and stand establishment. The nine month growing season was dry from October through March and nearly average from April to June. Winter barley grain yields and test weights were low.

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

Table. Precipitation: October 2013 to June 2014.

	--------------Monthly Total Preciptation (inches)------------									
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	**Total**
Precipitation	0.56	0.73	0.03	0.27	0.34	0.41	1.26	2.23	2.05	**7.88**

Table .Dryland Winter Barley Cultivar Performance Trial, Walsh, 2014.

Cultivar	Grain Yield	Test Weight	Grain Moisture	Head Drop	Winter Survival	Plant Height
	bu/acre	lb/bu	%	%	%	in
PST WB 8493	9.0	43.5	12.7	30	61	17
PST WB 8	7.9	41.5	13.4	14	51	19
PST WB 9	7.9	42.0	12.6	2	45	20
PST WB 7	--	--	--	1	26	18
PST WB 7541	--	--	--	0	22	18
Average	8.3	42.3	12.9	9	41	18
LSD 0.20	6.29			1.8	29.0	

Planted: October 4, 2013; Harvested: July 7, 2014.
Grain yield adjusted to 13% moisture content and 48 lb/bu test weight.

Weed Control Efficacy of Huskie Rates in Grain Sorghum at Walsh, 2014

COOPERATORS: Bayer CropScience; Kevin Larson, PRC, Walsh, Colorado.

PURPOSE: To evaluate Huskie for post emergence weed control in grain sorghum.
RESULTS: The 13 to 16 oz/a rates of Huskie provided 93% to 100% control of pigweed, Russian thistle, kochia, and devil's claw compared to the untreated control. The 12 oz/a Huskie rate resulted in significantly less kochia control than the 13 to 16 oz/a rates of Hukie. The 13 to 16 oz/a Huskie rates, but not the 12 oz/a rate, produced significantly more yield than the control. The yield results of the Huskie rates correspond to the labeled rates (the labeled rates of Huskie on grain sorghum are 12.8 to 16 oz/a). Huskie treatments caused slight crop injury (bleaching of leaves) but the effects were hardly discernible 17 days after treatment. No seed damage was noted by the Huskie rates. The atrazine, dicamba, 2,4-D, crop oil mix produced the least yield and was significantly less than the 13 to 16 oz/a Huskie rates, and was not significantly different than the untreated control.

PLOT: Eight rows with 30 in. row spacing, 1000 ft. long with 3 replications.
SEEDING DENSITY: 32,000 seeds/a.
PLANTED: June 6. HYBRID: Mycogen 627. HARVESTED: November 5, 2014.
SITE PEST CONTROL: Dual II Magnum 12 oz/a, atrazine 0.5/a. CULTIVATION: None. INSECTICIDE: None.

TREATMENT APPLICATION: Covered 20 ft. sprayer at 40 psi and 12.5 gal/a. All treatments applied July 8, grain sorghum 11 in. tall with 6 leaves. Russian thistle, 5 in. tall, 5% coverage; kochia, 5 in. tall, 2% coverage; devil's claw, 5 in. tall, 2% coverage; pigweed 10 to 24 in. tall, 8% coverage.

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------No. of Days--------		
June	2.05	554	14	1	24
July	2.14	832	19	11	55
August	1.98	832	23	2	86
September	2.10	555	6	1	116
October	1.27	347	0	0	147
Total	10.03	3120	63	15	147

\1 Growing season from June 6 (planting) to October 31 (first freeze, 29 F)
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

FIELD HISTORY: Last Crop: Wheat. FIELD PREPARATION: Strip-till.
COMMENTS: Planted in adequate soil moisture for seed germination and stand establishment. The growing season was nearly average and rains were generally well timed. Grain yields and test weights were good.

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

Table .--Huskie on Grain Sorghum, Grain Yield and Test Weight,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	Seed Moisture %	Test Weight lb/bu	Grain Yield bu/a
1 Untreated			13.1	61.7	28.1 b
2 Huskie	12	oz/a	13.2	61.7	33.1 ab
2 Atrazine	24	oz/a			
2 Activator 90	0.25	% v/v			
2 Ammonium Sulfate	1	lb/a			
3 Huskie	13	oz/a	13.1	62.5	35.6 a
3 Atrazine	24	oz/a			
3 Activator 90	0.25	% v/v			
3 Ammonium Sulfate	1	lb/a			
4 Huskie	14	oz/a	13.1	62.3	37.3 a
4 Atrazine	24	oz/a			
4 Activator 90	0.25	% v/v			
4 Ammonium Sulfate	1	lb/a			
5 Huskie	15	oz/a	13.1	62.3	39.2 a
5 Atrazine	24	oz/a			
5 Activator 90	0.25	% v/v			
5 Ammonium Sulfate	1	lb/a			
6 Huskie	16	oz/a	13.0	61.3	37.1 a
6 Atrazine	24	oz/a			
6 Activator 90	0.25	% v/v			
6 Ammonium Sulfate	1	lb/a			
7 Atrazine	24	oz/a	13.1	62.0	27.2 b
7 Banvel	3	oz/a			
7 2,4-D ester	3	oz/a			
7 Crop Oil	1	qt/a			
Average			13.1	62.0	33.9
LSD 0.05					6.24

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a.
Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Table .--Huskie on Grain Sorghum, Crop Injury,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	3 DAT Crop Injury %	17 DAT Crop Injury %
1 Untreated			0.0	0.0
2 Huskie	12	oz/a	8.7	0.3
2 Atrazine	24	oz/a		
2 Activator 90	0.25	% v/v		
2 Ammonium Sulfate	1	lb/a		
3 Huskie	13	oz/a	10.0	1.3
3 Atrazine	24	oz/a		
3 Activator 90	0.25	% v/v		
3 Ammonium Sulfate	1	lb/a		
4 Huskie	14	oz/a	10.0	0.7
4 Atrazine	24	oz/a		
4 Activator 90	0.25	% v/v		
4 Ammonium Sulfate	1	lb/a		
5 Huskie	15	oz/a	10.0	1.3
5 Atrazine	24	oz/a		
5 Activator 90	0.25	% v/v		
5 Ammonium Sulfate	1	lb/a		
6 Huskie	16	oz/a	10.0	1.7
6 Atrazine	24	oz/a		
6 Activator 90	0.25	% v/v		
6 Ammonium Sulfate	1	lb/a		
7 Atrazine	24	oz/a	11.3	8.7
7 Banvel	3	oz/a		
7 2,4-D ester	3	oz/a		
7 Crop Oil	1	qt/a		
Average			8.6	2.0
LSD 0.05			1.05	1.35

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a. Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Table .--Huskie on Grain Sorghum, Kochia Control,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	8 DAT Kochia Control %	28 DAT Kochia Control %
1 Untreated			0.0	0.0
2 Huskie	12	oz/a	85.0	78.3
2 Atrazine	24	oz/a		
2 Activator 90	0.25	% v/v		
2 Ammonium Sulfate	1	lb/a		
3 Huskie	13	oz/a	91.7	93.3
3 Atrazine	24	oz/a		
3 Activator 90	0.25	% v/v		
3 Ammonium Sulfate	1	lb/a		
4 Huskie	14	oz/a	88.3	95.0
4 Atrazine	24	oz/a		
4 Activator 90	0.25	% v/v		
4 Ammonium Sulfate	1	lb/a		
5 Huskie	15	oz/a	98.3	96.7
5 Atrazine	24	oz/a		
5 Activator 90	0.25	% v/v		
5 Ammonium Sulfate	1	lb/a		
6 Huskie	16	oz/a	96.0	100.0
6 Atrazine	24	oz/a		
6 Activator 90	0.25	% v/v		
6 Ammonium Sulfate	1	lb/a		
7 Atrazine	24	oz/a	65.0	66.7
7 Banvel	3	oz/a		
7 2,4-D ester	3	oz/a		
7 Crop Oil	1	qt/a		
Average			74.9	75.7
LSD 0.05			5.42	9.64

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a.
Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Table .--Huskie on Grain Sorghum, Pigweed Control,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	8 DAT Pigweed Control %	28 DAT Pigweed Control %
1 Untreated			0.0	0.0
2 Huskie	12	oz/a	91.7	96.7
2 Atrazine	24	oz/a		
2 Activator 90	0.25	% v/v		
2 Ammonium Sulfate	1	lb/a		
3 Huskie	13	oz/a	91.7	96.7
3 Atrazine	24	oz/a		
3 Activator 90	0.25	% v/v		
3 Ammonium Sulfate	1	lb/a		
4 Huskie	14	oz/a	91.7	98.3
4 Atrazine	24	oz/a		
4 Activator 90	0.25	% v/v		
4 Ammonium Sulfate	1	lb/a		
5 Huskie	15	oz/a	97.7	99.3
5 Atrazine	24	oz/a		
5 Activator 90	0.25	% v/v		
5 Ammonium Sulfate	1	lb/a		
6 Huskie	16	oz/a	96.0	100.0
6 Atrazine	24	oz/a		
6 Activator 90	0.25	% v/v		
6 Ammonium Sulfate	1	lb/a		
7 Atrazine	24	oz/a	76.7	60.0
7 Banvel	3	oz/a		
7 2,4-D ester	3	oz/a		
7 Crop Oil	1	qt/a		
Average			77.9	78.7
LSD 0.05			4.54	5.90

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a.
Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Table .--Huskie on Grain Sorghum, Russian Thistle Control,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	8 DAT Russian Thistle Control %	28 DAT Russian Thistle Control %
1 Untreated			0.0	0.0
2 Huskie	12	oz/a	100.0	100.0
2 Atrazine	24	oz/a		
2 Activator 90	0.25	% v/v		
2 Ammonium Sulfate	1	lb/a		
3 Huskie	13	oz/a	100.0	100.0
3 Atrazine	24	oz/a		
3 Activator 90	0.25	% v/v		
3 Ammonium Sulfate	1	lb/a		
4 Huskie	14	oz/a	100.0	100.0
4 Atrazine	24	oz/a		
4 Activator 90	0.25	% v/v		
4 Ammonium Sulfate	1	lb/a		
5 Huskie	15	oz/a	100.0	100.0
5 Atrazine	24	oz/a		
5 Activator 90	0.25	% v/v		
5 Ammonium Sulfate	1	lb/a		
6 Huskie	16	oz/a	100.0	100.0
6 Atrazine	24	oz/a		
6 Activator 90	0.25	% v/v		
6 Ammonium Sulfate	1	lb/a		
7 Atrazine	24	oz/a	88.0	90.0
7 Banvel	3	oz/a		
7 2,4-D ester	3	oz/a		
7 Crop Oil	1	qt/a		
Average			84.0	84.3
LSD 0.05			1.94	3.36

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a.
Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Table .--Huskie on Grain Sorghum, Devil's Claw Control,
Plainsman Research Center, Walsh, Colorado, 2014.

Treatment	Product Dosage	Dosage Unit	8 DAT Devil's Claw Control %	28 DAT Devil's Claw Control %
1 Untreated			0.0	0.0
2 Huskie	12	oz/a	100.0	100.0
2 Atrazine	24	oz/a		
2 Activator 90	0.25	% v/v		
2 Ammonium Sulfate	1	lb/a		
3 Huskie	13	oz/a	100.0	100.0
3 Atrazine	24	oz/a		
3 Activator 90	0.25	% v/v		
3 Ammonium Sulfate	1	lb/a		
4 Huskie	14	oz/a	100.0	100.0
4 Atrazine	24	oz/a		
4 Activator 90	0.25	% v/v		
4 Ammonium Sulfate	1	lb/a		
5 Huskie	15	oz/a	100.0	100.0
5 Atrazine	24	oz/a		
5 Activator 90	0.25	% v/v		
5 Ammonium Sulfate	1	lb/a		
6 Huskie	16	oz/a	100.0	100.0
6 Atrazine	24	oz/a		
6 Activator 90	0.25	% v/v		
6 Ammonium Sulfate	1	lb/a		
7 Atrazine	24	oz/a	96.7	100.0
7 Banvel	3	oz/a		
7 2,4-D ester	3	oz/a		
7 Crop Oil	1	qt/a		
Average			85.2	85.7
LSD 0.05			3.88	0.78

Planted: June 6, 2014, grain sorghum hybrid: Mycogen 627 at 32,000 seeds/a.
Treatments applied: July 8, 2014, 20 ft. by 1000 ft. with 3 replications. Grain sorghum: 6 leaves, 11 in. tall; Russian thistle: 5 in. tall, 5% coverage; kochia: 5 in. tall, 2% coverage; devil's claw: 5 in. tall, 2% coverage; pigweed: 10 to 24 in. tall, 8% coverage.

Dryland Grain Sorghum Seeding Rates, Walsh, 2014

Brett Pettinger and Kevin Larson

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

Materials and Methods

Field preparation consisted of an early spring strip till application of 50 pounds nitrogen per acre via anhydrous ammonia and 5 gallons 10-34-0 per acre. Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The study was planted on May 28, 2014 using an 8R30 John Deere 7300 vacuum planter equipped with sixty cell Precision Planting seed plates. An early maturing hybrid, Mycogen 1G557, was selected and five different seeding rates: 24.6, 29.7, 35.8, 44.4 and 53.7 seeds/a X 1000 were tested. Two randomized replications were laid out using eight row strips of greater than 1200 feet in length. Tractor speed at planting was held to a constant 4.2 MPH using consistent engine rpm and gear selection. Stand counts were taken on June 20, 2014. A .002 acre area was used for stand counts which consisted of equal length observations in planter rows 2 and 5 for replication number one and planter rows 4 and 7 for the second replication. A post emergence herbicide application was done using Huskie, 2-4-D and Atrazine. A late season application of glyphosate was applied with a hooded sprayer just prior to boot stage for control of sandbur. Observations were taken to determine the average date of 50% flowering in each treatment in August 2014. The study was harvested October 30, 2014 using a self propelled combine and weigh cart with yields being adjusted to 14% moisture.

Results and Discussion

Extremely well timed moisture events made for very ideal growing conditions for grain sorghum. Yields in this study ranged from 61.2 to 65.3 bushels per acre. Figure 1 illustrates a highly significant linear trend for increased yields as seeding rate is increased. We found no differences in maturation across all treatments in this study. This observation contrasts previous non-singulated studies, which found a relationship of decreasing time of maturation as seeding rate was increased. (Larson and Pettinger 2012, 2013) The absence of a trend for maturation time to seeding rate could however, require additional studies to justify. The late season application of glyphosate applied with the hooded sprayer caused slight leaf desiccation, which affected the crop canopy and may have hindered the production of late season tillers. This crop damage was solely a visual observation and includes canopy comparison to adjacent fields under similar management that did not receive the late herbicide application. Obviously, damage to this crop was only minor given the tremendous yields.

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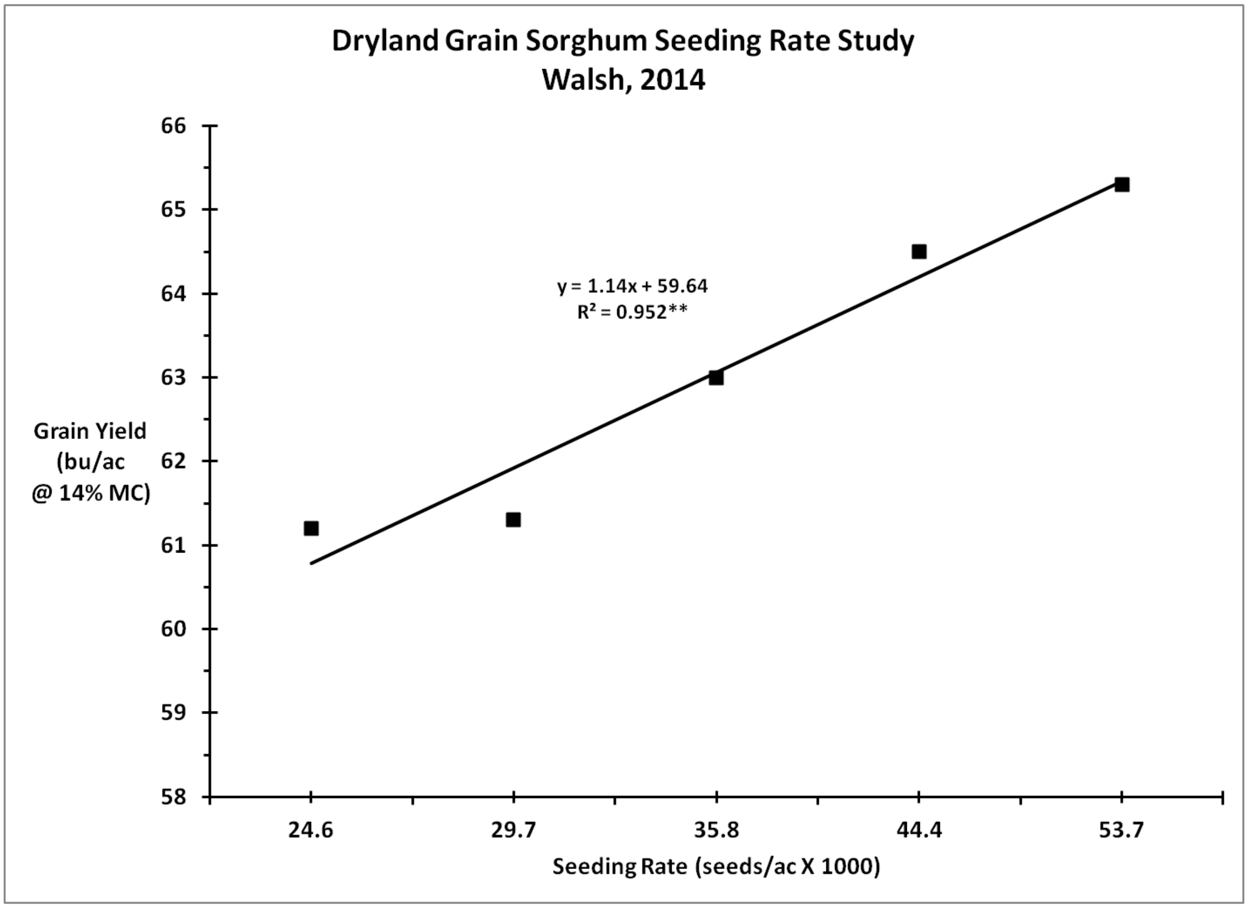


Figure 1-Yield relationship observed in dryland grain sorghum as seeding rate increased. The seeding rates were: 24.6, 29.7, 35.8, 44.4 and 53.7 seeds/acre X 1000. The grain sorghum hybrid was Mycogen 1G557.

Table 1.-Seeding Density, Plant Stand and Emergence of Dryland Grain Sorghum at Walsh, 2014.

Seeding Density	Plant Stand	Emergence
Seeds/Acre	Plants/Acre	Percent
24600	22750	92
29700	28000	94
35800	33000	92
44400	40250	91
53700	47500	88

Plant stands counted on June 20, 2014.

Effects of Planting Speed on Dryland Grain Sorghum Production

Brett Pettinger and Kevin Larson

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

Materials and Methods

John Deere and Precision Planting meters were cleaned and calibrated on a MeterMax test stand using Mycogen 1G557 hybrid seed (13,150 seeds per pound) to determine optimum vacuum setting for each system. Seed plates for both systems were sprayed with graphite lubricant per manufacturer's recommendations. Precision "WaveVision" sensors were installed on the station's 8 row John Deere 7300 planter, coupled with a 20/20 seed sense monitor for meter evaluation. The planter's ground drive transmission chart was modified in effort to keep planting population as close as possible between the two planting systems given the difference in number of cells on the plates (45 John Deere, 60 Precision Planting). A two replication, large plot was designed using eight row strips of 1199 feet in length. Speed categories of 4.5, 5, 5.5, 6, 6.5 and 7 mph were set to be tested. A chart was made for the operator, showing tractor gear range and rpm setting for each speed category to maximize testing accuracy.

