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Agricultural Experiment Station

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

Plainsman Research Center 2017 Research Reports

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This Plainsman Research Center booklet is dedicated to:

The Neill Foundation Board:

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

This grant from the Neill Foundation will allow Plainsman to more effectively handle and transport harvested grain from research and commodity acres. This funding helps support agronomic research studies that are the first step to create cost effective change, helping growers become economically viable and sustainable stewards of the land. Thank you.

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

Plainsman Research Center, 2017 Research Reports

Content Page

Content	Page
Winter Wheat Variety Performance Trials	
Overview of 2016-2017 Eastern Colorado wheat trials	1
Dryland wheat variety performance trials, 3-year summary	3
Irrigated wheat variety performance trials, 3-year summary	4
Sorghum Hybrid Performance Trials	
Dryland grain sorghum hybrid performance at Sheridan Lake	5
Dryland grain sorghum hybrid performance at Walsh	7
Drip irrigated grain sorghum hybrid performance at Walsh	10
Dryland forage sorghum hybrid performance at Walsh	13
Sprinkler Irrigated Corn and Grain Sorghum Hybrid Performance Trials	
Overview of sprinkler irrigation on corn and grain sorghum hybrid trials	17
Sprinkler irrigated grain sorghum hybrid performance	18
Sprinkler irrigated corn hybrid performance	21
Corn borer resistant and nonresistant hybrid comparisons	24
Sprinkler full irrigation corn, Hume Farm	26
Crop Rotation Studies	
Dryland crop rotation	28
Four-year (W-C-M-F) and three-year (W-S-F) rotation comparison	33
Dryland millet and wheat rotation	37
The Effects of Spring and Winter Cover Crops on Dryland Crop Production	42
Grain Sorghum Production Studies	
Strip till and no till comparison for dryland grain sorghum production	52
Narrow row air seeder and conventional row vacuum planter comparison	54
Twin row and single row spacing comparison for W-S-F production	56
Pest Management Studies	
Herbicide and single tillage control of kochia for W-S-F production	61
SCA management: avoidance, tolerance, and control	65
Long Term Evaluation of CRP Conversion Back into Crop Production	70
Dryland Galena Genetics Soybean Variety Trial	75

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2017 Climatological Summary
Plainsman Research Center