Field preparation consisted of early spring strip-till application of 50 pounds nitrogen per acre via anhydrous ammonia and 5 gallons 10-34-0 per acre. Pre-plant herbicide applications consisted of Dicamba, Atrazine, Metolachlor, 2-4-D and Glyphosate. The study was planted on June 4, 2014 using Mycogen 1G557 grain sorghum hybrid. Standard talc was used for seed lubricant on John Deere vac meters, while an 80/20 Talc-Graphite mix was used for Precision Planting meters per manufacturer's recommendation. Vacuum settings were approximately 11 psi for Precision Planting and 6 psi for John Deere systems respectively. Due to differences in meter performance and planter transmission settings, seed populations were slightly different. Seeded populations were approximately 30,900 seeds/acre with Precision Planting versus 34,000 seeds/acre for John Deere. Stand were taken on June 25, 2014. For stand counts, one 0.005 acre sample was taken per treatment per replication. A post emergence herbicide application was done consisting of Huskie, 2-4-D and Atrazine.

Results and Discussion

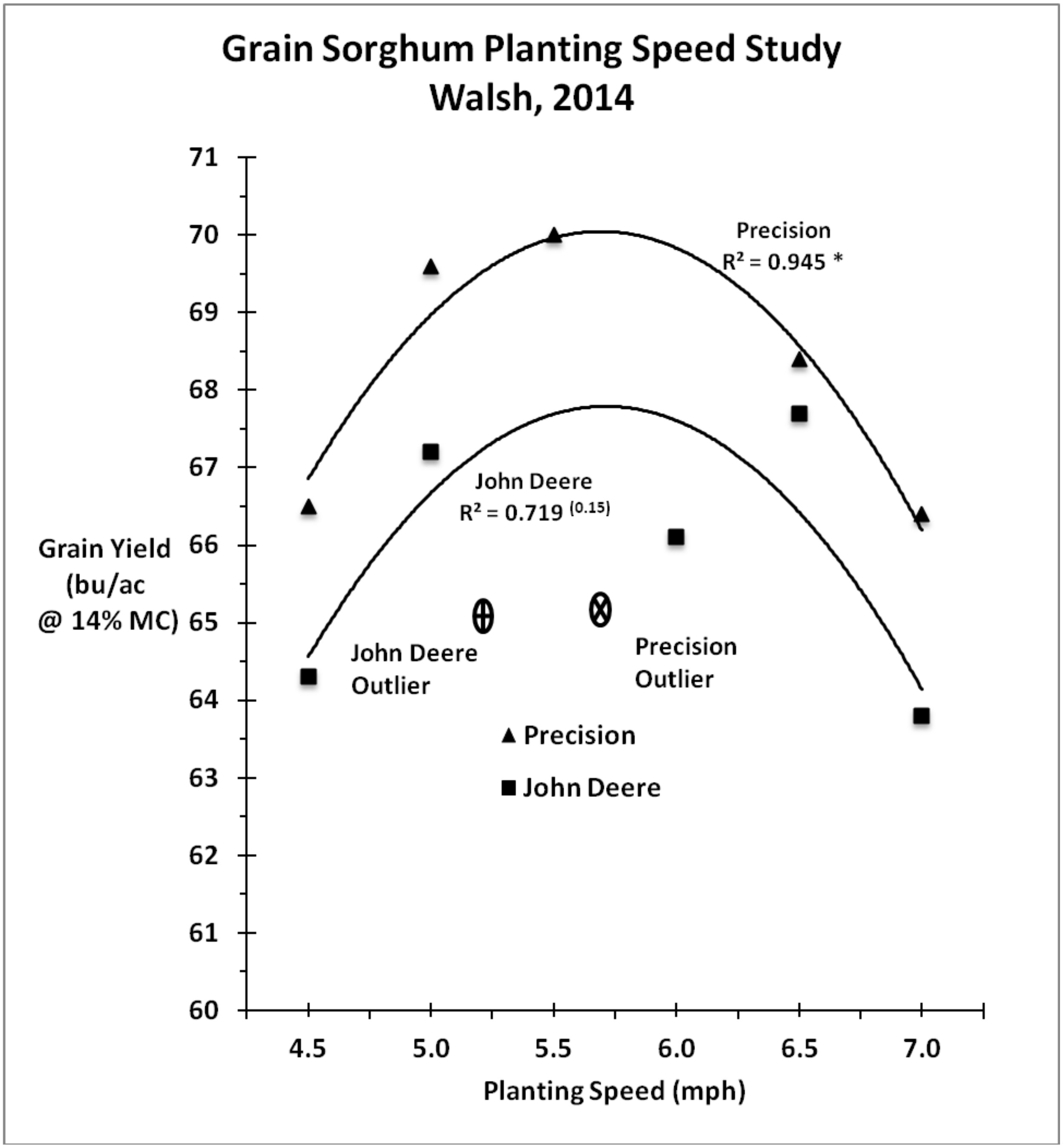
Timely moisture events during the growing season led to exceptional yields. The entire study averaged just over 67 bushels per acre. Statistical analysis for both planting systems produced an optimum yield between 5.5 and 6 mph planting speeds. While yields for both planting systems followed a similar trend, yields for Precision Planting averaged slightly higher than John Deere by approximately 2 bushels per acre across all planting speeds. Sensory data retrieved from the planter monitor revealed detailed singulation based upon the number of skips and doubles as well as SRI (Seed Release Index). Seed Release Index is an indication of how many seeds in a normal distribution are within one standard deviation of the target seed spacing. An example of a 14 SRI would explain that approximately 68% of seeds were placed within 14% of the target spacing. As the SRI number increases, the consistency and accuracy of seed placement drops.

The Precision Planting meters achieved their highest singulation (99.4%) and lowest SRI (14.16) at the 4.5 mph planting speed. As a general trend, Precision Planting meters experienced slightly increased levels of skips (0.414% to 0.63%), decreased singulation (99.4% to 99.181%) and increased SRI levels (14.16 to 18.59) as planting speed increased. The percentage of doubles exhibited by the Precision Planting meters showed less consistency in relation to speed as they varied from 0.162% to 0.232%, with the lowest number of occurrences happening at the 6.5 mph speed category. Singulation percentage for the John Deere meters peaked at the 7 mph category (98.417%) but showed relatively low variation (98.289% to 98.417%) across all speeds. The occurrence of skips on John Deere meters was minimized at 5.5 mph (0.256%) while having the highest occurrence (0.463%) at 7 mph. The occurrence of doubles on the John Deere meters trended slightly lower as speed was increased (1.256%) at 4.5 mph to (1.133%) at 7 mph.. Seed Release Index for the John Deere Meters negatively impacted seed placement as speed increased (17.13 to 20.75) from 4.5 to 7 mph.

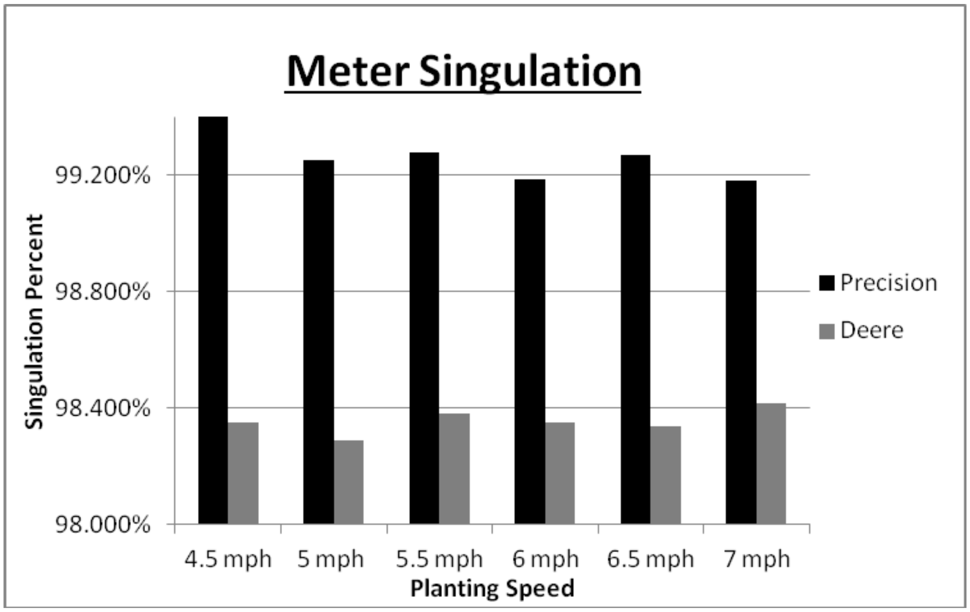
The results were surprising as our research team certainly believed there would be a consistent, negative impact on yield as speed was increased. Certainly, there is not sufficient evidence in singulation or seed release index that would support lower yields at the 4.5 and 5.0 mph speed categories. However, because both Precision Planting and John Deere systems produced lower yields at slower speeds, we can theorize that the difference must come from the planter itself. Further studies would be needed to prove or disprove yield drag at lower speeds. At speeds from 5.5 to 7 mph, the negative relationship to yield as planting speed increases can be supported by the declining performance of consistent seed placement of the Seed Release Index.

A 2014 seeding rate study conducted on an adjacent field using the same hybrid variety showed a positive linear trend in yield versus increased seeding rate. (Pettinger and Larson, 2014) The fact that Precision Planting yields were approximately 2 bushels higher across all speeds, despite being planted at a lower seeding rate (30,900 seeds versus 34,000 seeds) suggests that singulation and seed spacing have a strong impact on the yield of early maturing grain sorghum hybrids.

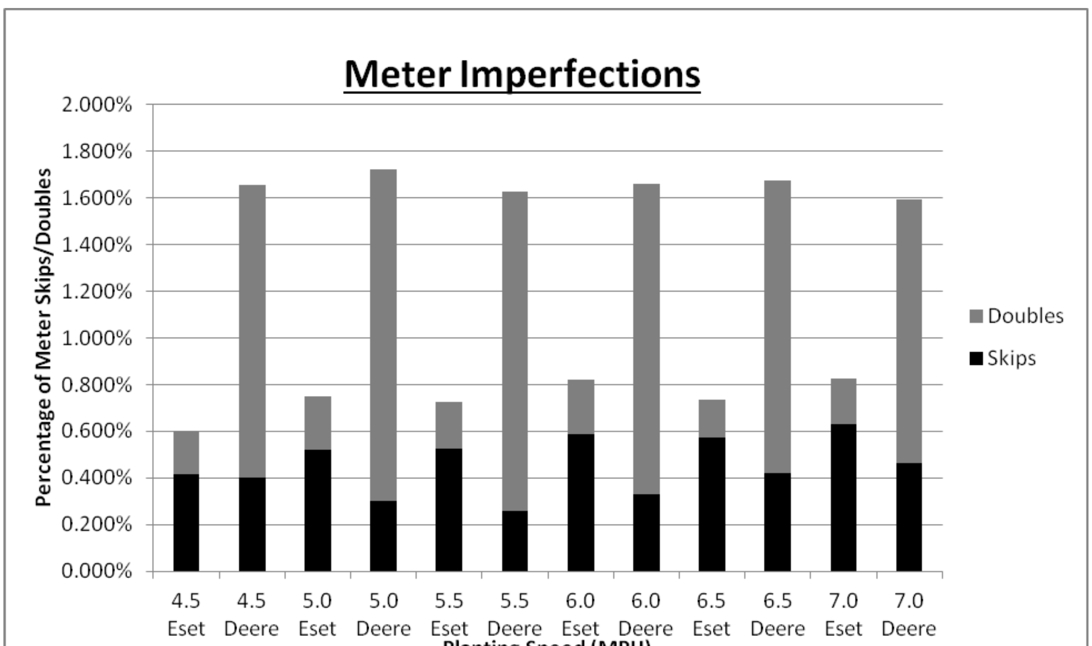
Reference Cited
Pettinger, B., K. Larson. 2014. “Dryland Grain Sorghum Seeding Rate.” Technical Report, TR-15-2. Colorado Agricultural Experiment Station, CSU.



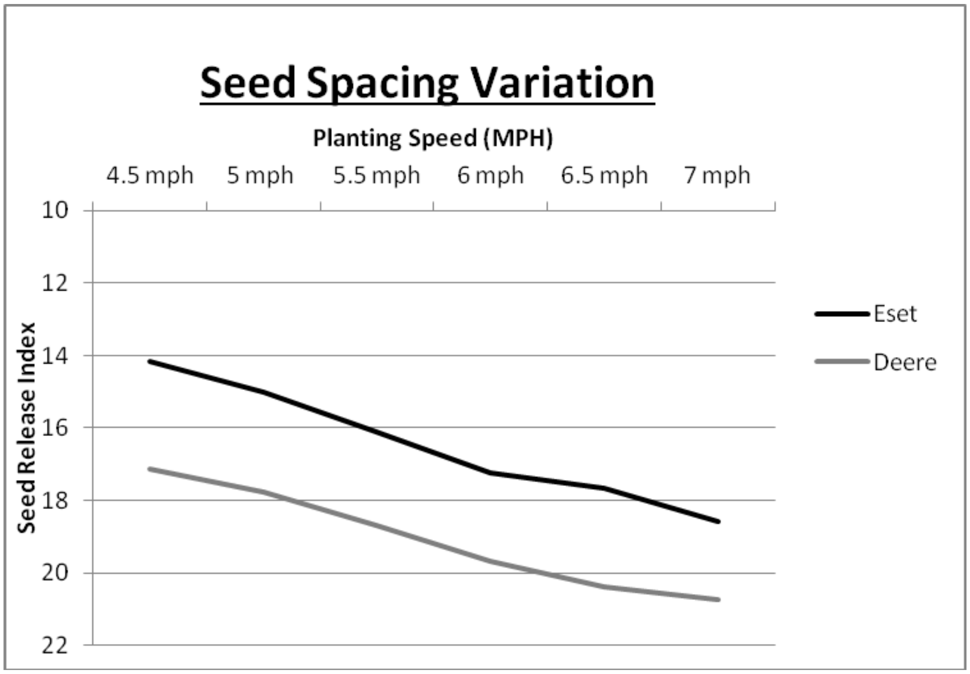
Graph 1: Yield comparison of Precision Planting and John Deere seeding systems in dryland grain sorghum (PRC, Walsh, CO) at speeds of 4.5, 5.0, 5.5, 6.0, 6.5 and 7.0 MPH.



Graph 2: Singulation performance of John Deere and Precision Planting seeding systems. Singulation is achieved by dropping one seed off the seed disk per hole. Data was taken when planting Grain Sorghum at 4.5, 5.0, 5.5, 6.0, 6.5 and 7.0 MPH.



Graph 3: Proportion of skips and doubles observed as a percentage of seeds planted using Precision Planting and John Deere sorghum seeding systems. Doubles and skips are the only two variables in calculating singulation. Data was taken from planting speeds of 4.5, 5.0, 5.5, 6.0, 6.5 and 7.0 MPH.



Graph 4: Differences in seed spacing between John Deere and Precision Planting sorghum seeding systems. Seed spacing is represented by the Seed Release Index (SRI). Lower SRI's translate to more precise, consistent spacing throughout the field. Data was taken at planting speeds of 4.5, 5.0, 5.5, 6.0, 6.5 and 7.0 MPH.

Population Counts

Plants Per Acre 6/25/14

Speed	Precision	Deere
4.5 mph	26000	25900
5 mph	26700	28700
5.5 mph	25800	29500
6 mph	27300	28600
6.5 mph	26400	28200
7 mph	25500	29500

	Singulation	**Skips**	**Doubles**	**SRI**
4.5 Eset	99.408%	0.414%	0.187%	14.155
4.5 Deere	98.353%	0.400%	1.256%	17.128
5.0 Eset	99.254%	0.520%	0.231%	14.996
5.0 Deere	98.289%	0.302%	1.420%	17.779
5.5 Eset	99.279%	0.526%	0.200%	16.091
5.5 Deere	98.382%	0.256%	1.370%	18.704
6.0 Eset	99.185%	0.589%	0.232%	17.236
6.0 Deere	98.351%	0.330%	1.330%	19.674
6.5 Eset	99.271%	0.573%	0.162%	17.661
6.5 Deere	98.339%	0.421%	1.253%	20.385
7.0 Eset	99.181%	0.630%	0.198%	18.594
7.0 Deere	98.417%	0.463%	1.133%	20.748

Twin Row and Single Row Comparison on Dryland Grain Sorghum

Kevin Larson and Brett Pettinger

Studies on row spacing have reported that narrow rows increased grain yield and reduced weed competition because of earlier canopy coverage (Larson and Thompson, 2001). However, narrow row spacing makes cultivation impractical and harvest of lodged tillers difficult. Twin row orientation may provide some the benefits of narrow row spacing (increased yield and earlier canopy coverage) while allowing row header harvesting of lodged tillers. We conducted this row orientation study to determine the potential yield effects of twin row planting compared to single row planting on dryland grain sorghum production.

Materials and Methods

We conducted this dryland grain sorghum study at Brandon, Colorado on a site in which the previous crop was sorghum. We planted Mycogen 1G577 at either 38,000 seeds/a or 55,000 seeds/a in single 30 in. rows and in twin rows spaced 7.5 in. apart and centered on 30 in. spacing on June 2, 2014 with a distributor cone planter. N fertilizer was applied at 50 lb/a to the site. For weed control, only post emergence herbicides were applied: Huskie 16 oz/a and atrazine 0.75 lb/a. We harvested the grain sorghum plots on November 14 with a self-propelled combine equipped with a digital scale. Grain samples were collected for seed moistures and test weights. Grain yields were adjusted to 14% seed moisture content.

Results and Discussion

The twin row at 55,000 seeds/a treatment produced significantly higher grain yield (at the 0.20 alpha level) than any of the other row orientation and seeding rate treatments. Flowering dates and seed maturation dates were the same or similar for the twin row and single row treatments and for the high (55,000 seeds/a) and low (38,000 seeds/a) seeding rates. Therefore, row orientation and seeding rate did not appear to influence maturation.

The grain sorghum in this study emerged before weeds could be controlled with broad spectrum herbicides. The post emergence application of Huskie and atrazine controlled some of the broadleaf weeds; however, many grass and broadleaf weeds remained. Since the highest grain yield was from twin row combined with a high seeding rate, the yield increase may be due to more rapid canopy coverage, which provided shade competition against the weeds.

Literature Cited

Larson, K. and C. Thompson. 2002. “Row spacing for dryland grain sorghum production for Southeastern Colorado,” pp: 47-50, in Plainsman Research Center 2001 Research Results. Colorado Agricultural Experiment Station, CSU.

Table .-Dryland Grain Sorghum Twin Row and Single Row Comparison,
Brandon, 2014.

Row Orientation	Row Spacing	Seeding Rate	Plant Density	Flowering Date	Maturation Date	Plant Ht.	Test Wt.	Grain Yield
	in	seeds/a (X1000)	plants/a (X1000)	DAP	DAP	in	lb/bu	bu/a
Twin	7.5 (30)	55.0	41.4	68	113	35	59	24.4
Single	30	55.0	36.0	68	114	34	59	21.9
Twin	7.5 (30)	38.0	30.3	68	113	33	59	21.3
Single	30	38.0	27.2	68	113	34	58	20.8
Average		46.5	33.7	68	113	34	59	22.1
LSD 0.20			3.86					1.80

Planted: June 2; Harvested: November 14, 2014.
Grain sorghum hybrid: Mycogen 1G557.
DAP is Days After Planting.
Row spacing: twin rows were spaced 7.5 in. apart and centered on 30 in. rows; single rows were spaced 30 in. apart.
Grain yields were adjusted to 14% seed moisture content.