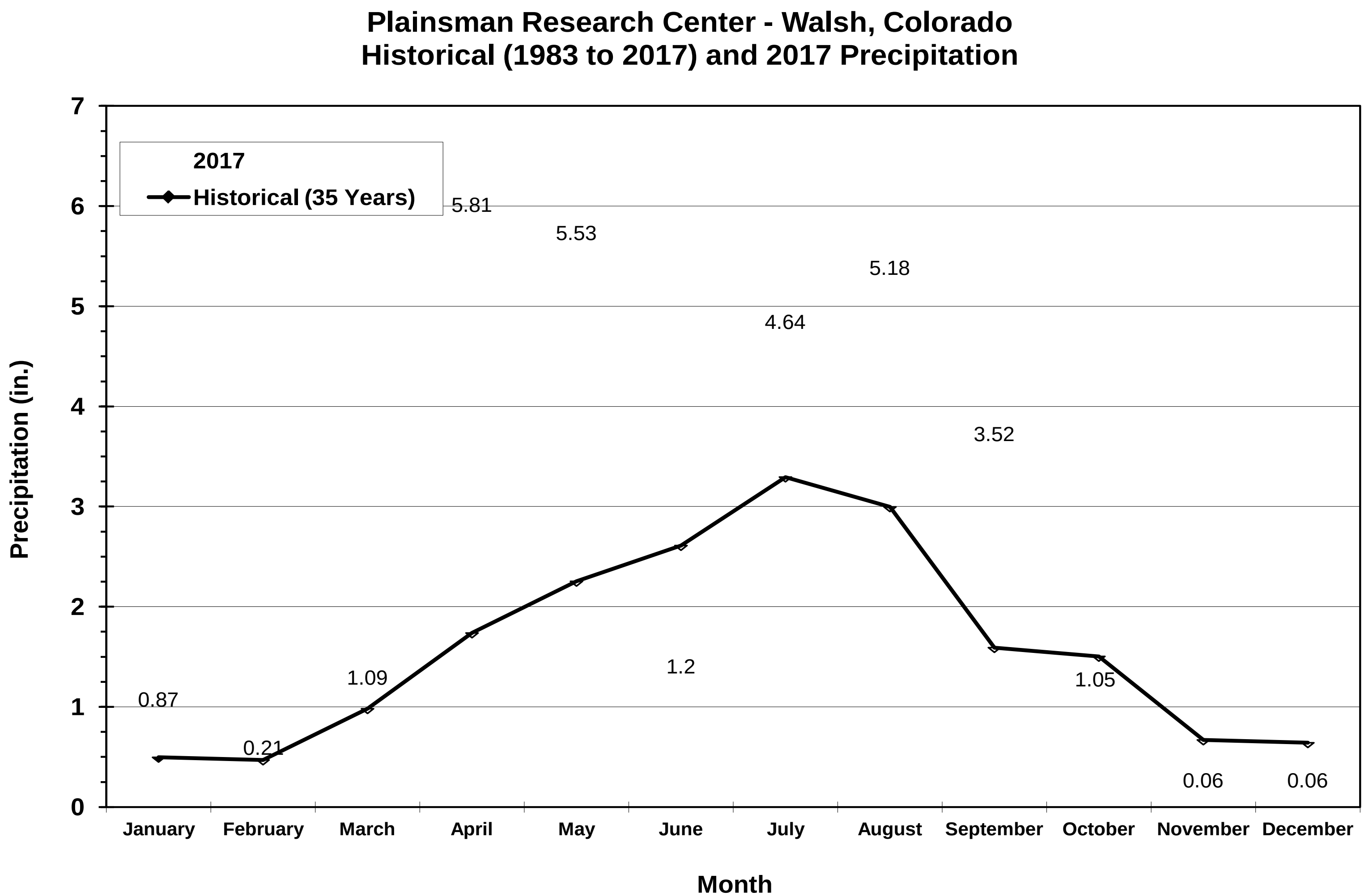
Month	Temperature Max. F	Min. F	Max. Mean F	Min. Mean F	Precip. In.	Greatest Day of Precip-atation	Snow-Fall In.	Greatest Snow Depth In.	Average Soil Temp.	Evapor-ation In.
Jan.	70	-7	44.9	18.2	0.87	0.52	7.00	4.00	31.90	
Feb.	83	5	60.0	25.7	0.21	0.21	0.00	0.00	37.50	
Mar.	88	15	66.5	31.1	1.09	0.97	0.00	0.00	44.50	
Apr.	87	29	66.3	39.7	5.81	1.68	21.00	12.00	49.40	3.48
May	92	30	73.2	45.0	5.53	1.20	5.00	5.00	55.10	7.32
Jun.	102	51	89.3	57.8	1.20	0.42	0.00	0.00	67.30	12.99
Jul.	102	53	92.6	63.5	4.64	1.39	0.00	0.00	72.00	11.23
Aug.	91	48	83.5	58.1	5.18	2.24	0.00	0.00	70.90	6.78
Sept.	93	44	80.9	53.6	3.52	1.85	0.00	0.00	65.60	7.63
Oct.	87	18	71.1	39.1	1.05	0.89	0.00	0.00	56.50	2.72
Nov.	82	18	61.3	31.9	0.06	0.02	0.00	0.00	48.00	
Dec.	74	3	50.3	18.0	0.06	0.02	2.00	0.50	40.60	
Total			**70.0**	**40.14**	**29.22**		**35.00**			**52.15**

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

	2017	2016
Highest Temperature:	102 on June 23, July 12	104 F on July 24
Lowest Temperature:	-7 F on January 7	-14 F on December 18
Last freeze in spring:	30 F on May 1	29 F on May 2
First freeze in fall:	29 F on Oct. 10	26 F on Oct. 7
Frost free season:	162 frost free days	158 frost free days
Avg. Precip for 35 yrs:	19.24 Inches	

Maximum Wind:

Jan.	32 mph on 12th & 24th	July.	35 mph on 8th
Feb.	35 mph on 24th	Aug.	46 mph on 11th
Mar.	45 mph on 25th	Sept.	30 mph on 22nd
Apr.	43 mph on 30th	Oct.	33 mph on 27th
May	43 mph on 1st, 11th, 28th	Nov.	39 mph on 1st
Jun.	61 mph on 26th	Dec.	39 mph on 5th


Plainsman Research Center - Walsh, Colorado
Historical (1983 to 2017) and 2017 Precipitation
2017
Historical (35 Years)
Precipitation (in.)
7
6
5
4
3
2
1
0
5.81
5.53
5.18
4.64
3.52
1.2
1.09
0.87
1.05
0.21
0.06
0.06
January
February
March
April
May
June
July
August
September
October
November
December
Month

Overview of 2016-2017 Eastern Colorado Winter Wheat Trials

Jerry Johnson and Sally Jones

Colorado State University researchers work hard to provide current, reliable, and unbiased wheat variety information to Colorado producers. Support of our research keeps public variety testing thriving in Colorado. Farmer support of public variety testing is our hope for the future. Our work in Colorado is possible due to the support and cooperation of the entire Colorado wheat industry, especially support from the Colorado Wheat Administrative Committee (wheat assessment) and the Colorado Wheat Research Foundation (seed royalties).

We test under a broad range of environmental conditions to best determine expected performance of new varieties. We have a uniform variety testing program, meaning that all dryland varieties are tested in all eleven dryland test locations and all irrigated varieties are tested in all three irrigated trials. There were 46 varieties including experimental lines in each of the 11 dryland trials. The three irrigated trials each had 32 varieties and the 30 collaborative on-farm tests (COFT) each had four varieties. The trials included a combination of public and private varieties and experimental lines from Colorado, Texas, Kansas, Nebraska, Wyoming, and Montana. Seed companies with entries in the variety trials included WestBred (Monsanto), AgriPro (Syngenta), Limagrain Cereal Seeds, and AGSECO. 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 ft2 (except the Fort Collins IVPT, which was 80 ft2) and all varieties were planted at 700,000 seeds per acre for dryland trials and 1.2 million seeds per acre for irrigated trials. Plot sizes for the COFT ranged from 0.25 to 1.5 acres per variety and seeding rates conformed to the wheat seeding rate of the collaborating farmer. Yields were corrected to 12% moisture. Variety trial plot weight, test weight, and grain moisture content information was obtained from a Harvest Master weighing system on the plot combine.

General Growing Season Comments

The 2016-2017 growing season can be characterized by three factors:

Planting followed by rain later in the fall resulted in good stands, except in SE and west-central Colorado where drought conditions prevailed and wheat didn’t emerge until spring. Drought conditions and high winds led to severe blowing in some locations in SE Colorado. Very long fall without freezing temperatures into November favored movement of the wheat curl mite (harboring viruses) from corn and other mite refuges to winter wheat fields. A severe cold snap in November stopped fall growth abruptly.

Dry weather conditions in the winter and early spring. Very warm temperatures in February throughout Colorado. In the spring there were widespread virus symptoms showing on large areas in eastern Colorado.

Above-average and well distributed precipitation at the end of April and in May and June that led to high yields despite prevalence of spring emergence and widespread virus infections. A heat wave in late May reduced the threat of widespread stripe rust infections.

General Growing Conditions in Southeast Colorado - Kelly Roesch

In the Southeast, a very dry fall and warm, dry winter conditions made it challenging to establish good wheat stands. The southernmost part of the area was the most challenging with some fields in Baca County not being planted and some emerged wheat was blown out. Planting conditions were better in the central and northern parts of the area but some fields had spots that didn't germinate until spring. Temperatures were average to slightly warmer in November through February. Moisture during this period followed the historic average.

As a result of warm temperatures and moisture in March, the wheat grew rapidly causing concern for potential damage from a late freeze. Pale western cutworm, army cutworm, and Russian wheat aphid were observed at levels that required treatment in many fields. Very beneficial April rain saved the 2017 wheat crop. An April 29th blizzard brought heavy wet snow and strong winds causing some stem breakage and it laid some fields flat, particularly in areas south of highway 50. In most cases the wheat stood back up and could be harvested. Freeze damage resulting from the storm was minimal as temperatures did not drop as low as predicted and the accumulated snow provided insulation.

As the crop progressed throughout May and June, disease issues were more widespread than in previous years with wheat streak mosaic virus (WSMV) and Triticum mosaic virus (TriMV) being the most prevalent. Stripe rust was present but was less of an issue in 2017 than in the past two years.

Harvest was well underway by June 20th and warm, dry weather in June allowed for the harvest to progress well. Moisture throughout the first two weeks of July caused the remaining harvest to be delayed; however the majority of the crop was completed by mid-July. Variation in yield was wide, ranging from 15 to 90-plus bu/ac across the area. Yields for the area as a whole were above-average.