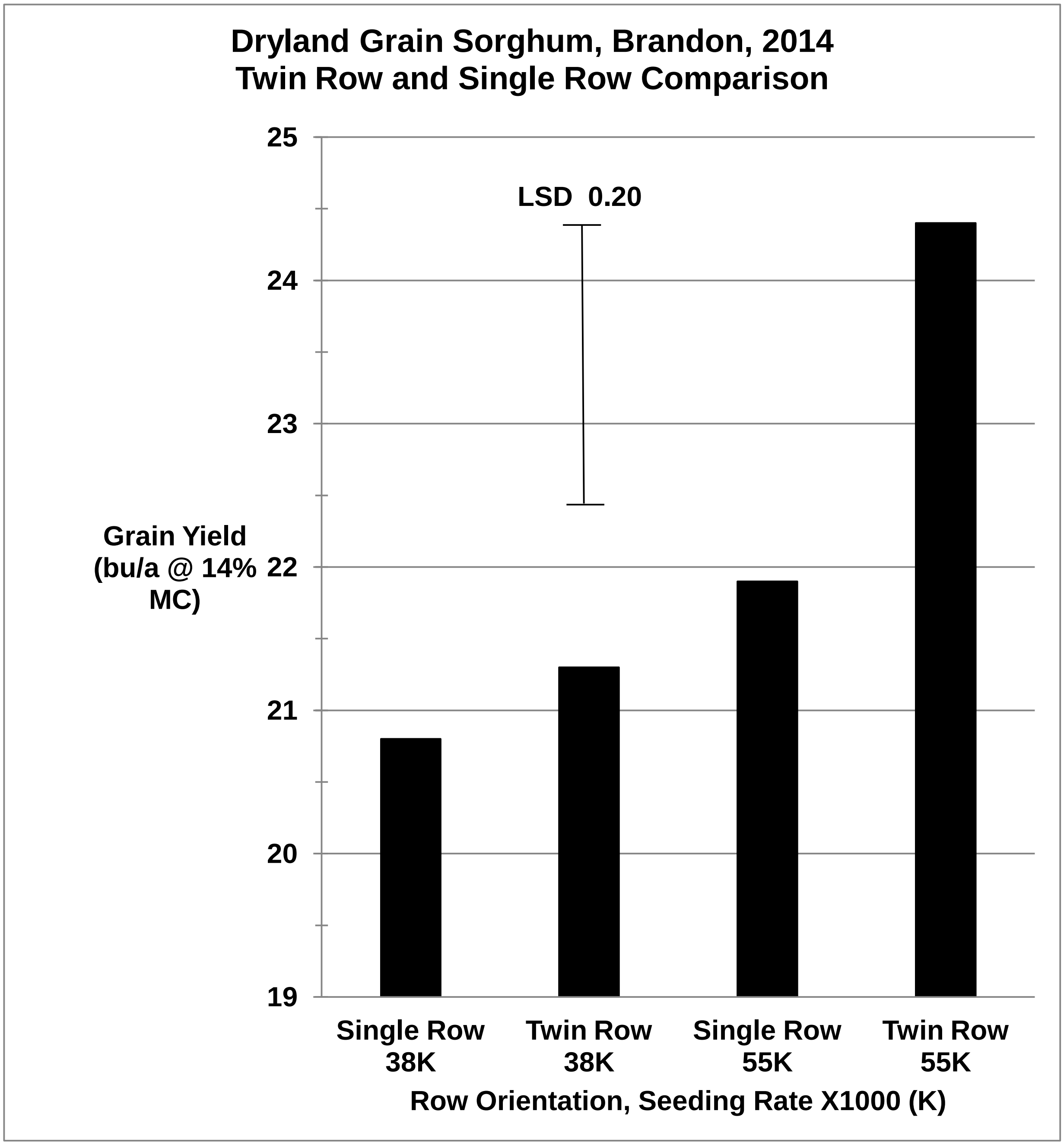


Fig. .Twin row and single row comparison with two seeding rates on dryland grain sorghum at Brandon. The twin row treatment was two rows 7.5 in. apart and centered on 30 in. spacing and the single row was spaced 30 in. apart. The seeding rates were 38 ,000 seeds/a and 55,000 seeds/a. . The sorghum hybrid was Mycogen 1G557.

Dryland Grain Sorghum Hybrid Performance Trial at Brandon, 2014

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2730 sorghum heat units in loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 43,600 seed/a. PLANTED: June 2. HARVESTED: November 14.

PEST CONTROL: Preemergence Herbicides: None. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a. Cultivation: None. Insecticides: None.
FIELD HISTORY: Previous Crop: Sorghum. FIELD PREPARATION: No-till.

Summary: Growing Season Precipitation and Temperature \1
Chivington, Kiowa County.

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
June	1.88	640	14	2	28
July	2.45	784	18	10	59
August	2.48	751	19	0	90
September	1.13	524	7	1	120
October	0.00	29	0	0	123
Total	7.94	2728	58	13	123

\1 Growing season from June 2 (planting) to October 3 (first freeze, 30 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in marginal soil moisture, but it rained shortly after planting. Weed control was poor with volunteer sorghum and kochia predominating (the crop emerged rapidly, which prevented preemergence herbicide application) . Precipitation for the growing season was about one inch below the average of the past 28 years. June was dry, but the rest of the monthly precipitation totals for the growing season were near their long term averages. No greenbug infestation. Yields and test weights were fair, especially considering the lack of early season precipitation and heavy weed pressure.
SOIL: Loam for 0-8” and loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.8	0.4	1.5	8	5.0	462	0.5	2.2
8”-24”				8				
Comment	Alka	VLo	Mod	Mod	Lo	VHi	Lo	Lo

Manganese and Copper levels were adequate.

Summary: Fertilization.

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

Yield Goal: 30 bu/a.
Actual Yield: 18 bu/a.

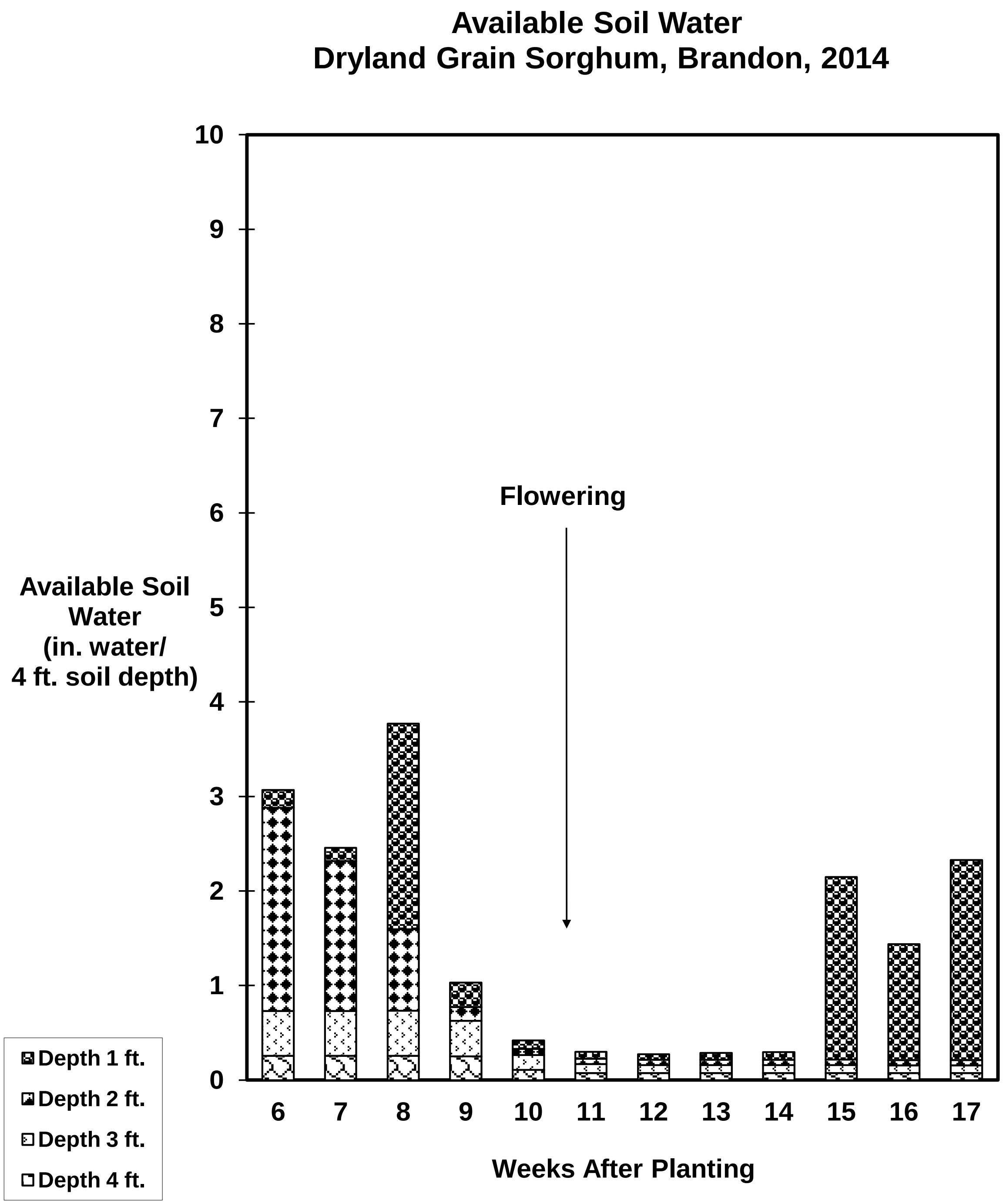


Fig. 1. Available soil water in dryland grain sorghum at Brandon. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Brandon from planting to first freeze was 7.94 in. Any increase in available soil water between weeks is from rain.

Table .--Dryland Grain Sorghum Hybrid Performance Trial at Brandon, 2014. \1

Brand	Hybrid	Grain Yield	Yield % of Test Average	Test Wt.	Plants Lodg.	Harvest Density	Plant Ht.	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group
		bu/a	%	lb/bu	%	plants/a (1000 X)	in				
ALTA	AG1201	24.6	135	60	35	26.7	32	71	1701	115	E
DEKALB	DKS28-05	22.4	123	59	49	27.7	33	71	1701	115	E
MYCOGEN SEEDS	1G557	17.0	93	58	48	24.8	32	67	1611	111	E
RICHARDSON SEEDS	99773	13.3	73	57	34	29.2	31	60	1442	106	E
ALTA	AG1101	13.0	71	58	49	26.1	35	65	1562	110	E
DEKALB	DKS29-28	12.9	71	60	69	26.9	30	69	1657	113	E
RICHARDSON SEEDS	91743	7.5	41	59	70	25.8	30	71	1701	115	E
MYCOGEN SEEDS	1G588	24.2	133	60	31	27.1	43	74	1781	117	ME
RICHARDSON SEEDS	11043	22.5	124	59	45	27.1	42	73	1756	117	ME
ALTA	AG1203	24.4	134	61	28	28.1	46	79	1917	123	M
Average		18.2		59	46	27.0	35	70	1683	114	ME
LSD 0.05		12.69			31.8						
LSD 0.20		7.87			20.4						

\1 Planted: June 2; Harvested: November 14, 2014.
Yields are adjusted to 14.0% seed moisture content.
DAP: Days After Planting.
GDD: Growing Degree Days for sorghum.

Table . Summary: Dryland Grain Sorghum Hybird Performance Trials at Brandon, 2012-2104.

			Grain Yield					Yield as % of Test Average				
		Maturity				2-Year	3-Year				2-Year	3-Year
Brand	Hybrid	Group[a]	2012	2013	2014	Avg	Avg	2012	2013	2014	Avg	Avg
Alta	AG1101	E	--	17	13	15	--	--	119	71	88	--
Alta	AG1201	E	--	17	25	21	--	--	114	135	124	--
Dekalb	DKS29-28	E	45	24	13	19	27	133	166	71	109	124
Dekalb	DKS28-05	E	40	12	22	17	25	118	84	123	100	112
Mycogen Seeds	1G557	E	45	18	17	18	27	131	124	93	103	121
Average			**34**	**15**	**18**	**17**	**22**					

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

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2014

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

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

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 43,600 seed/a. PLANTED: May 30. HARVESTED: November 5.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, Medal 21 oz/a, Glyphosate, 32 oz/a; 2,4-D, 0.5 lb/a, Banvel 4 oz/a. Post Emergence Herbicides: Huskie 12 oz/a, 2,4-D 3.0 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

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

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
May	0.49	48	1	0	2
June	2.05	690	16	1	32
July	2.14	832	19	11	63
August	1.98	832	23	2	94
September	2.10	555	6	1	124
October	1.27	347	0	0	155
Total	10.03	3304	65	15	155

\1 Growing season from May 30 (planting) to October 31 (first freeze, 29 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in adequate soil moisture. Weed control was excellent. No greenbug infestation. The growing season precipitation was nearly average and generally well timed. Very long growing season with the first freeze date on October 31. Grain yields and test weights were very 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	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.9	0.6	1.5	20	7.0	395	0.7	2.7
8”-24”				17				
Comment	Alka	VLo	Mod	Hi	Lo	VHi	Lo	Lo

Manganese and Copper levels were adequate.

Summary: Fertilization.

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

Yield Goal: 40 bu/a.
Actual Yield: 48 bu/a.

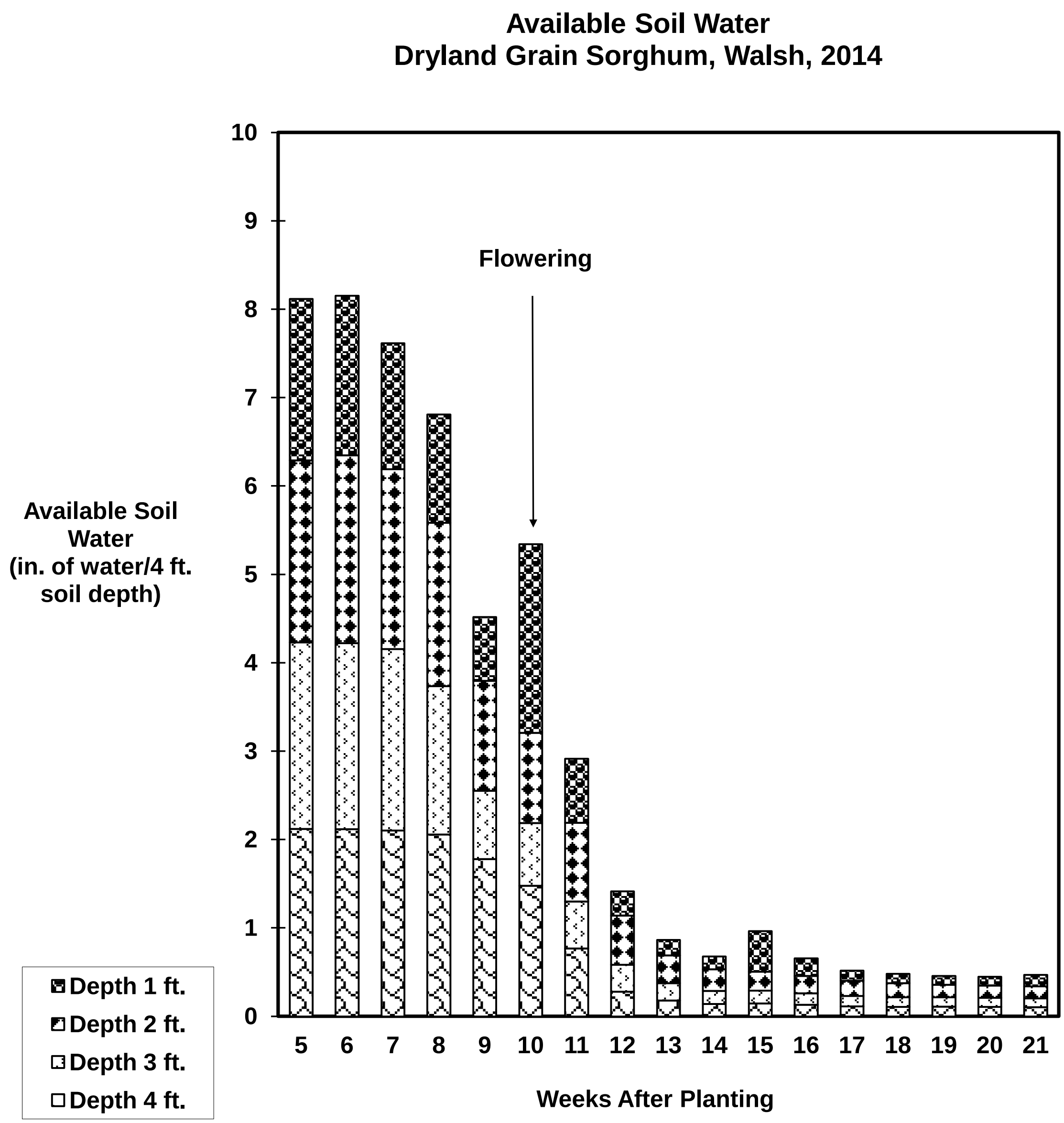


Fig. 2. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 10.03 in. Any increase in available soil water between weeks is from rain.

Table .--Dryland Grain Sorghum Hybrid Performance Test at Walsh, 2014. \1

Brand	Hybrid	Grain Yield	Yield % of Test Average	Test Wt.	Harvest Density	Plant Ht.	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group
		bu/a	%	lb/bu	plants/a (1000 X)	in				
RICHARDSON SEEDS	11043	55.0	114	61	29.0	42	69	1724	112	E
ALTA	AG1201	54.8	114	61	25.6	36	68	1696	112	E
RICHARDSON SEEDS	91743	48.7	101	61	27.3	46	67	1668	109	E
SORGHUM PARTNERS	SP3425	46.0	95	62	31.6	36	69	1724	114	E
ALTA	AG1101	43.7	91	60	27.5	36	65	1615	108	E
DYNA-GRO SEED	M71GB01	36.1	75	59	31.8	39	62	1539	103	E
RICHARDSON SEEDS	99773	33.8	70	60	30.0	37	61	1522	101	E
SORGHUM PARTNERS	251	28.0	58	60	26.3	34	64	1589	104	E
DEKALB	DKS38-88	68.3	142	63	30.6	45	75	1883	121	ME
DYNA-GRO SEED	GX13501	55.7	116	61	23.4	44	71	1779	115	ME
DYNA-GRO SEED	722B	50.5	105	60	26.5	33	73	1825	118	ME
SORGHUM PARTNERS	SP3303	45.8	95	63	25.9	40	72	1802	118	ME
SORGHUM PARTNERS	KS310	39.4	82	63	27.5	38	72	1802	117	ME
DEKALB	DKS44-20	63.6	132	62	28.9	41	80	2032	125	M
ALTA	AG1203	53.5	111	62	28.9	42	79	2001	122	M
DYNA-GRO SEED	GX13231	52.6	109	62	25.6	39	79	2001	123	M
DYNA-GRO SEED	766B	51.3	106	53	25.2	41	78	1968	122	M
DYNA-GRO SEED	M72GW14	40.7	84	60	25.2	43	81	2063	128	M
Average		48.2		61	27.6	40	71	1791	115	ME
LSD 0.05		14.66								
LSD 0.20		9.48								

\1 Planted: May 30; Harvested: November 5, 2014.
Yields are adjusted to 14.0% seed moisture content.
DAP: Days After Planting.
GDD: Growing Degree Days for sorghum.

Table . Summary: Dryland Grain Sorghum Hybrid Performance Trials at Walsh, 2012-2014.

			-------------Grain Yield--------------					---Yield as % of Test Average---				
		Maturity				2-Year	3-Year				2-Year	3-Year
Brand	Hybrid	Group[a]	2012	2013	2014	Avg	Avg	2012	2013	2014	Avg	Avg
Alta	AG1101	E	--	3	44	24	--	--	71	91	87	--
Alta	AG1201	E	--	5	55	30	--	--	100	114	111	--
Dekalb	DKS44-20	ME	36	4	64	34	35	143	88	132	126	133
Dekalb	DKS38-88	ME	--	4	68	36	--	--	77	142	133	--
Sorghum Partners	KS310	ME	24	4	39	22	22	98	88	82	80	86
Sorghum Partners	251	E	18	6	28	17	17	74	119	58	63	67
Sorghum Partners	SP3303	E	--	5	46	26	--	--	94	95	94	--
Average			**25**	**5**	**48**	**27**	**26**					

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

Dryland Forage Sorghum Performance Trial at Walsh, 2014

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: May 30. HARVESTED: October 15.

PEST CONTROL: Preemergence Herbicides: Atrazine 1 lb/a, Glyphosate 32 oz/a, 2,4-D 0.5 lb/a, Dicamba 4 oz/a. Post Emergence Herbicides: Huskie 12 oz/a, 2,4-D 3.0 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

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

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
May	0.49	48	1	0	2
June	2.05	690	16	1	32
July	2.14	832	19	11	63
August	1.98	832	23	2	94
September	2.10	555	6	1	124
October	1.27	155	0	0	139
Total	10.03	3112	65	15	139

\1 Growing season from May 30 (planting) to October 15 (harvest).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in adequate soil moisture. Weed control was excellent. No greenbug infestation. The growing season precipitation was nearly average and generally well timed. Very long growing season with the first freeze date on October 31. Forage yields were very 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	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8"	7.9	0.6	1.5	20	7.0	395	0.7	2.7
8"-24"				17				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Lo	Lo

Manganese and Copper levels were adequate.

Summary: Fertilization.

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

Yield Goal: 8 tons/a.
Actual Yield: 13.2 tons/a.

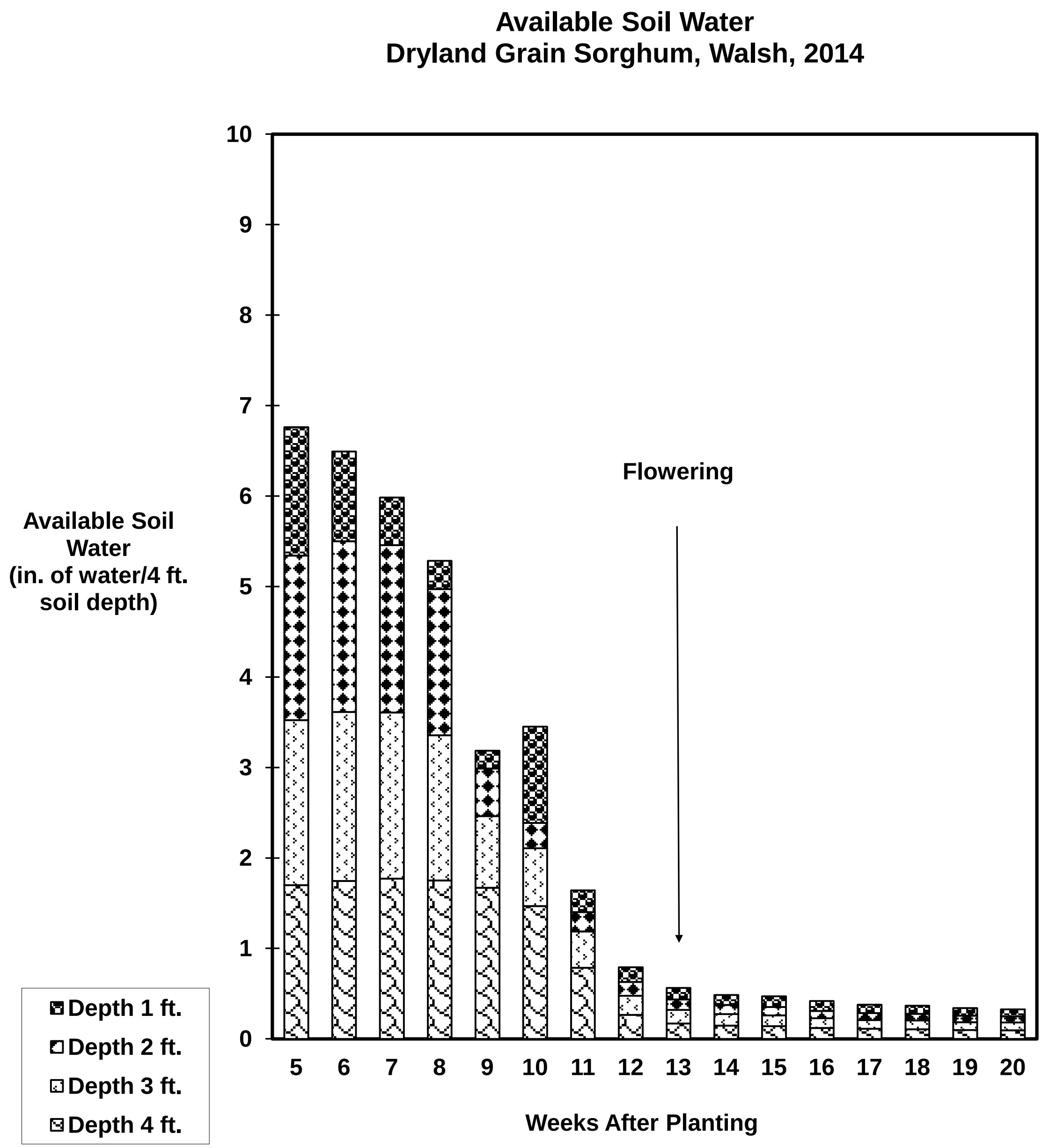


Fig. 3. Available soil water in dryland forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 10.03 in. Any increase in available soil water between weeks is from rain.

Table .--Dryland Forage Sorghum Hybrid Performance Trial at Walsh, 2014. \1

Brand	Hybrid	Forage Yield	Yield % of Test Avg.	Stem Sugar	Days to 50% Bloom	Harvest Density	Plant Ht.	Stage \3 at Harvest	Plant Ldg.	Forage Type \2
		tons/a	%	%		plants/a (1000 X)	in		%	
SORGHUM PARTNERS	SPX28313	18.1	137	6.5	113	41.6	70	MM	25	FS
GAYLAND WARD SEED	GW 400 BMR	16.8	127	17.3	77	42.2	64	MT	0	FS
SORGHUM PARTNERS	NK300	15.9	120	10.6	86	45.7	51	MT	0	FS
SORGHUM PARTNERS	SDH2942BMR	15.7	119	12.7	131	44.9	80	FL	0	SS
SORGHUM PARTNERS	SPX902	15.6	118	15.5	Veg	39.7	66	Veg	0	FS
SORGHUM PARTNERS	SPX904	15.5	118	11.6	Veg	42.0	65	Veg	0	FS
SORGHUM PARTNERS	X942	15.3	116	11.4	Veg	40.1	69	Veg	0	SS
SORGHUM PARTNERS	1990	14.7	112	13.2	Veg	36.0	63	Veg	0	FS
SORGHUM PARTNERS	Sordan Headless	14.4	109	16.7	132	46.5	73	FL	0	SS
SORGHUM PARTNERS	SD1741BMR	14.1	107	16.2	79	39.3	83	MT	0	SS
SORGHUM PARTNERS	SPX901	13.8	104	15.1	Veg	42.4	73	Veg	0	FS
GAYLAND WARD SEED	Super Sugar (sterile)	13.2	100	19.3	69	43.4	77	MT	0	SS
GAYLAND WARD SEED	GW 300 BMR	12.8	97	11.9	78	37.8	70	MT	0	SS
SORGHUM PARTNERS	Trudan Headless	12.8	97	13.3	Veg	41.4	65	Veg	0	SS
MYCOGEN	2Y767	12.5	95	16.4	75	23.6	54	HD	0	Corn
GAYLAND WARD SEED	Sweet Forever BMR	12.3	93	10.3	85	40.3	71	MM	0	SS
GAYLAND WARD SEED	Super Sugar	12.1	92	18.7	90	35.6	77	SD	0	SS
GAYLAND WARD SEED	GW 600 BMR	11.9	90	12.9	78	38.1	65	HD	0	FS
SORGHUM PARTNERS	SPX3903	11.5	87	17.2	112	41.4	66	MM	0	FS
SORGHUM PARTNERS	SPX903	11.2	85	10.4	Veg	45.5	66	Veg	0	FS
SORGHUM PARTNERS	SPX3952	11.0	83	13.7	79	45.7	61	MT	0	SS
SORGHUM PARTNERS	SS405	10.9	82	8.9	96	39.7	86	HD	30	FS
GAYLAND WARD SEED	Dwarf BMR 6	9.7	73	17.6	88	33.7	37	BT	0	FS
SORGHUM PARTNERS	SPX3902	9.5	72	21.7	86	37.0	45	PM	0	FS
GAYLAND WARD SEED	Sweet Six BMR	9.1	69	14.3	71	40.3	74	MT	0	SS
Average		13.2		14.1	90	40.2	67	MM	2	FS
LSD 0.20		3.30								

\1 Planted: May 30; Harvested: October 15.

\2 Forage Type: FS, Forage Sorghum; HS, Hybrid sudangrass; SS, Sorghum Sudangrass.

\3 Harvest Stage: Veg, vegetative; BT, boot; FL, flowering; PM, premilk; MM, midmilk; SD, soft dough; HD, hard dough; MT, mature.

Forage Yield adjusted to 70% moisture content based on oven-dried sample.

Table .--Dryland Forage Sorghum Hybrid Dry Matter Analysis at Walsh, 2014.

Brand	Hybrid	Forage Type \1	Days to Boot	Boot Plant Ht	CP	ADF	NDF	TDN	RFV	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				in	---------------	---%---	---	---	----------	-----MCal/lb-----		
SORGHUM PARTNERS	SPX28313	FS	97	54	15.4	29.5	59.5	68.9	103	0.73	0.45	0.71
GAYLAND WARD SEED	GW 400 BMR	FS	69	46	13.4	29.3	55.2	69.2	111	0.73	0.46	0.72
SORGHUM PARTNERS	NK300	FS	81	38	13.9	31.9	62.2	66.2	96	0.69	0.42	0.68
SORGHUM PARTNERS	SDH2942BMR	SS	122	73	10.6	29.4	53.4	69.0	115	0.73	0.45	0.71
SORGHUM PARTNERS	SPX902	FS	Veg	62	9.7	29.8	58.7	68.6	104	0.72	0.45	0.71
SORGHUM PARTNERS	SPX904	FS	Veg	57	10.5	29.8	58.9	68.6	104	0.72	0.45	0.71
SORGHUM PARTNERS	X942	SS	Veg	62	11.0	30.9	54.5	67.3	111	0.70	0.43	0.70
SORGHUM PARTNERS	1990	FS	Veg	59	11.4	30.0	59.2	68.3	103	0.72	0.45	0.71
SORGHUM PARTNERS	Sordan Headless	SS	123	63	11.2	29.0	55.9	69.5	110	0.74	0.46	0.72
SORGHUM PARTNERS	SD1741BMR	SS	70	55	14.8	30.4	60.3	67.9	101	0.71	0.44	0.70
SORGHUM PARTNERS	SPX901	FS	Veg	72	9.4	31.5	60.4	66.6	99	0.69	0.42	0.69
GAYLAND WARD SEED	Super Sugar (sterile)	SS	65	44	13.4	30.3	60.7	68.0	100	0.71	0.44	0.70
GAYLAND WARD SEED	GW 300 BMR	SS	71	56	14.7	31.9	62.1	66.2	96	0.69	0.42	0.68
SORGHUM PARTNERS	Trudan Headless	SS	Veg	70	9.6	29.7	52.0	68.7	118	0.72	0.45	0.71
MYCOGEN	2Y767	Corn	71	58	15.9	31.3	61.5	66.8	97	0.70	0.43	0.70
GAYLAND WARD SEED	Sweet Forever BMR	SS	77	59	14.3	30.4	59.8	67.9	101	0.71	0.44	0.70
GAYLAND WARD SEED	Super Sugar	SS	78	40	15.1	31.0	61.0	67.3	99	0.70	0.43	0.69
GAYLAND WARD SEED	GW 600 BMR	FS	71	48	15.4	29.3	58.9	69.1	104	0.73	0.46	0.72
SORGHUM PARTNERS	SPX3903	FS	102	42	17.1	28.1	58.0	70.5	108	0.75	0.47	0.73
SORGHUM PARTNERS	SPX903	FS	Veg	68	9.8	31.5	60.0	66.6	100	0.69	0.42	0.69
SORGHUM PARTNERS	SPX3952	SS	72	42	15.8	30.0	60.4	68.3	101	0.72	0.45	0.71
SORGHUM PARTNERS	SS405	FS	87	74	15.4	29.4	58.8	69.1	104	0.73	0.46	0.72
GAYLAND WARD SEED	Dwarf BMR 6	FS	83	37	15.4	27.6	56.4	71.1	111	0.76	0.48	0.74
SORGHUM PARTNERS	SPX3902	FS	79	38	14.6	29.9	57.1	68.4	107	0.72	0.45	0.71
GAYLAND WARD SEED	Sweet Six BMR	SS	64	46	14.7	27.5	54.8	71.2	114	0.76	0.48	0.74
Sorghum Average		FS	82	55	13.3	30.0	58.4	68.4	105	0.72	0.45	0.71

\1 Forage Type: FS, Forage Sorghum; SS, Sorghum Sudangrass.

Infrared analysis performed on whole plant samples taken at boot.

CP, Crude Protein; ADF, Acid Detergent Fiber; NDF, Neutral Detergent Fiber; TDN, Total Digestible Nutrients;
RFV, Relative Feed Value; Net Energy: Maintenance, Gain, Lactation..

Limited Sprinkler Irrigation on Corn and Grain Sorghum, Walsh 2014

Kevin Larson, Brett Pettinger, Deborah Harn

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

MATERIALS AND METHODS: We tested 14 corn hybrids and 14 grain sorghum hybrids under limited sprinkler irrigation. We planted the corn study on May at 22,000 seeds/a, and the grain sorghum study on June 5 at 53,000 seeds/a. We fertilized both studies using a strip-till implement with 150 lb N/a to the corn and 100 lb N/a to the grain sorghum with 20 lb P_2O_5/a as 10-34-0, and at planting we seedrow applied an additional 20 lb P_2O_5/a, and 0.38 lb Zn/a. We applied 20 acre-in./a of water to the corn and to the grain sorghum we applied 8 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. The yield potential of earliest maturing grain sorghum hybrid (Sorghum Partners 251) was too low to match our irrigated conditions and subsequently produced low yields. Green snap lodging severely affected two corn hybrids after a high wind event following an application of dicamba. Green snap lodging was 43% for both Golden Harvest G11U85-3111 and Golden Harvest G13S06-3111. The average yield of these green snap affected hybrids was 44 bu/a less than the highest yielding hybrid, Mycogen 2V709, which produced 170 bu/a. The very long growing season (the first freeze was on October 31) and timely rains contributed to very high yields and test weights of the grain sorghum study.

DISCUSSION: This is the first year that green snap lodging was a significant problem in our irrigated corn study. Green snap lodging is cause by high winds coinciding with excessive growth of the meristem (growth plate) of susceptible corn hybrids. One critical developmental stage for green snap is V5 (the five leaf stage). Herbicides such as 2,4-D and dicamba accelerate growth and exacerbate green snap lodging. This year I applied dicamba at 6 oz/a when the sorghum was in the five leaf stage. Two days after the dicamba application we had very high winds in excess of 40 mph. By applying the dicamba at the critical developmental stage, combined with the high winds, I created a “perfect storm” and exacerbated the green snap lodging of the susceptible corn hybrids. Two Golden Harvest hybrids, G11U85-3111 and G13S06-3111, had 43% green snap lodging, because of the green snap lodging these hybrids produced between 20 bu/a and 44 bu/a less than the study average.

The production of the grain sorghum irrigated study was very good; it averaged 103 bu/a. We typically do not produce over 100 bu/a for limited irrigated grain sorghum when applying 8 in./a of irrigation. Rainfall was actually slightly below average for June, July and August, which are normally our highest rainfall months. However, the rain events were well timed and timing greatly contributed to high yields.

There was a large discrepancy between the highest yielding hybrid, Alta AG1203, with 125 bu/a and the lowest yielding hybrid, Sorghum Partners 251, with 67 bu/a. The 58 bu/a yield difference is due to 251, the earliest maturing hybrid in our study, having too low of a yield potential for our irrigated conditions. It is more suited for late planting, perhaps after wheat harvest, where early maturation is crucial.

Sprinkler Irrigated Grain Sorghum Study at Walsh, 2014

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

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

RESULTS: The 14 grain sorghum hybrids tested averaged 103 bu/a. The yield ranged from 67 bu/a for Sorghum Partners 251 to 125 bu/a for Alta AG1203. The earliest maturing hybrids perform poorly: their yield potential were too low for the conditions. .

PLOT: Four rows with 30 in. row spacing, at least 600 ft. long. SEEDING DENSITY: 53,500 seeds/a. PLANTED: June 5. HARVESTED: November 7. IRRIGATION: Sprinkler applied 8 acre-in/a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Huskie 12 oz/a; Atrazine 0.75 lb/a; Glyphosate 32 oz/a (shielded sprayer). 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	2.05	0.00	578	14	1	25
July	2.14	2.00	832	19	11	56
August	1.98	2.00	832	23	2	87
September	2.10	4.00	555	6	1	117
October	1.27	0.00	347	0	0	148
Total	9.54	8.00	3144	62	15	148

\1 Growing season from June 5 (planting) to October 31 (freeze, 29F).
\2 Total in-season water from irrigation and precipitation was 27.02 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was good. The growing season precipitation was nearly average and generally well timed. Yields were very good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.9	0.6	1.7	20	1.0	395	2.8	7.6
8”-24”				17				
Comment	Alka	VLo	Hi	Hi	VLo	VHi	Marg	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization.

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

Yield Goal: 90 bu/a.
Actual Yield: 103 bu/a.

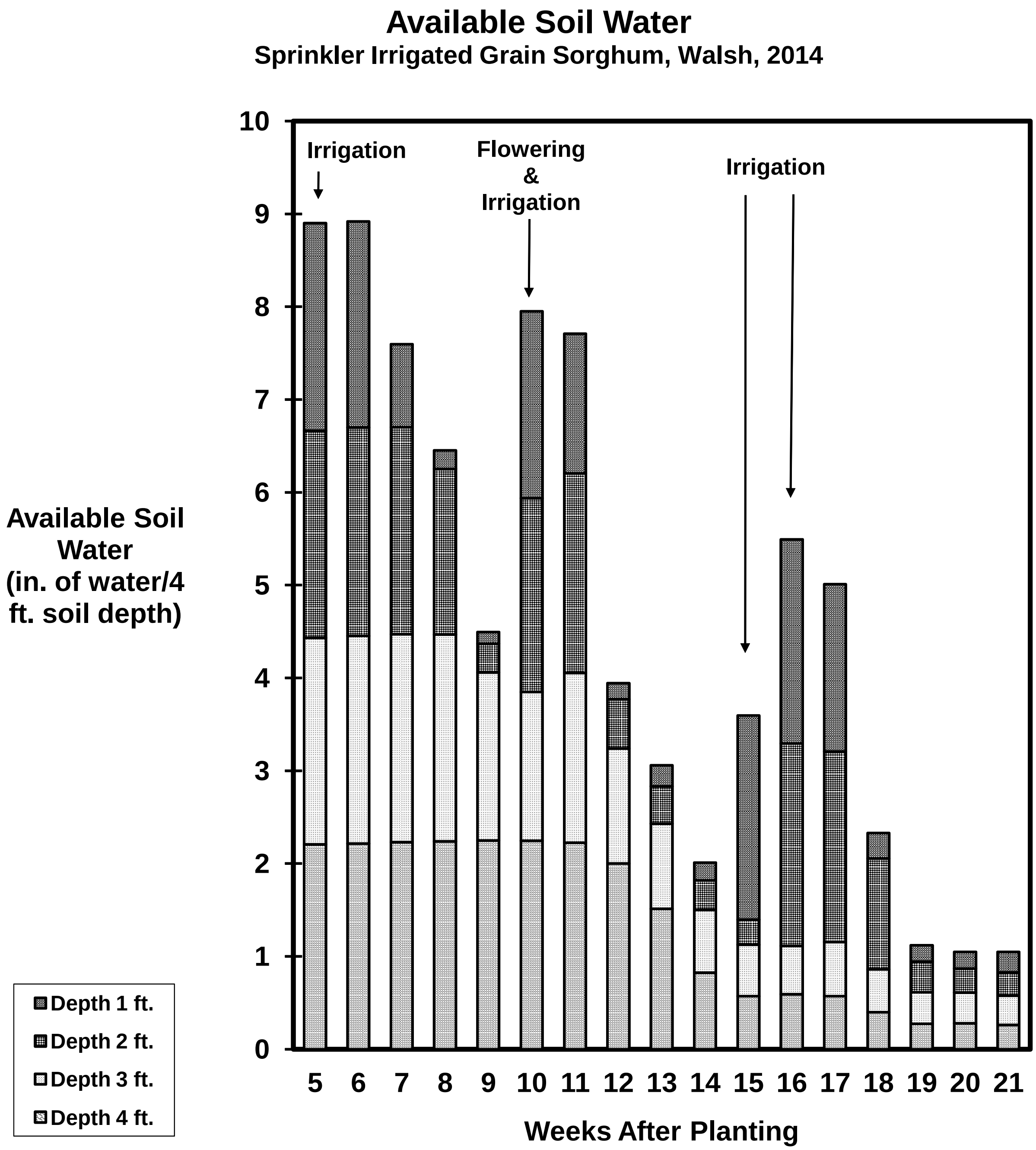


Fig. . Available soil water in limited sprinkler irrigation grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 9.54 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigated Grain Sorghum, Plainsman Research Center, Walsh, 2014.