Dryland Wheat Variety Performance Summary of 3-Yr (2015, 2016 and 2017)

			3-Year Average[a]			
Variety[b]	Brand/Source	Market Class[c]	Yield	Yield	Test Weight	Plant Height
			bu/ac	% trial avg	lb/bu	in
Joe	Kansas Wheat Alliance	**HWW**	78.6	112%	59.6	34
Antero	PlainsGold	**HWW**	78.5	111%	58.4	34
Langin	PlainsGold	HRW	75.6	107%	59.3	31
Oakley CL	Kansas Wheat Alliance	HRW	73.0	104%	58.7	32
Avery	PlainsGold	HRW	72.2	102%	58.8	35
SY Monument	AgriPro Syngenta	HRW	71.8	102%	58.4	32
WB-Grainfield	WestBred Monsanto	HRW	71.8	102%	59.6	33
Byrd	PlainsGold	HRW	71.4	101%	59.2	34
LCS Mint	Limagrain	HRW	70.5	100%	59.2	34
Denali	PlainsGold	HRW	70.5	100%	59.1	35
Sunshine	PlainsGold	**HWW**	70.0	99%	57.5	32
TAM 114	AGSECO	HRW	69.9	99%	59.9	33
Ruth	Husker Genetics	HRW	69.7	99%	60.1	34
Winterhawk	WestBred Monsanto	HRW	68.1	97%	59.2	34
Snowmass	PlainsGold	**HWW**	68.0	96%	58.6	34
Hatcher	PlainsGold	HRW	67.5	96%	57.7	32
SY Wolf	AgriPro Syngenta	HRW	67.5	96%	57.4	32
Cowboy	Crop Res. Foundation of WY	HRW	66.8	95%	56.8	33
Settler CL	Husker Genetics	HRW	64.4	91%	57.4	32
Brawl CL Plus	PlainsGold	HRW	63.3	90%	58.7	33
		Average	**70.5**		**58.7**	**33**

[a]The 3-year average yield and plant heights are based on eight 2017, eight 2016, and nine 2015 trials. Test weights are based on eight 2017, eight 2016, and six 2015 trails.

[b]Varieties ranked according to average 3-year yield.

[c]Market class: HRW=hard red winter wheat; HWW=hard white winter wheat.

Irrigated Wheat Variety Performance Summary of 3-Yr (2015, 2016 & 2017)

			3-Year Average[a]				
Variety[b]	Brand/Source	Market Class[c]	Yield bu/ac	Yield % trial avg	Test Weight lb/bu	Plant Ht. in	Lodging scale (1-9)[d]
Denali	PlainsGold	HRW	92.5	108%	58.5	39	4
SY Sunrise	AgriPro Syngenta	HRW	91.2	106%	58.8	35	3
SY Wolf	AgriPro Syngenta	HRW	90.3	105%	56.3	37	3
Langin	PlainsGold	HRW	88.1	102%	57.5	36	6
KanMark	Kansas Wheat Alliance	HRW	86.4	101%	57.0	33	2
Byrd Brawl	PlainsGold	HRW	85.2	99%	57.4	37	6
CL Plus	PlainsGold	HRW	84.1	98%	57.7	37	2
Sunshine	PlainsGold	**HWW**	83.8	97%	55.0	35	5
Avery	PlainsGold	HRW	83.6	97%	56.9	38	7
Cowboy	Crop Research Fnd of WY	HRW	82.8	96%	55.7	36	8
Antero	PlainsGold	**HWW**	82.0	95%	56.3	38	7
Thunder CL	PlainsGold	**HWW**	81.2	95%	57.3	38	2
		Average	**85.9**		**57.0**	**37**	**5**

[a]The 3-year average yield and test weight are based on two 2015, three 2016, and three 2017 trials. Plant heights are based on two 2015, three 2016, and one 2017 trial. Lodging is base on one 2015, three 2016, and two 2017 trials.

[b]Varieties ranked according to average 3-year yield.

[c]Market class: HRW=hard red winter wheat; HWW=hard white winter wheat.

[d]Lodging scale: 1=no lodging, 9=severe lodging.

Dryland Grain Sorghum Hybrid Performance Trial at Sheridan Lake, 2017

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2700 sorghum heat units in sandy loam soil.

PLOT: Four rows with 30 in. row spacing, 35 ft. long. SEEDING DENSITY: 43,600 seed/ac. PLANTED: June 9. HARVESTED: October 25.

PEST CONTROL: Preemergence Herbicides: (May 2) Panther 2.5 oz/ac, atrazine 0.5 lb/ac, glyphoshate 5 18 oz/ac, 2,4-D ester 6.4 oz/ac, dicamba 2.5 oz/ac; (June 6) S-Metolachlor 21 oz/a, atrazine 0.5 lb/ac, glyphosate 5 18 oz/ac, 2,4-D ester 4.5 oz/ac. Post Emergence Herbicides: None. Cultivation: None. Insecticides: None.

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

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.16	513	14	4	21
July	7.16	805	21	4	52
August	1.60	632	5	0	83
September	2.07	491	13	0	113
October	0.16	291	0	0	138
Total	12.15	2732	75	9	138

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

SOIL: Fort Collins sandy loam. FERTILIZER: Preplant: N at 46 lb/ac; Starter: N at 6.5 lb/ac, S at 6.5 lb/ac, Zn at 0.25 lb/ac.

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

COMMENTS: Planted into good soil moisture and good stand establishment. Good in-season weed control. Received abundant rain throughout July and early August during flowering.

2017 Dryland Grain Sorghum Hybrid Performance Trial at Sheridan Lake

Brand	Hybrid	Grain Yield[a]	Yield	Test Weight	Harvest Plant Population	Plant Height	50% Bloom	Maturity Group[b]	Grain Color
		bu/ac	% of test avg.	lb/bu	plants/ac	in	days after planting		
Dekalb	DKS29-07	76.8	128	54.3	42,834	48	79	ME	Cream
Dekalb	DKS28-05	76.5	128	57.2	40,656	44	64	E	Bronze
Dyna-Gro Seed	M60GB88	75.4	126	54.9	42,834	49	75	ME	Bronze
Dyna-Gro Seed	M59GB57	74.5	125	59.6	42,108	37	67	E	Bronze
Warner Seeds	W 5701	69.5	116	56.1	39,204	46	78	ME	Red
Sorghum Partners	SP 34A19	68.6	115	55.7	41,382	46	79	ME	Bronze
Alta Seeds	AG1203	65.1	109	54.1	39,204	49	80	ME	Bronze
Alta Seeds	ADV G1150	64.1	107	55.1	37,752	44	79	ME	Bronze
Warner Seeds	W 625 Y	64.0	107	56.2	41,382	50	77	ME	Yellow
Dyna-Gro Seed	M71GB01	57.9	97	55.4	38,478	43	59	E	Dark Bronze
Dyna-Gro Seed	GX16535	57.8	97	56.1	33,396	50	82	ME	Bronze/Red
Warner Seeds	W 5901	53.0	89	58.0	39,204	45	78	ME	Red
Gayland Ward Seed	GW-1160	51.8	87	53.6	42,108	51	80	ME	Bronze
Warner Seeds	W 844 E	51.6	86	50.2	41,382	47	91	ML	Red
Dyna-Gro Seed	M60GB31	47.4	79	53.9	39,930	48	79	ME	Bronze
Dyna-Gro Seed	GX16523	45.3	76	56.7	30,492	44	78	ME	White
Dyna-Gro Seed	GX16855	17.5	29	48.7	31,944	53	96	ML	Bronze/Red
Average		**59.8**		**55.0**	**39,076**	**47**	**78**		
[c]LSD (P<0.30)		7.9							

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

[b]Maturity group: E=early; ME=medium-early; ML=medium-late

[c]If the difference between two varieties yields equals or exceeds the LSD value, there is a 70% chance the difference is significant.

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2017

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2800 sorghum heat units in a silt loam soil.

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

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 24 oz/a, Mesotrione 6.4 oz/a Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

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

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

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.20	619	14	3	25
July	4.64	870	23	3	56
August	5.18	641	3	0	87
September	3.52	528	9	0	117
October	1.05	128	0	0	127
Total	15.59	2786	49	6	127

[a]Growing season from June 5 (planting) to October 10 (first freeze, 29 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was very good. Sugarcane aphid populations were very light and below control threshold. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Grain yields and test weights were exceptional with record level grain yields.

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

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.3	0.3	2.1	13	5.5	529	0.6	9.6
8”-24”				15				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Lo	Adeq

Iron was marginal.

Summary: Fertilization.

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

Yield Goal: 40 bu/a.
Actual Yield: 133 bu/a.