Brand	Hybrid	Grain Yield	Seed Moisture Content	Test Weight	Plant Density	Plant Height	50% Flowering Date	50% Maturity Date
		bu/a	%	lb/bu	plants/a (1000X)	in		
ALTA	AG1203	125	12.6	65	44.7	50	8/15	9/27
ALTA	AG1301	117	12.4	64	44.9	45	8/17	10/1
MYCOGEN	1G600	116	12.6	63	43.1	48	8/18	10/2
ALTA	AG2115	116	12.6	63	39.5	46	8/19	10/3
MYCOGEN	1G588	110	12.3	63	42.3	50	8/14	9/26
MYCOGEN	627	110	12.3	63	33.9	49	8/15	9/29
MYCOGEN	M3838	106	12.6	65	38.5	45	8/13	9/29
SORGHUM PARTNERS	K35Y5	104	12.1	62	37.7	44	8/10	9/26
ALTA	AG1201	100	12.1	62	34.5	42	8/11	9/23
SORGHUM PARTNERS	SP3425	98	12.7	65	41.9	41	8/10	9/26
MYCOGEN	1G557	97	12.0	63	40.5	42	8/6	9/19
SORGHUM PARTNERS	KS310	93	12.1	63	40.1	48	8/10	9/24
SORGHUM PARTNERS	SP3303	79	12.4	62	38.1	44	8/9	9/23
SORGHUM PARTNERS	251	67	10.7	61	44.5	40	8/4	9/13
Average		103	12.3	63	40.3	45	8/12	9/25
LSD 0.20		8.8						

Planted: June 5; Harvested: November 7, 2014.
50% Flowering Date: minimum date on which a hybrid flowers on half of its population.
50% Maturity Date.
Sprinkler irrigated grain sorghum received 8 acre-in of applied water.
Yields are adjusted to 14.0% seed moisture content.

Sprinkler Irrigation Corn Study at Walsh, 2014

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

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

RESULTS: The average yield for all 14 hybrids tested was 157 bu/a. All four seed firms (Golden Harvest, LG Seeds, Mycogen, 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: 22,000 seeds/a. PLANTED: May 1. HARVESTED: November 20.

PEST CONTROL: Preemergence Herbicides: Balance 1.75 oz/a, Glyphosate 32 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a; Post Herbicides: Glyphosate 32 oz/a, Dicamba 6 oz/a. CULTIVATION: None. INSECTICIDE: For mites.

FIELD HISTORY: Previous Crop: Corn. 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	2.23	4.00	469	3	0	31
June	2.05	4.00	690	16	1	61
July	2.14	4.00	832	19	11	92
August	1.98	4.00	832	23	2	123
September	2.10	4.00	555	6	1	153
October	1.27	0.00	347	0	0	184
Total	11.77	20.00	3725	67	15	184

\1 Growing season from May 1 (planting) to October 31 (freeze, 29F).
\2 Total in-season water from irrigation and precipitation was 31.77 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 fair. A few hybrids suffered severe green snap lodging after an application of dicamba followed by high winds two days later. The growing season precipitation was nearly average and generally well timed. Grain yields and test weights were good. We applied 20 in/a of irrigation.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.9	0.6	1.7	20	1.0	395	2.8	7.6
8”-24”				17				
Comment	Alka	VLo	Hi	Hi	VLo	VHi	Marg	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	6	40	2	0
Applied	150	40	0.4	0

Yield Goal: 150 bu/a.
Actual Yield: 157 bu/a.

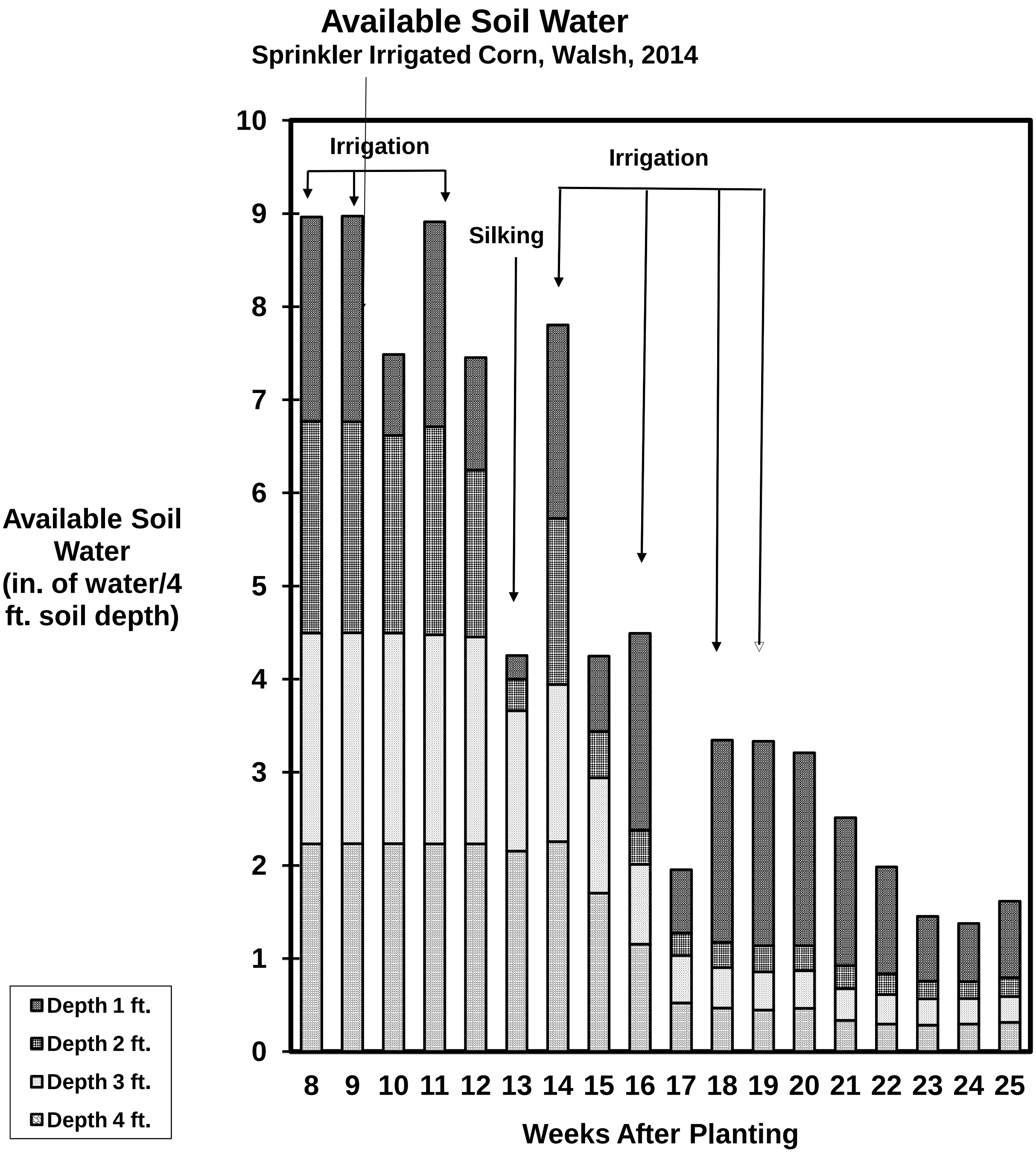


Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 11.77 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Sprinkler Irrigation Corn, Plainsman Research Center, 2014.

Firm	Hybrid	Grain Yield	Green Snap Lodge	Seed Moist.	Test Wt.	Plant Density	50% Silking Date
		bu/a	%	%	lb/bu	plants/a (X 1000)	
MYCOGEN	2V709	170	3	13.5	61	21.2	28-Jul
MYCOGEN	2C799	169	0	14.1	60	21.0	29-Jul
LG SEEDS	LG 5618 VT2	168	5	13.7	62	21.2	27-Jul
PRODUCERS HYBRIDS	7268	168	3	14.4	61	20.6	25-Jul
MYCOGEN	2Y767	167	0	14.3	60	20.4	29-Jul
LG SEEDS	LG 5579 VT3P	165	5	13.1	61	20.6	27-Jul
MYCOGEN	2K757	162	0	13.0	59	20.4	26-Jul
GOLDEN HARVEST	G14H66-GTA	160	8	14.7	60	20.2	28-Jul
PRODUCERS HYBRIDS	6878	159	8	13.7	61	20.6	26-Jul
MYCOGEN	2V717	157	3	13.7	60	21.0	30-Jul
LG SEEDS	LG 2549 VT3P	152	8	13.2	59	20.2	25-Jul
LG SEEDS	LG 5607 VT2	149	18	14.1	61	20.6	25-Jul
GOLDEN HARVEST	G11U85-3111	137	43	13.0	59	21.0	26-Jul
GOLDEN HARVEST	G13S06-3111	116	43	13.5	59	20.8	30-Jul
Average		157	10.2	13.7	60	20.7	27-Jul
LSD 0.20		10.5	3.6				

Planted: May 1; Harvested: November 20, 2014.
Grain Yield adjusted to 15.5% moisture content.
Green Snap Lodging after application of dicamba (6 oz/a) at 5 leaf stage (June 20) and high winds in excess of 40 mph two days after application.
This corn trial received a total of 20 acre-in./acre of water.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2014

Kevin Larson, Brett Pettinger, and Deborah Harn

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

RESULTS: Only the nonresistant corn borer hybrid displayed any first generation corn borer damage and this shot-hole damage was very minor. The nonresistant corn borer hybrid had very minor second generation corn borer damage (stalk holes and lodging). The lack of second generation corn borer damage is because the site was sprayed with a broad spectrum insecticide, Chlorpyrifos, (and an ovacide miticide, Oberon) to control spider mites and the insecticide inadvertently helped control the corn borer larvae. Grain yields were good, averaging 157 bu/a.

DISCUSSION: All 13 Bt hybrids tested showed excellent resistance to first generation corn borer compared to the nonresistant hybrid. The nonresistant corn borer hybrid had very low levels of stalk holes and almost no plant lodging. This year, the very low level of corn borer infestation was because of an insecticide application that killed both mites and corn borer; nonetheless, in recent years, we have reported low levels of corn borer. 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.

Table .Sprinkler Irrigated Corn, Corn Borer Ratings, Plainsman Research Center, 2014.

Firm	Hybrid	Grain Yield	Test Wt.	1st Gen. Shot Holes	2nd Gen. Stalk Holes	2nd Gen. Plants Lodged	50% Silking Date
		bu/a	lb/bu	--------plants/a---------			
MYCOGEN	2V709	170	61	0	0	0	28-Jul
MYCOGEN	2C799	169	60	0	0	0	29-Jul
LG SEEDS	LG 5618 VT2 RIB	168	62	0	0	0	27-Jul
PRODUCERS HYBRIDS	7268 STXRIB	168	61	0	0	0	25-Jul
MYCOGEN	2Y767	167	60	0	0	0	29-Jul
LG SEEDS	LG 5579 VT3 RIB	165	61	0	0	0	27-Jul
MYCOGEN	2K757	162	59	0	0	0	26-Jul
GOLDEN HARVEST	G14H66-GTA	160	60	8	5	3	28-Jul
PRODUCERS HYBRIDS	6878 STXRIB	159	61	0	0	0	26-Jul
MYCOGEN	2V717	157	60	0	0	0	30-Jul
LG SEEDS	LG 2549 VT3 RIB	152	59	0	0	0	25-Jul
LG SEEDS	LG 5607 VT2 RIB	149	61	0	0	0	25-Jul
GOLDEN HARVEST	G11U85-3111	137	59	0	0	0	26-Jul
GOLDEN HARVEST	G13S06-3111	116	59	0	0	0	30-Jul
Average		157	60	0.5	0.4	0.2	27-Jul
LSD 0.05		16.7		2.04	NA	NA	

Planted: May 1; Harvested: November 20, 2014.
Grain Yield adjusted to 15.5% moisture content.
This corn trial received a total of 20 acre-in./acre of water.

Dragonline Precision Mobile Drip Irrigation and Long Drop Spray Nozzle Comparison on Sprinkler Irrigated Corn

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 to quantify this potential production advantage.

Materials and Methods

We planted Mycogen 2K757 at 22,000 seeds/a on May 1 and 2 in a circular pattern. We seedrow applied 5 gal/a of 10-34-0 and 0.38 lb/a of Zn chelate at planting. We strip-tilled 150 lb N/a and 5 gal/a of 10-34-0 to the site. For weed control in the corn, we applied preemergence herbicides: Balance 1.75 oz/a, glyphosate 32 oz/a, Sharpen 3.0 oz/a and atrazine 1.0 lb/a; and for post emergence herbicides we applied: glyphosate 32 oz/a and dicamba 6 oz/a. We cultivated one time to control volunteer corn and to make a small furrow for the driplines to follow. The entire pivot was irrigated with LDSNs until June 30 after cultivation and installation of the Dragonlines. 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 30 to September 24, 2,0 in./a irrigations were applied every other week through the Dragonlines and spray nozzles. However, because the pressure regulators were removed from the LDSN’s, there was differential water flow through the pressure-compensated Dragonlines and the unregulated spray nozzles. The corn crop received 20 in/a in total irrigation. We harvested the corn plots on November 24 and 25 with a self-propelled combine and weighed the grain in a digital scale cart. Grain yields were adjusted to 15.5% seed moisture content.

Results and Discussion

There was no significant yield difference between sprinkler irrigations applied through the Dragonlines and the Long Drop Spray Nozzles.

We expected larger yield differences between Dragonline and LDSN irrigation methods. There was only 0.3 bu/a difference between these sprinkler irrigation delivery methods. After the irrigation season at Plainsman's Fall Field Day, Monty Teeter uncovered a design flaw in our experimental conditions that may account for the lack of yield difference. The Dragonlines were pressure compensated, but our spray nozzles did not have pressure compensating regulators. Without pressure compensating regulators on the spray nozzles, a greater amount of water, beyond the nozzle designation, would have potentially been applied, giving the LDSNs additional irrigation water and a competitive advantage over the pressure compensated Dragonlines. Bob Jochens with WISH Colorado, calculated the water flow difference between the pressure-compensating Dragonlines and the unregulated LDSN's as 30.6% more water through the LDSN's compared to the Dragonlines using 12 psi on the top of the pivot. In an email to Monty Teeter, Bob Jochens stated his water flow calculations:

> Monty,
> If the Plainsman Research Project ran 12 psi on top of the pivot instead of the 7 psi we show, the conventional non regulated sprays would be releasing 20.9% more water than we show. Also the new calculation on the Dragonline would require 1164 ft of tubing instead of the 1064 ft the old chart shows. This is 9.7% shortage on the flow of the Dragonline making the total difference 30.6% more water on the conventional non regulated sprays than on the Dragonline. Still pretty impressive if they did get the same yield.
> Thanks,
> Bob Jochens
> WISH-CO

Considering that the Dragonlines had 30.6% less water applied through them, it is astonishing that they produced the same grain yield as the unregulated spray nozzles.

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. With the current technology, there is another disadvantage to drag driplines: row crop production requires circular planted fields to keep the driplines precisely placed between the crop rows.

For a subsequent study comparing Dragonlines and LDSNs, after, of course, installing pressure compensating regulators on our LDSNs, we will test circular row planting compared to straight row planting for grain sorghum production.

Table .--Dragonline PMDI and Long Drop Spray Nozzle Comparison on Corn at Walsh, 2014.

Treatment	Grain Yield	Test Weight	Moisture
	bu/a	lb/bu	%
Irrigation Method			
Long Drop Spray Nozzle	148.5	58.7	14.1
Dragonline	148.2	59.0	14.1
LSD 0.05	NS		
Average	**148.4**	**58.9**	**14.1**

Planted: May 1 & 2; Harvested: November 24 & 25.
The entire pivot was irrigated with LDSNs until June 30 after cultivation and installation of the driplines.
From June 30 to September 24, 2.0 in./a irrigations were applied every other week.
The pressure-compensating Dragonline may have had 30.6% less water applied compared to the unregulated LDSNs.
The study received 20 in. of total irrigation.

Long-Term N Effects on Irrigated Sunflower-Corn Rotation, Walsh, 2014

Kevin Larson, Brett Pettinger, and Deborah Harn

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

Materials and Methods: All crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted each year, except in 2012. We did not plant sunflowers in 2012 because we mistakenly applied corn herbicides over all the plots, including the plots reserved for sunflower planting. This year, all crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted. We planted corn, Mycogen 2K757, on May 2 at 22,000 seeds/a, and sunflower, Syngenta 3495 NS/CL/DM, on June 20 at 22,000 seeds/a. We planted the corn in dry soil, therefore we used a towable sprinkler to irrigate the corn site to establish a stand. At sunflower planting, there was sufficient soil moisture to germinate the sunflowers, therefore, unlike the corn site, the sunflower site was not sprinkler irrigated for stand establishment. For our N treatments, we streamed liquid N (32-0-0) at 100, 150, or 200 lb/a with two replications. We seedrow applied 20 lb P_2O_5/a to the corn, but not the sunflowers. In addition to the seedrow applied P, the corn received 0.38 lb/a of Zn chelate. For weed control, we applied pre-emergence glyphosate 32 oz/a, 0.5 lb/a of 2,4-D, and Banvel 4 oz/a to both the corn and sunflower plots. The corn also received pre-emergence Balance Pro 2.0 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a, and COC 16 oz/a. For postemergence weed control in the corn, we applied two applications of Glystar Plus at 32 oz/a. For weed control in the sunflower, we applied pre-emergence Spartan 2 oz/a. For postemergence weed control in the sunflower, we applied Select 12 oz/a and Beyond 4 oz/a. The corn received approximately 17.3 in/a of irrigation (14.3 in/a from drip and 2 in/a from sprinkler irrigation). The sunflower received 8.3 in./a of drip irrigation. The sunflower had an aerial application of Warrior to control head moth. We harvested two replications of the 20 ft. by 650 ft. plots on November 26 for corn and December 2 for sunflower with a self-propelled combine and weighed them in a digital weigh cart. Yields were adjusted to 15.5% for corn and 10% for sunflower.