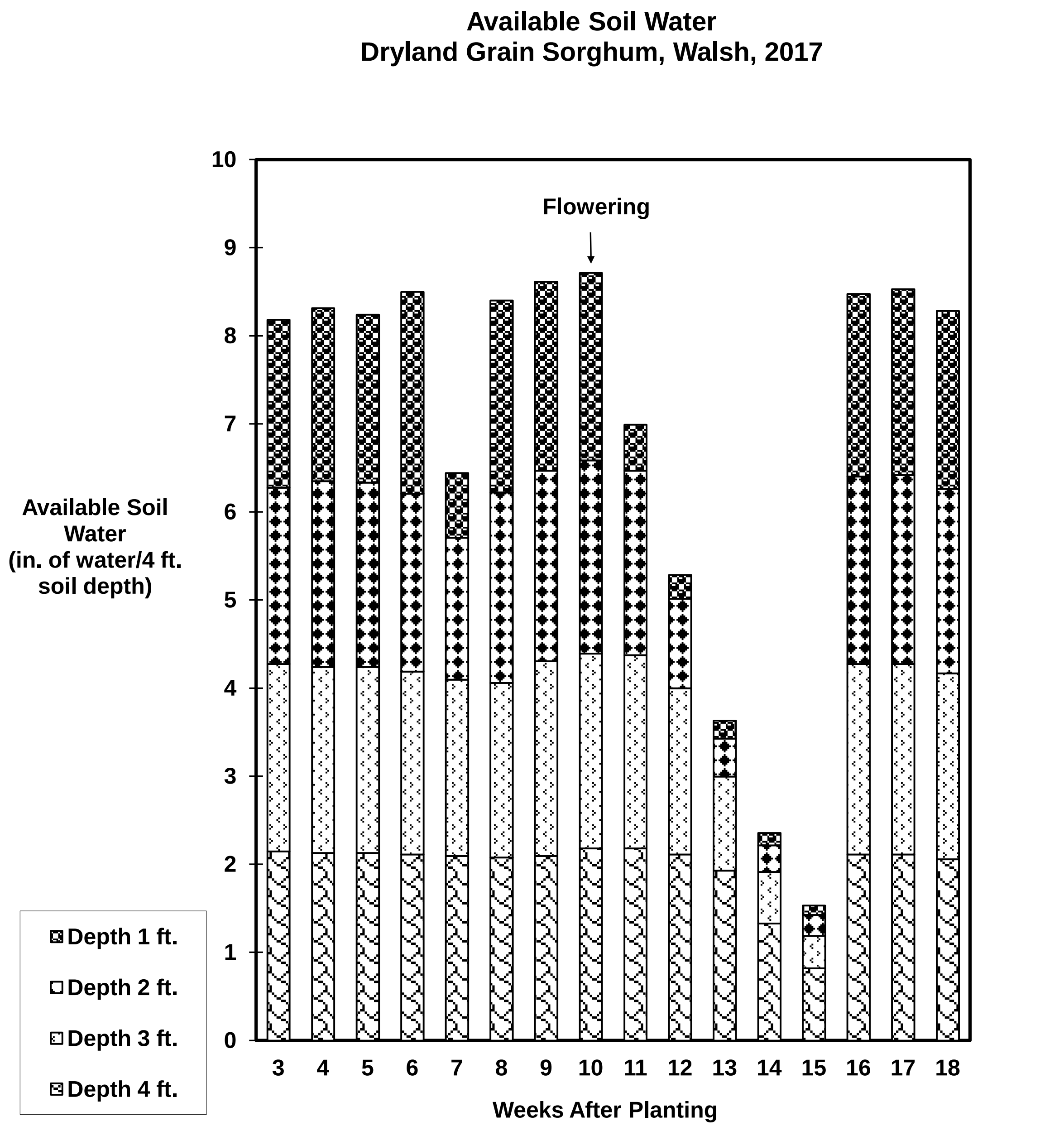


Fig. 1. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 15.59 in. Any increase in available soil water between weeks is from rain.

2017 Dryland Grain Sorghum Hybrid Performance Trial at Walsh

Source	Hybrid	Grain Yield[a]	Yield	Test Weight	Harvest Plant Population	Plant Height	50% Bloom	GDD[b]	50% Mature	Maturity Group[c]	Grain Color
		bu/ac	% of trial avg	lb/bu	plants/ac	in	days after planting		days after planting		
Dyna-Gro Seed	M60GB31	150.4	113	60.3	44,500	58	72	1829	117	ME	Bronze
Alta Seeds	AG1203	146.5	110	61.2	33,300	56	72	1829	116	ME	Bronze
Dyna-Gro Seed	M60GB88	143.5	108	60.1	27,500	56	68	1743	112	ME	Bronze
Gayland Ward Seed	GW Exp 9100	143.0	107	59.4	27,900	66	79	1992	129	ML	-
Alta Seeds	ADV G1150	141.0	106	59.2	31,000	53	74	1871	121	M	Bronze
Heartland Genetics	HG44-R	139.7	105	58.6	29,000	50	74	1871	120	M	Red
AgVenture	7R01	138.9	104	59.3	32,900	55	75	1896	122	M	Red
Gayland Ward Seed	GW Exp 9050	137.6	103	61.3	31,400	55	77	1948	127	ML	-
Warner Seeds	W 5701	137.1	103	60.2	30,600	58	69	1763	117	ME	Bronze
Dyna-Gro Seed	GX16855	135.8	102	58.4	28,700	62	80	2014	128	ML	Red
Gayland Ward Seed	GW Exp 9134	134.3	101	59.4	29,400	63	75	1896	123	M	-
Warner Seeds	W 844 E	134.1	101	59.4	27,500	57	77	1948	128	ML	Bronze
Gayland Ward Seed	GW 15G901	134.0	101	59.6	28,300	66	74	1871	121	M	-
Gayland Ward Seed	GW Exp 9135	132.6	100	59.2	31,600	56	75	1896	124	M	-
Dyna-Gro Seed	GX16535	132.0	99	60.5	25,200	59	72	1829	117	ME	Bronze
Gayland Ward Seed	GW-1160	132.0	99	59.5	33,300	55	74	1871	120	M	Bronze
Dekalb	DKS28-05	131.6	99	59.8	45,700	52	61	1599	109	E	Bronze
Gayland Ward Seed	GW Exp 9092	130.7	98	59.4	30,200	59	71	1807	118	ME	-
Warner Seeds	W 625 Y	130.5	98	60.4	28,700	61	73	1849	121	M	Yellow
Dekalb	DKS29-07	129.3	97	59.8	28,300	57	69	1763	115	ME	Cream
Warner Seeds	W 5901	129.1	97	60.3	27,900	60	67	1724	114	ME	Bronze
Gayland Ward Seed	GW Exp 9127	128.2	96	59.8	33,700	60	74	1871	121	M	-
Gayland Ward Seed	GW Exp 9066	127.7	96	60.4	31,400	63	73	1849	120	M	-
Dyna-Gro Seed	GX16523	127.1	95	59.8	26,300	56	68	1743	114	ME	White
Gayland Ward Seed	GW Exp 9138	125.6	94	61.4	34,100	62	73	1849	120	M	-
Gayland Ward Seed	GW Exp 9139	122.9	92	60.3	34,100	53	75	1896	123	M	-
Heartland Genetics	HG23-R	122.3	92	60.3	35,200	53	67	1724	113	ME	Red
Heartland Genetics	HG Ex-101	121.6	91	60.1	27,900	53	72	1829	118	ME	Bronze
Dyna-Gro Seed	M59GB57	118.5	89	59.6	29,400	48	60	1582	106	E	Bronze
Average		**133.0**		**59.9**	**31,200**	**57**	**72**	**1833**	**119**		
[d]LSD (P<0.20)		6.5									

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

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

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

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

Drip Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2017

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

PURPOSE: To identify high yielding hybrids under subsurface drip irrigated conditions with 2800 sorghum heat units in a silt loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 87,100 seed/a. PLANTED: June 5. HARVESTED: November 1.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 24 oz/a, Mesotrione 6.4 oz/a, Glyphosate 32 oz/a, 2,4-D, 0.5 lb/a, Banvel 5 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a, 2,4-D 0.38 lb/a. Cultivation: Once. Insecticides: None.

Irrigation: Seven subsurface drip irrigations, totaling 9.3 in/a.

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

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.20	619	14	3	25
July	4.64	870	23	3	56
August	5.18	641	3	0	87
September	3.52	528	9	0	117
October	1.05	128	0	0	127
Total	15.59	2786	49	6	127

[a]Growing season from June 5 (planting) to October 10 (first freeze, 29 F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was good. Sugarcane aphid populations were very light and below control threshold. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Grain yields and test weights were exceptional with record level grain yields.

SOIL: Wiley 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	S
		mmhos/cm	%	----------------ppm----------------				
0-8"	8.1	0.5	1.9	14	14.4	714	1.2	16
8"-24"				16				
Comment	Alka	VLo	Hi	Hi	HI	VHi	Marg	Adeq

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	0	1	0
Applied	100	40	0.3	10

Yield Goal: 80 bu/a.
Actual Yield: 142 bu/a.