Results and Discussion: Grain yield in the continuous corn rotation increased linearly with increasing N rates. Continuous corn required high rates of N for high grain yields. High rates of N for high yields would be the anticipated practice for corn production. Therefore, increased yields with increasing N rates for the continuous corn rotation were expected. The corn in Sunflower-Corn rotation produced at a higher yield level than the continuous corn rotation, but unlike the continuous corn rotation, there was no N responds to increasing N rates for the Sunflower-Corn rotation. This lack of N response to increasing N rates for the Sunflower-Corn rotation is similar to the no or low N response we reported in previous years.

Sunflower following corn had a yield drop at 150 lb N/a. The 100 lb N/a and the 200 lb N/a rates produced similarly high sunflower yields. This is the opposite N response recorded last year for sunflower yield. Last year, sunflower produced its optimum yield at 150 lb N/a. After reviewing the soil test recommendation, the large residual nitrate N indicated that there would be no sunflower or corn yield response to increasing N rates. However, sunflower produced a yield drop at 150 lb N/a and continuous corn produced its highest yield at the highest N rate. In the past, we reported no or declining sunflower yield with increasing N in combination with lower residual soil N than this year. We have no explanation for the sunflower yield drop at 150 lb N/a, especially with such high residual soil N. The recommended N fertilizer rates for our yield goals were 0 lb/a for sunflower and 0 lb/a for corn. Our yield goal for the corn was 150 bu/a, our actual average grain yield was 144 bu/a, and the yield goal for the sunflowers was 1500 lb/a, our actual average seed yield was 982 lb/a or 334 lb/a oil yield. Typically we have reported oil percentages decreasing with increasing N rates. This year, the oil percentages increased with increasing N rates; however, there was little difference between the 100 and 150 lb N/a rates. The oil percentages were low: 33.7, 33.6, and 34.6, respectively for 100, 150, and 200 lb N/a.

Table .-Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe	S
		mmhos/cm	%	--ppm--					
0-8”	7.8	0.7	1.5	22	7	459	0.6	2.7	12.9
8-24”				33					

This is the ninth 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 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.

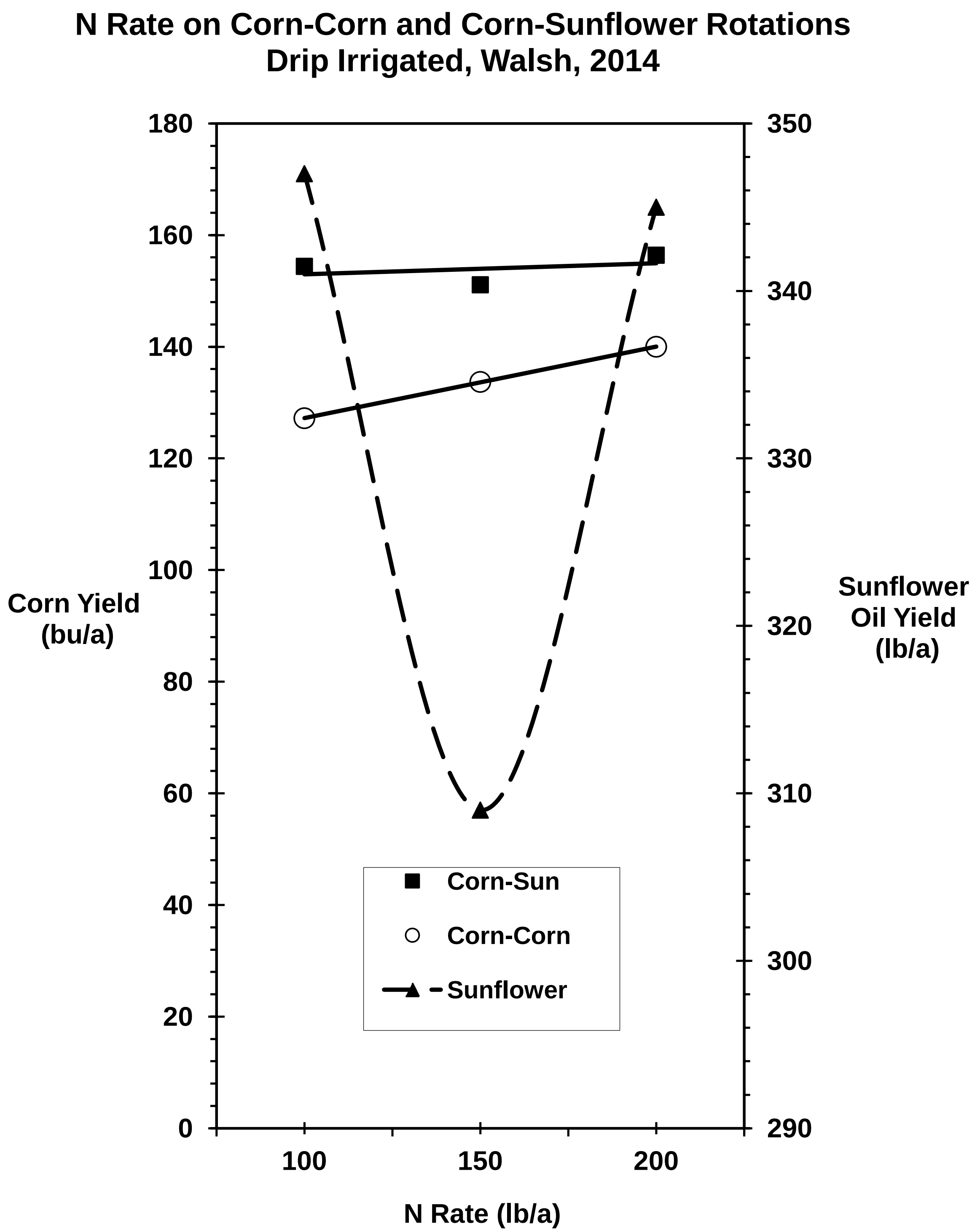


Fig. . N rate on drip irrigated sunflower and corn in Sunflower-Corn rotations at Walsh. The N rates were 100, 150, and 200 lb N/a as 32-0-0. The sunflower hybrid was Syngenta 3495 NS/CL/DM planted at 22,000 seeds/a. The corn hybrid was Mycogen 2K757 planted at 22,000 seeds/a.

Long-Term N Effects on Wheat-Sunflower-Fallow Rotation, Walsh, 2014

Kevin Larson, Brett Pettinger, and Deborah Harn

Purpose: To study the long-term N fertilizer effects on a wheat-sunflower-fallow rotation where N is applied to the same treatment plots for multiple years.

Materials and Methods: We planted wheat, Byrd, at 50 lb seed/a on October 15, 2013, and sunflower on June 20, 2014 at 15,000 seeds/a using Syngenta 3495 NS/CL/DM. We banded liquid N (32-0-0) at 0, 30, 60, and 90 lb N/a to the treatment plots with two replications to both N and N residual sides of the sunflower plots on July 31, 2014. No N treatments were applied to the wheat because it had winterkilled. We seedrow applied 5 gal/a of 10-34-0 (20 lb P_2O_5/a) at planting to the wheat, but not the sunflowers. For weed control in the wheat, we applied pre-emergence glyphosate 32 oz/a, dicamba 4.0 oz/a, and 2,4-D 0.5 lb/a and post emergence Express, 0.33 oz/a and 2,4-D, 0.38 lb/a. For weed control in the sunflower, we applied pre-emergence glyphosate 32 oz/a, Spartan 2 oz/a, and Aim 1.5 oz/a and post emergence Beyond 4oz/a. The wheat winterkilled and was not harvested. We harvested two replications of the 20 ft. by 1100 ft. plots on December 3 for sunflower with a self-propelled combine and weighed the seed in a digital weigh cart. Yields were adjusted to 10% for sunflower.

Results: There was no yield trend with increasing N rates for sunflower: the yield response to applied N was flat ($R^2 = 0.0547$) with 80 lb/a separating the high and low yields. Sunflower yields were low, ranging from 552 lb/a to 632 lb/a. The percent oil in the sunflower seeds was variable with 0 and 90 lb N/a rates producing higher percent oil than the 30 and 60 lb N/a rates. The wheat was not harvested because it winterkilled.

Discussion: This is the thirteenth harvest year of this long-term N on wheat-sunflower-fallow rotation study. We started this study to test reports of no yield response from applied N on dryland sunflower (Vigil and Bowman, 1998).

This year sunflower yield response to increasing N rates was flat: there was little yield response. Obviously, the net return from N fertilizer application was negative for all N rates. For most years of this study, sunflower yields increased with increasing N rates; however the yield response failed to offset the cost of the N fertilizer. The no N fertilizer treatment produced the highest income every year of sunflower production (there was no sunflower crop in 2002, 2008, 2011 and 2013 because of drought). This lack of N response suggests that N fertilizer is not needed for dryland sunflower production if the expected yield is 1200 lb/a or less.

This year the oil content was higher at the 0 and 90 lb N/a rates and dropped at the mid N rates. Generally in previous years, we observed no response or a decline in oil content with increasing N rates. This negative correlation of oil content with N rate has been previously reported (Vigil and Bowman, 1998).

This year the wheat winterkilled. The late planting date (October 15) and dry conditions caused inadequate fall growth to survive the below zero winter temperatures. Last year, there was no wheat yield response to increasing N rates. Only one time in eleven harvest years did the wheat positively respond to applied N. The lack of response of wheat yields to increasing N rates for ten out of eleven years can be explained by sufficient residual N for the first year and low to average yields for the subsequent years. In 2007, there was sufficient winter moisture to produce very good wheat yields (over 50 bu/a), and in 2009 the wheat responded to N rates. However in 2009, this positive response to applied N was not economical. Generally, however, moisture has been the primary yield-limiting factor for this study, not N.

With the exception of 2007, we have reported no wheat yield response to N rates since establishing this wheat-sunflower-fallow rotation study. For ten of eleven years, wheat yields in this rotation were very low to average, 6 to 33 bu/a. The low to average wheat yields can be attributed to the lack of moisture remaining after the sunflower crops extracted all available soil water and to insufficient soil water replenishment due to dry conditions during fallow.

Literature Cited

Vigil, M.F., R.A. Bowman. 1998. Nitrogen response and residue management of sunflowers in a dryland rotation. 1998 Annual Report, Central Great Plains Research Station. ARS, USDA.

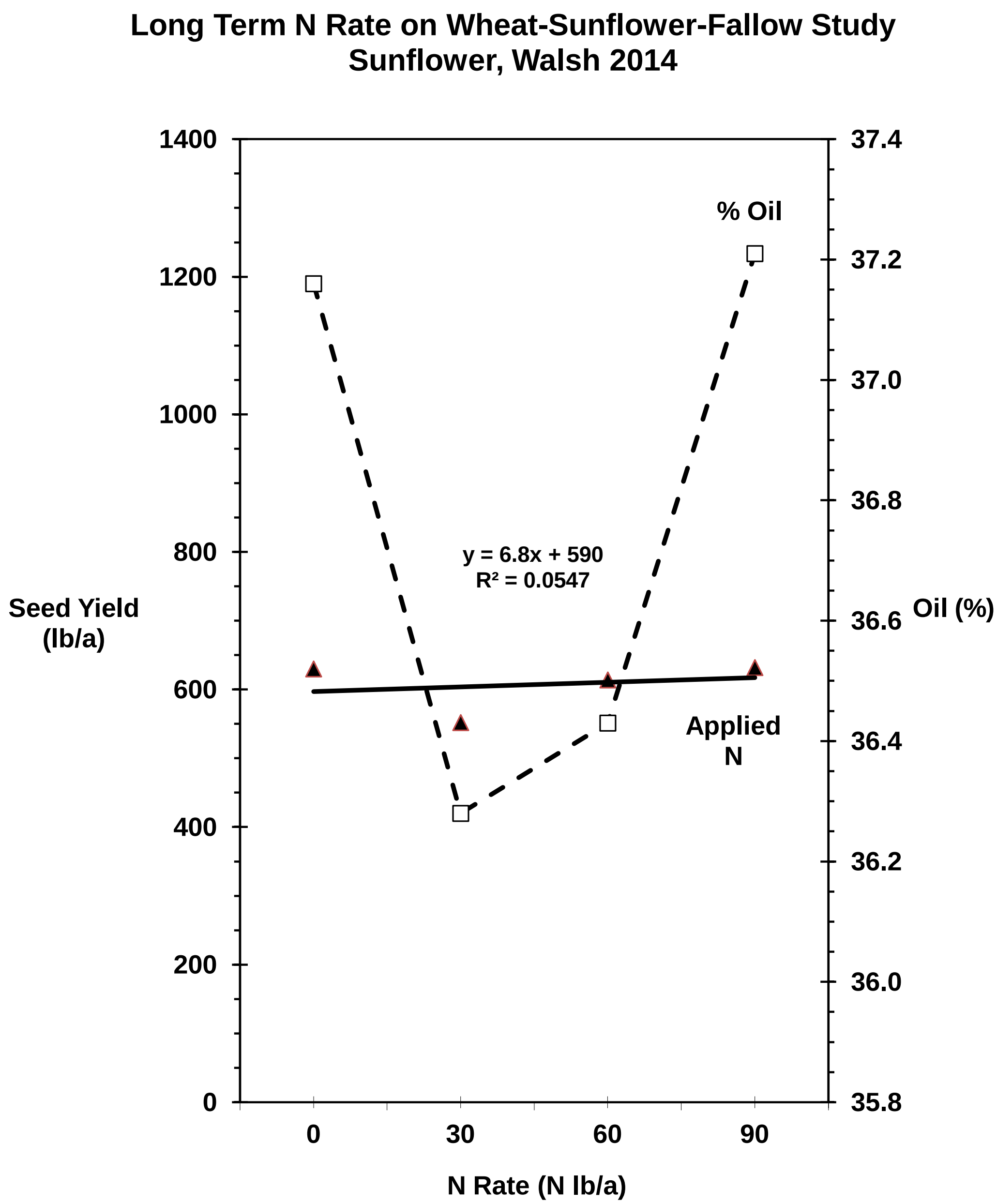


Fig. . N rate on dryland sunflower in Wheat-Sunflower-Fallow rotation at Walsh. The N rates were 0, 30, 60, and 90 lb N/a as 32-0-0. N applied in current year. The sunflower hybrid was Syngenta 3495 NS/CL/DM at 15,000 seeds/a.

Dryland Crop Rotation Study

Kevin Larson and Brett Pettinger

This is the tenth 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.

Materials and Methods

This is our eighth harvest year in testing the following rotations: Wheat-Grain Sorghum-Fallow (W-S-F), Wheat-Sunflower-Fallow (W-Sun-F), and Sorghum-Millet (S-M). We added a fourth rotation of Millet/Wheat-Fallow (M/W-F) in 2006. In 2008 and 2011, no crops were harvested because of drought. We planted winter wheat, Byrd, at 50 lb/a on October 15, 2013; Proso millet, Huntsman, at 12 lb/a on June 27; grain sorghum, Mycogen 627, at 24,600 seeds/a on June 6; and sunflower, Syngenta 3495 NS/CL/DM, at 15,000 seeds/a on June 20, 2014. We applied 50 lb/a of N to the study site. Before planting we sprayed two applications of glyphosate at 32 oz/a, LoVol at 0.5 lb/a, and dicamba 6 oz/a. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Activator 90 8 oz/a; millet, comet 21 oz/a and 2,4-D 8 oz/a; grain sorghum, Huskie 16 oz/a, atrazine 0.75 lb/a, dicamba 4 oz/a; sunflower, glyphosate 32 oz/a, Spartan 2 oz/a; and fallow, glyphosate 32 oz/a, dicamba 6 oz/a and LoVol 0.5 lb/a two times. In addition, we applied Sharpen 2.0 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: millet, September 23; grain sorghum, November 8. The wheat winterkilled and was not harvested. The sunflower crop was not harvested because of a poor stand. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

The S-M rotation produced the highest total rotation production of 3914 lb/a, just surpassing the W-S-F rotation with 3808 lb/a. All of the production for the W-S-F rotation was from grain sorghum, because the wheat winterkilled and was not harvested. The high production level of the S-M rotation was overwhelmingly from grain sorghum since the millet yield was low. Without the winter wheat crop, grain sorghum, and to a much lesser extent, proso millet comprised total production. In the past we have stated: “Less fallow, more crops, more income.” This statement is still true in the long term under average moisture conditions, but when conditions are dry fallow produces more yield. This year, without wheat production, which is the major summer fallow crop, the value of fallow was harder to quantify.

Along with the highest annual rotation production, the S-M rotation also returned the highest annual rotation variable net income of $105.98/a for 2014. The W-S-F rotation was able to return the second highest annual rotation income despite having only two crops in three years; whereas, the S-M rotation had a crop each year. 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 2014 total production for the S-M rotation was 3912 lb/a. The crop rotational phases were: grain sorghum, 3522 lb/a; millet 395 lb/a. The annual rotation production would be 1957 lb/a, which is half the total production because the S-M rotation takes two years to complete one rotation cycle.

For all seven harvest years, the W-Sun-F rotation produced the least variable net incomes, because in five of seven of these harvested years the sunflowers either outright failed or had poor stands and were not harvested.

The long term annual rotational income, after seven harvest years, favors the S-M rotation with $109.68/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 $87.72/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. This year we had nearly average precipitation with well timed rains in the summer. The previous couple of years have been quite dry and 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. This year, there was no wheat production and the high grain sorghum yields were primarily responsible for production and income for the rotations containing it. The sunflower crop was not harvest because of poor stand (the fifth failed sunflower crop in seven cropping years). Without sunflower crop income this year, rotations containing grain sorghum and millet 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, 2014.

Rotation	Wheat	Grain Sorghum	Millet	Sunflower	Fallow	2014 Total Rotation Production	Annual Rotation Production
	Crop Production 2014 Crop						
	lb/a						
S-M		3522	392			3914	1957
W-S-F	0	3808			0	3808	1269
M/W-F	0		560		0	560	280
W-Sun-F	0			0	0	0	0
Average	0	3665	476	0	0	2071	877
LSD 0.20	--	2128.8	284.5				

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The wheat winterkilled and was not harvested.
The sunflower crop was not harvested because of poor stand.

Table .-Dryland Crop Rotation Study, Variable Net Income, 2014.

Rotation	Wheat	Grain Sorghum	Millet	Sunflower	Fallow	2014 Total Crop Net Income	Annual Rotation Variable Net Income
	2014 Crop						
	$/a						
S-M		208.79	3.16			211.95	105.98
W-S-F	-26.02	227.91			-32.12	169.77	56.59
M/W-F	-26.02		14.41		-32.12	-43.73	-21.87
W-Sun-F	-26.02			-40.65	-32.12	-98.79	-32.93
Average	-26.02	218.35	8.79	-40.65	-32.12	59.80	26.94

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 sunflower crop had a poor stand and was not harvested.
the wheat crop winterkilled and was not harvest.

Table .-Dryland Crop Rotation Study, Walsh, 2014.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		-----------------------------$/a-----------------------------					
Wheat	50 lb	10.00	16.02	0 bu	6.00/bu	0.00	-26.02
M/W-F				0.0	6.00	0.00	-26.02
W-Sun-F				0.0	6.00	0.00	-26.02
W-S-F				0.0	6.00	0.00	-26.02
Millet	12 lb	4.20	18.89	8.5 bu	3.75/bu	31.88	8.79
S-M				7.0	3.75	26.25	3.16
M/W-F				10.0	3.75	37.50	14.41
Grain Sorghum	24,600 seeds	3.69	23.40	65.5 bu	3.75/bu	245.44	218.35
S-M				62.9	3.75	235.88	208.79
W-S-F				68.0	3.75	255.00	227.91
Sunflower	15,000 seeds	22.50	18.15	0 lb	0.16/lb	0.00	-40.65
W-Sun-F				0	0.16	0.00	-40.65
Fallow	---	---	32.12	---	---	-32.12	-32.12
Average			21.72			49.04	25.67

Planted: Grain Sorghum, Mycogen 627 at 24,600 seeds/a on June 6; Millet, Huntsman at 12 lb/a on June 27; and Sunflower, Syngenta 3495 NS/CL/DM at 15,000 seeds/a on June 20; Wheat, Byrd at 50 lb/a on October 15, 2013.
Harvested: Millet, September 23; Grain Sorghum, November 8.
Wheat and sunflower crops were not harvested.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .-Dryland Crop Rotation Study, Annual Rotation Income, 2006 to 2014.

	Annual Rotation Variable Net Income							Total Crop Net Income	Average Annual Rotation Variable Net Income
Rotation	2006	2007	2009	2010	2012	2013	2014		
	$/a								
S-M	12.70	118.18	141.76	262.97	98.38	27.79	105.98	767.76	109.68
W-S-F	36.67	120.47	105.16	198.75	39.81	56.60	56.59	614.05	87.72
M/W-F	30.79	121.22	143.26	135.55	52.97	41.67	-21.87	503.59	71.94
W-Sun-F	8.01	103.07	27.69	99.95	-32.88	8.17	-32.93	181.08	25.87
Average	22.04	115.74	104.47	174.31	39.57	33.55	26.94	516.62	73.80

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

Dryland Millet and Wheat Rotation Study

Kevin Larson and Brett Pettinger

This was the eighth 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 seventh 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 15, 2013 and Proso millet, Huntsman, at 12 lb/a on June 27, 2014. 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 one application of Sharpen 2.0 oz/a to help control glyphosate resistant kochia. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Activator 90 8 oz/a; millet Comet 21 oz/a and 2,4-D ester 8 oz/a; and fallow, glyphosate 32 oz/a, dicamba 6 oz/a and LoVol 0.5 lb/a two times. We harvested the millet on September 23 and the wheat on July 7 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14% moisture content for the millet and 12% moisture content for the wheat. We recorded cost of production and yields in order to determine rotation revenues. There were no crops harvested in 2008 because of drought. Only wheat was harvested in 2011: the millet was not planted because of drought. This year the continuous millet (M-M) rotation failed to establish a stand and therefore was not harvested.

Results and Discussion

Both wheat and millet yields were very low. The wheat yields were low because of the mid-October planting. The October 15 planting date for the rest of Plainsman farm completely winterkilled, in fact, this is the only mid-October planted wheat that we harvested. The late June planting date for the millet undoubtedly contributed to its low yield. In a nearby dryland rotation study which included grain sorghum and millet (M-S) rotation, the grain sorghum phase had a very good yield, while the yield of the millet phase was poor. The planting date of the grain sorghum was June 6 (near the optimum planting date); whereas, the June 27 planting date of the millet was well beyond its optimum planting date. This year, none of the rotation produced positive annual rotation variable net incomes. The W/M-F rotation lost the least amount of income, losing -$12.48/a. Despite returning the least amount of income this year, the continuous wheat (W-W) rotation produced the highest net return of $68.17/a after seven harvest years.

For the seven years that we have conducted this study, we have had crop multiple failures and missed plantings, therefore rotational affects are, at best, difficult to generalize and quantify. This year, late planting dates for both wheat and millet reduced yields (and the M-M rotation went so far that it failed to establish a stand). After seven harvest years, and acknowledging crop failures and missed planting, the W-W rotation produced the highest and the W-M-F the second highest rotation average annual rotation variable net income of $68.17/a and $44.42/a, respectively. The four other rotations provided around $30/a to $39/a in average annual rotation variable net income after seven harvest years. 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 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, 2014.

Rotation	-----------2014 Crop---------- Wheat	Millet	Fallow	2014 Total Rotation Production	Annual Rotation Production
	-------------------------lb/a----------------------------				
W-F	390			390	195
W-W	3			3	3
W-M-F	165	202		367	122
M/W-F	285	398		683	342
W/M-F	327	470		797	399
M-M		0		0	0
Average	234	268		373	177
LSD 0.20	130.5	225.1			

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The continuous millet (M-M) rotation failed to make a stand.

Table .Dryland Millet-Wheat Rotation, Variable Net Income, 2014.

Rotation	-----------2014 Crop---------- Wheat	Millet	Fallow	2014 Total Crop Net Income	Annual Rotation Variable Net Income
	-------------------------$/a----------------------------				
W-F	12.98		-44.54	-31.56	-15.78
W-W	-25.42			-25.42	-25.42
W-M-F	-9.22	-9.59	-44.54	-63.35	-21.12
M/W-F	-7.41	3.54	-44.54	-48.41	-24.21
W/M-F	6.98	12.61	-44.54	-24.95	-12.48
M-M		-23.09		-23.09	-23.09
Average	-4.42	-4.13	-44.54	-36.13	-20.35

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 continuous millet (M-M) rotation failed to make a stand.

Table .-Dryland Millet and Wheat Rotation Study, Walsh, 2014.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
	lb/a	$/a	$/a	bu/a	$/a	$/a	$/a
Wheat							
W-F	50	10.00	16.02	6.5	6.00	39.00	12.98
W-W	50	10.00	16.02	0.1	6.00	0.60	-25.42
W-M-F	50	10.00	16.02	2.8	6.00	16.80	-9.22
M/W-F	50	10.00	26.21	4.8	6.00	28.80	-7.41
W/M-F	50	10.00	16.02	5.5	6.00	33.00	6.98
Wheat Average	**50**	**10.00**	**18.06**	**3.9**	6.00	**23.64**	**-4.42**
Millet							
M-M	12	4.20	18.89	0	3.75	0.00	-23.09
W-M-F	12	4.20	18.89	3.6	3.75	13.50	-9.59
M/W-F	12	4.20	18.89	7.1	3.75	26.63	3.54
W/M-F	12	0.00	18.89	8.4	3.75	31.50	12.61
Millet Average	**12**	**4.20**	**7.78**	**4.8**	3.75	**17.91**	**-4.13**
Fallow	---	---	44.54	---	---	0.00	-44.54
Average			18.43			23.64	-17.70

Planted: Millet, Huntsman at 12 lb/a on June 27; Wheat, Byrd at 50 lb/a on October 15, 2013.
Harvested: Millet on September 23; Wheat on July 7.
Wheat herbicides: Express 0.33 oz/a, 2,4-D, 0.38 lb/a; Wheat hericide cost: $10.02/a.
Millet herbicides: Comet 21 oz/a, 2,4-D ester 8 oz/a: Millet herbicide cost: $12.89/a
Fallow herbicides: glyphosate 32 oz/a, 2,4-D 0.5 lb/a, dicamba 6 oz/a;
Fallow herbicide cost: $10.15/a per application (two applications, $6.00/a per application)
Fallow herbicides to control glyphosate resistant kochia: Sharpen 2.0 oz/a.
Kochia control cost: $12.24/a.
Wheat in M/W-F additional herbicide: glyphosate 32 oz/a cost $4.19/a.
Weed control cost is herbicide cost and $6.00/a application cost for each application.

Table .Millet-Wheat Rotation, Annual Rotation Income, 2007 to 2014.

Rotation	Annual Rotation Variable Net Income 2007	2009	2010	2011	2012	2013	2014	Total Crop Net Income	Average Annual Rotation Variable Net Income
	$/a								
W-F	108.22	52.13	112.08	63.66	-21.47	-27.93	-15.78	270.90	38.70
W-W	193.14	105.30	170.76	78.46	-19.04	-26.02	-25.42	477.18	68.17
W-M-F	95.53	72.66	116.42	37.05	-1.65	12.05	-21.12	310.94	44.42
M/W-F	141.03	32.87	123.45	-34.96	-25.79	-1.95	-24.21	210.45	30.06
W/M-F	95.36	38.57	118.77	59.48	-21.47	-23.58	-12.48	254.65	36.38
M-M	102.97	73.83	93.66	-23.30	47.39	-0.56	-23.09	270.90	38.70
Average	122.71	62.56	122.52	30.07	-7.00	-11.33	-20.35	299.17	42.74

No crops were harvested in 2008 because of drought.
No millet was harvested in 2011 because of drought.
No wheat was harvested in 2012 because of hail damage.
Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Variable Net Income divided by years to complete one rotational cycle.

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

Kevin Larson and Brett Pettinger

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

Materials and Methods

We tested cover crops and N rates in two common crop rotations: Wheat-Fallow (W-F) and Wheat-Sorghum-Fallow (W-S-F). Our treatments for this cover crop study were: four spring and four winter cover crops, three N rates, and two crop rotations. We planted spring cover crops: oats at 60 lb/a, rapeseed at 5 lb/a, hairy vetch at 30 lb/a, and Spring N Mix at 58 lb/a (lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a). We planted the spring cover crops in the W-S-F rotation on March 19, 2014 during the summer fallow period after sorghum harvest. We had planned to terminate the spring cover crops in July before wheat planting, however this year the spring cover crops failed. We planted winter cover crops: triticale at 60 lb/a, rapeseed at 5 lb/a, hairy vetch at 30 lb/a, Winter N Mix at 43 lb/a (hairy vetch, 8 lb/a; winter pea, 8 lb/a; sweet clover, 2 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudan grass, 3 lb/a). We planted the winter cover crops for the wheat in the W-F rotation on August 28, 2012 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 3, 2013. We planted the winter cover crops prior to sorghum planting in the W-S-F rotation on October 2, 2013 into wheat stubble. Normally we terminate them in April, but this year the winter cover crops failed. All cover crop seeds were from Green Cover Seed in Bladen, Nebraska. Our three N rates were 0, 25, and 50 lb/a stream applied as 28-0-0 or 32-0-0. No N was applied to the cover crop plots. After establishing the rotations, all phases of each rotation were present each year. We were only able to test grain sorghum in the W-S-F rotation because the wheat crops in the W-F and W-S-F rotations winterkilled and were not harvested. We planted Mycogen 627 at 24,600 seeds/a on June 6, 2014 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 15 oz/a, atrazine 0.5 lb/a, AMS 2 lb/a, and Activator 90 8 oz/a. We inserted gypsum blocks at 6 in., 18 in., and 30 in. depths to measure soil water use by the cover crops and the subsequent grain crops. We harvested the grain sorghum on November 10, 2014 with a self-propelled combine equipped with a digital scale. Grain sorghum grain yields were adjusted to 14.0% seed moisture content.

Results and Discussion

Precipitation during the growth and termination of the winter cover crops (seven months, September through March) for the W-F rotation was 5.36 in. After seven months of growth, the average dry matter production of the cover crops was 4097 lb/a. The forage yield of the rapeseed was 6093 lb/a, which was significantly higher than any of the other cover crops.

When terminated after seven months of growth, the cover crops used: 2.93 in. for hairy vetch, 5.27 in. for Winter N Mix, 3.74 in. for rapeseed, and 4.87 in. for triticale of soil water to a depth of three feet. The fallow 0N check used 0.86 in. of soil water to a depth of three feet during the same seven month period. Therefore, subtracting soil water used by cover crops from soil water used during no-till fallow equals the water use cost of cover crops. The water use cost to a soil water depth of three feet was 2.07 in. for hairy vetch, 4.41 in. for Winter N Mix, 2.88 in. for rapeseed, and 4.01 in. for triticale. Rapeseed and hairy vetch had the lowest water use of the cover crops tested. The wheat crop following these winter cover crops winterkilled and was not harvested. Without wheat harvest, we were unable to perform any analysis of the effects of cover crops on wheat production.

The treatment with the highest grain sorghum yield was N at 25 lb/a with 68.0 bu/a; however, it did not produce significantly more yield than the triticale cover crop, which had the second highest grain sorghum yield of 66.5 bu/a. The grain yields of both the 25 lb N/a and the triticale treatments were significantly greater than the other N and cover crop treatments. The grain yields of the five other N and cover crop treatments were not significantly different from one another. Their grain yields ranged from 43 bu/a for hairy vetch to 53 bu/a for the Winter N Mix. Since the grain sorghum was planted in failed winter cover crop plots, there would be no cover crop influence on grain sorghum yields; however, the cost of planting and cover crop seed did have an impact on variable net income.

The 25 lb N/a fertilizer treatment produced the highest variable net income, $234.50/a, because it had the highest grain yield and a low treatment cost. The triticale cover crop treatment had the second highest grain yield and the second highest variable net income of $220.58/a. The lowest variable net income, $90.38/a, was from the hairy vetch cover, which had the lowest yield and the highest treatment cost. Because of the failure of the cover crops and the wheat crops, the value of the cover crops to improve crop yields cannot be determined by the sole harvested crop, the grain sorghum crop, especially considering it followed failed cover crops.

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Table .-Cover Crop Study, Grain Sorghum (W-S-F) after Winter Cover Crop, Walsh, 2014.

Treatment	Grain Sorghum Yield	Test Wt.	Cover Dry Matter	Cover N	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	$/a	$/a
Triticale	66.5	61	0	0.0	28.80	220.58
Rapeseed	49.4	60	0	0.0	16.75	168.50
Winter N Mix	53.2	62	0	0.0	46.25	153.25
Hairy Vetch	42.5	61	0	0.0	69.00	90.38
0 N	46.1	61			0.00	172.88
25 N	68.0	61			20.50	234.50
50 N	46.2	60			35.50	137.75
Average	53.1	61	0	0.0	30.97	168.26
LSD 0.20	9.80					

Cover crops planted: October 2, 2013; Cover crops failed.
Grain sorghum planted: June 6; Harvested: November 10, 2014.
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, 8lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudangrass BMR, 3 lb/a.
Cover seed cost: Winter N Mix, $34.25/a; hairy vetch, $57/a; rapeseed, $4.75/a; triticale, $16.80/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a;
N application, $5.50/a.
Grain sorghum price: $3.75/a.

Table .-Cover Crop Study, Wheat (W-F) after Winter Cover Crop, Walsh, 2014.

Treatment	Wheat Yield	Test Weight	Cover Dry Matter	Cover N	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	$/a	$/a
Triticale	0	0	3120	121.3	28.80	-28.80
Rapeseed	0	0	5821	163.0	16.75	-16.75
Winter N Mix	0	0	2692	94.8	46.25	-46.25
Hairy Vetch	0	0	2133	82.9	69.00	-69.00
0 N	0	0			0.00	0.00
25 N	0	0			20.50	-20.50
50 N	0	0			35.50	-35.50
Average	0	0	3442	115.5	30.97	-30.97
LSD 0.20						

Winter cover crops planted: August 28, 2012, winter cover for W-F; winter cover crops terminated: April 3, 2013.
Cover crop dry matter reported at 0% moisture.
Cover crop N is calculated from dry matter protein divided by 6.25.
Wheat planted: October 15, 2013; wheat winterkilled.
Winter cover crop seeding rate: Winter N Mix, 43 lb/a; hairy vetch , 30 lb/a; rapeseed, 5 lb/a; triticale, 50 lb/a.
Winter N Mix: hairy vetch, 8 lb/a; sweet clover, 2 lb/a; winter forage pea, 8 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudangrass BMR, 3 lb/a.
Cover seed cost: Winter N Mix, $34.25/a; hairy vetch, $57/a; rapeseed, $4.75/a; triticale, $16.80/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a; N application, $5.50/a.
Wheat price: $6.00/a.

Table .-Cover Crop Study, Wheat (W-S-F) after Spring Cover Crop, Walsh, 2014.

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

Spring cover crops planted: March 19, 2014, spring cover for wheat in W-S-F; spring cover crops failed.
Wheat planted: October 15, 2013; wheat winterkilled.
Spring cover crop seeding rate: Spring N Mix, 58 lb/a; hairy vetch , 30 lb/a; rapeseed, 5 lb/a; oats, 60 lb/a.
Spring N Mix: lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a.
Cover seed cost: Spring N Mix, $29.65/a; hairy vetch, $57/a; rapeseed, $4.75/a; oats, $12.60/a.
N fertilizer cost: 28-0-0, $0.60/lb.
Treatment application cost: cover crop planting, $12/a; N application, $5.50/a.
Wheat price: $6.00/a.

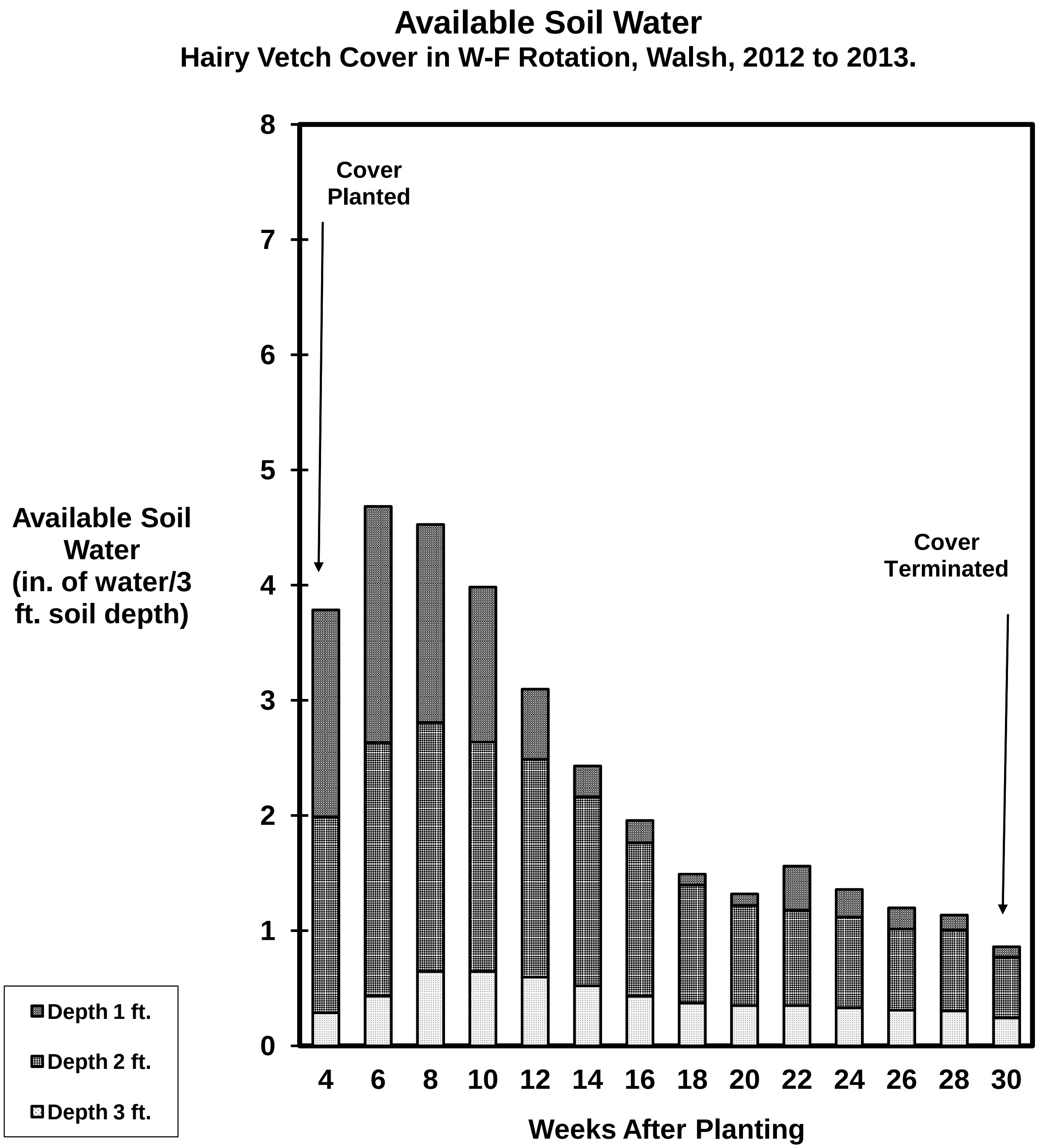

Fig. . Available soil water of Hairy Vetch Cover in W-F Rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 5.36 in. Any increase in available soil water between weeks is from rain.

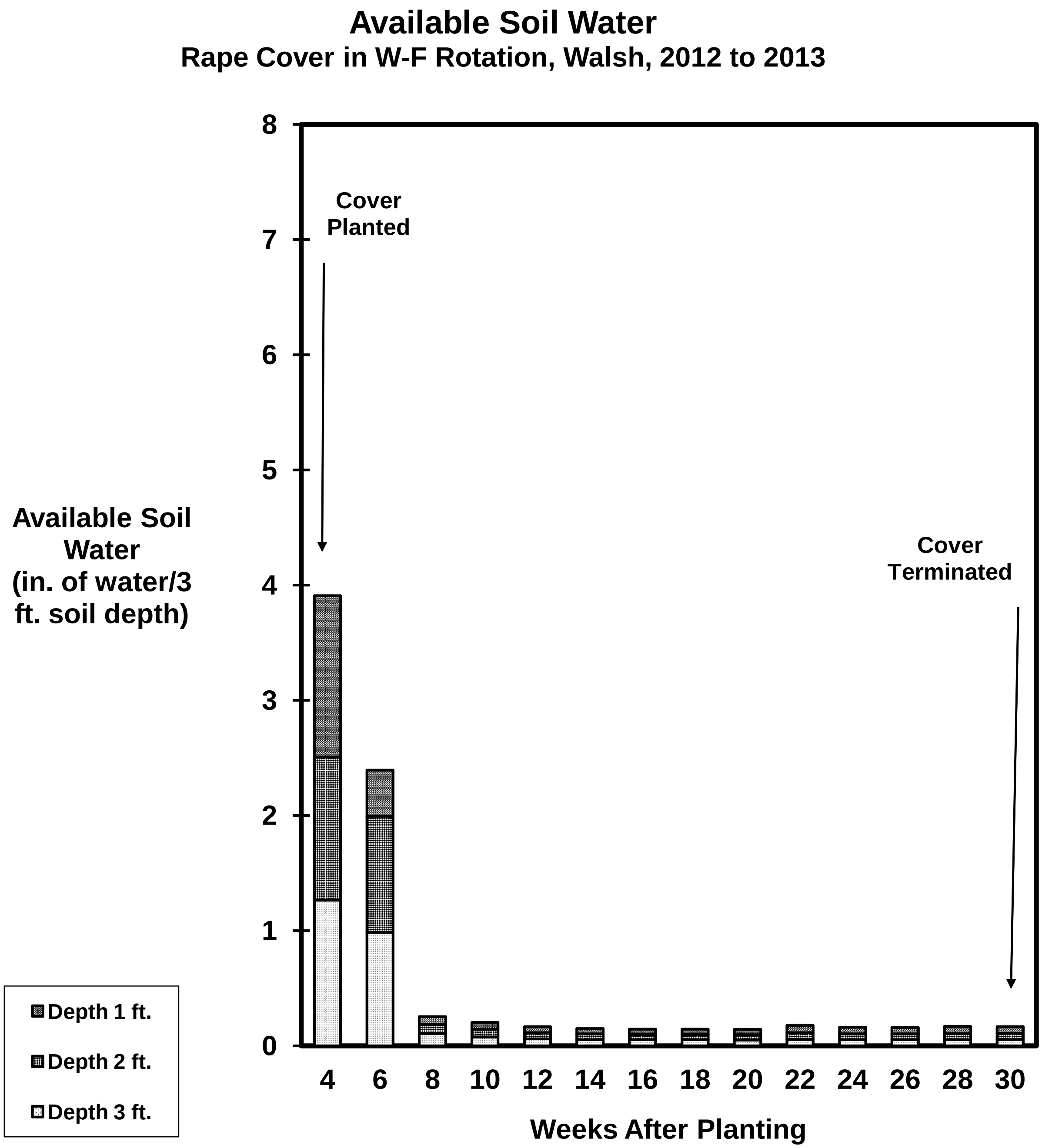

Fig. . Available soil water of Rape Cover in W-F rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 5.36 in. Any increase in available soil water between weeks is from rain.

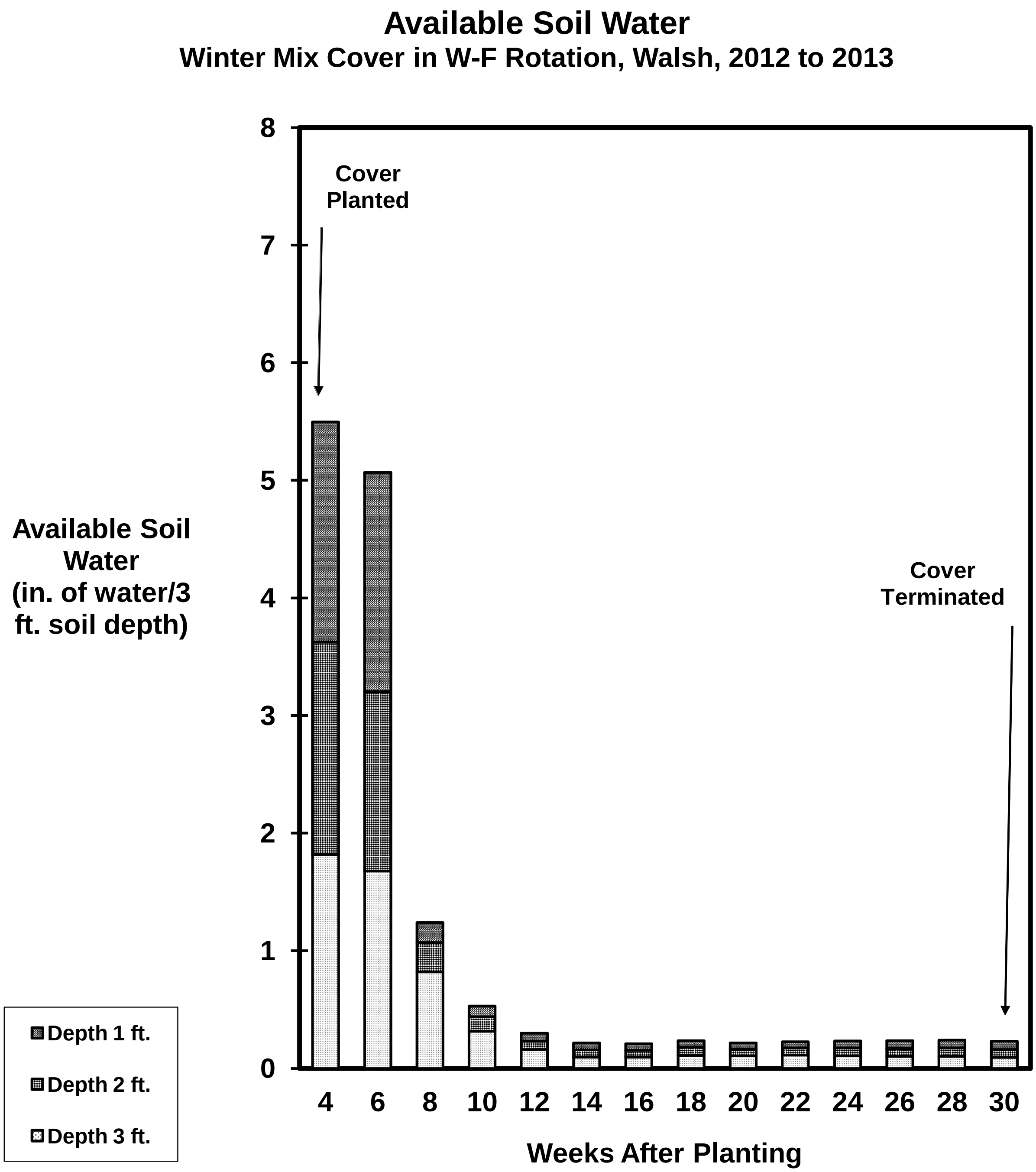

Fig.   . Available soil water of Winter Mix Cover in W-F Rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 5.36 in. Any increase in available soil water between weeks is from rain.

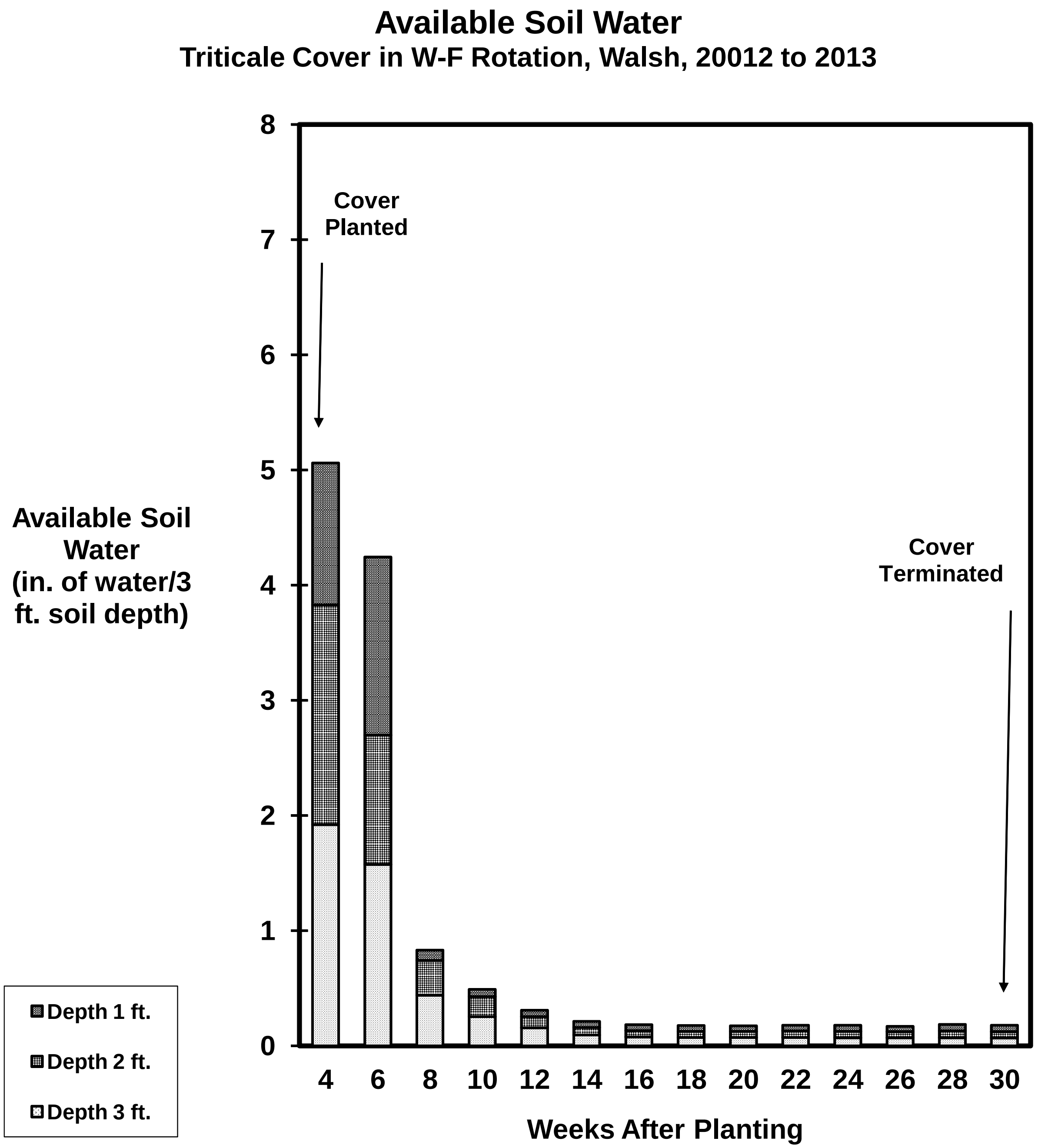

Fig.   . Available soil water of Triticale Cover in W-F Rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 5.36 in. Any increase in available soil water between weeks is from rain.

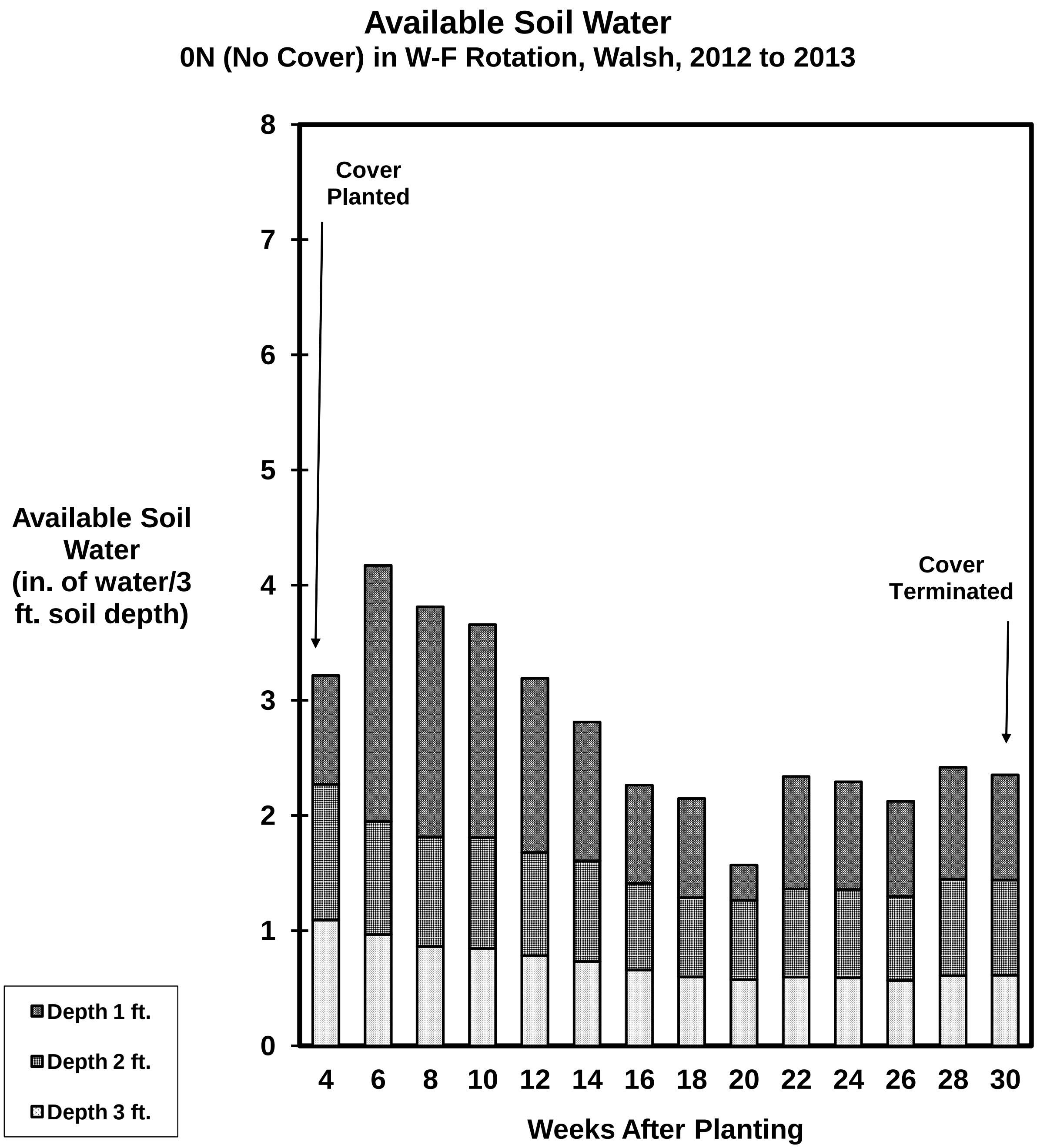

Fig. . Available soil water of 0N (no cover) in W-F rotation at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 5.36 in. Any increase in available soil water between weeks is from rain.

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 third cropping season, we maintained the chemical (no-till) and tillage treatments. For in-season broadleaf weed control in the grain sorghum crop, we applied a tank mix of Huskie 15 oz/a, atrazine 0.5 lb/a, Activator 90 8 oz/a and AMS 1 lb/a. For in-season broadleaf weed control in the wheat crop, we applied Ally Extra 0.4 oz/a, 2,4-D ester 0.38 lb/a, and Activator 90 8oz/a. For N fertilization, we streamed 32-0-0 at 50 lb N/a on 20 in. spacing. We planted wheat, Byrd at 50 lb/a and seedrow applied 5 gal 10-34-0/a, on October 15, 2013. For the sorghum crop, we planted Mycogen 1G557 at 24,600 seeds/a on June 4, 2014 and seedrow applied 5 gal 10-34-0/a at planting. The wheat winterkilled and was not harvested. We harvested the grain sorghum on November 11, 2014 with a self-propelled combine equipped with a digital scale. Grain sorghum yields were adjusted to 14% seed moisture content.

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, we have had only one harvested wheat crop (this year the wheat winterkilled), but this is our third harvested grain sorghum crop. The first wheat crop following our initial burn down or tillage to control the perennial grasses has been our only harvested wheat crop. .

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

We are still in the process of establishing the crop rotations, which last year created a 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.

This year, 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 need the additional tillage operations and extra chemical rates to maintain the tillage and no-till plots. This year with fewer tillage and chemical operations, the cost of both treatments is lower and the difference between chemical and tillage treatments is 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.

Total rotational variable net income (rotational income minus CRP conversion cost and treatment maintenance cost) for the first three years of this study (2012 to 2014) produced strongly negative incomes for the W-F rotation, -$183/a for the chemical treatment and -$158/a for the tillage treatment. The negative incomes for the

W-F rotation are due to harvesting only one low yielding wheat crop. By 2013 after the second grain sorghum crop, the W-S-F rotation was producing positive rotational variable net incomes. Grain sorghum production accounted for nearly all of the total rotational variable net incomes from 2012 to 2014, $251/a for chemical treatment and $166/a for 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 Using Tillage or Chemical, Third Season, Wheat-Sorghum-Fallow, Grain Sorghum Crop, Walsh, 2014.

CRP Conversion	Rotation	Test Weight	Grain Sorghum Yield	Gross Income	Treatment Cost	Variable Net Income
		lb/bu	bu/a	$/a	$/a	$/a
Chemical	W-S-F	60	70.6	264.75	64.64	200.11
Tillage	W-S-F	61	52.7	197.63	48.00	149.63
Average		61	61.7	231.19	56.32	174.87
LSD 0.20			3.05			

Chemical: glyphosate 32 oz/a, dicamba 5 oz/a, 2,4-D 11 oz/a, AMS 2lb/a applied four times.
Chemical cost: $10.16/a and $6.00/a for each application.
Chemical application dates: July 24, September 19, May 9 and June 3
Tillage: swept four times.
Tillage cost: $15/a per disking and $12/a per sweeping.
Tillage application dates: July 24, September 19, May 9 and June 4.
N fertilizer applied at 50 lb/a as 32-0-0.
Grain sorghum, Mycogen 1G557, planted at 24,600 seeds/a and seedrow applied 5 gal 10-34-0/a at planting.
Grain sorghum planted on June 4; harvested on November 11, 2014.
Grain sorghum price: $3.75/bu.
Variable Net Income is Gross Income minus Treatment Cost.

Table .-CRP Conversion, Chemical and Tillage Comparison,
Annual Rotational Income, 2012 to 2014.

Rotation & Conversion Treatment	Conversion Cost	Variable Net Income 2012	2013	2014	2012-2014 Total Rotational Net Income	Average Annual Rotation Variable Net Income
	$/a					
Chemical						
W-S-F	113.10	-34.80	86.04	200.11	251.35	83.78
W-F	113.10	--	-102.23	-80.80	-183.03	-91.52
Tillage						
W-S-F	84.00	-34.63	50.50	149.63	165.50	55.17
W-F	84.00	--	-97.88	-60.00	-157.88	-78.94
Average		-34.72	8.58	67.24	58.46	11.86

The first wheat crop was 2013. The wheat winterkilled in 2014.
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.