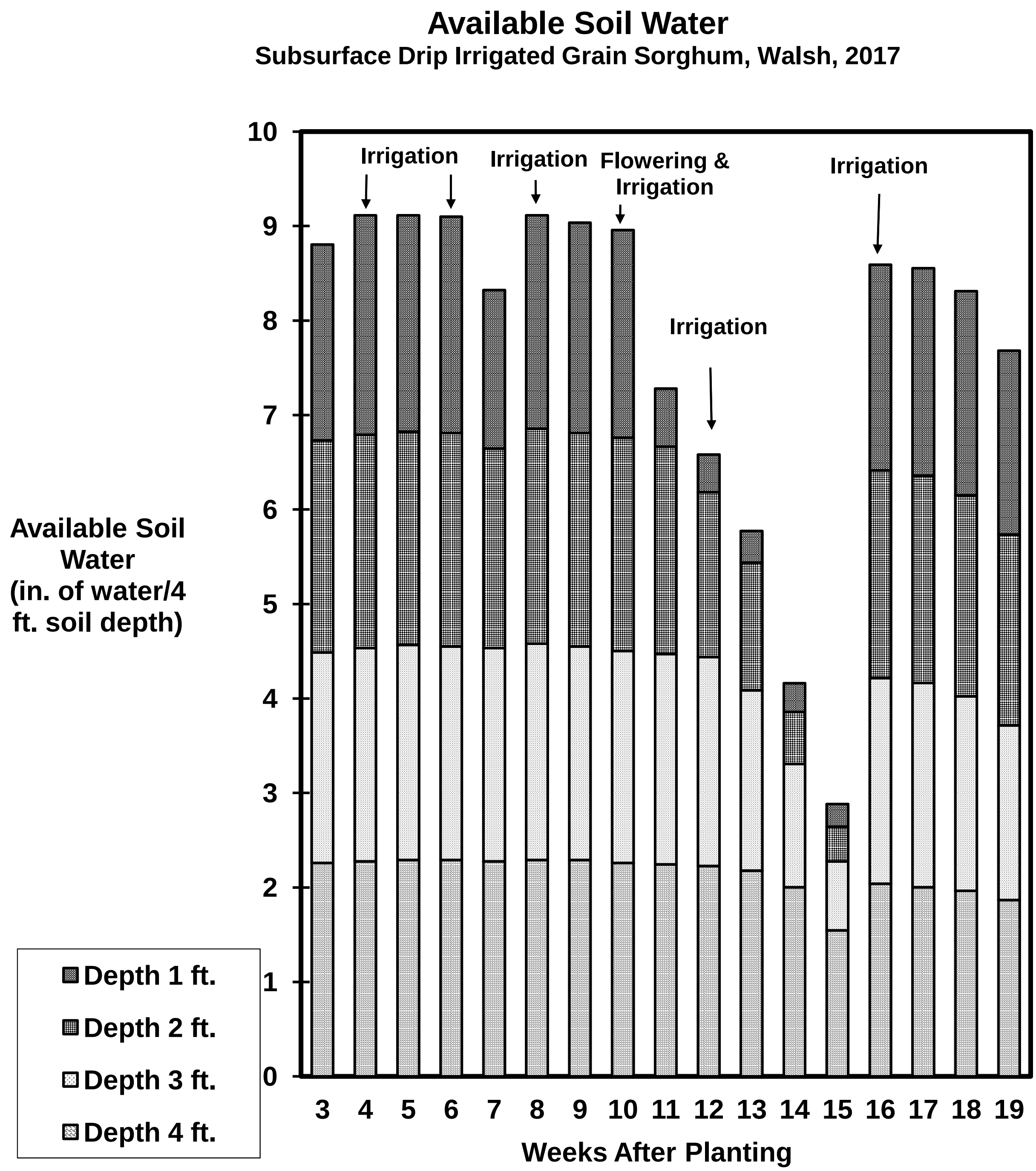


Fig. 2. Available soil water in drip irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 15.59 in. Any increase in available soil water between weeks not attributed to irrigation is from rain

2017 Irrigated Grain Sorghum Hybrid Performance Trial at Walsh

Source	Hybrid	Grain Yield[a]	Yield	Test Weight	Harvest Plant Population	Plant Height	50% Bloom	GDD[b]	50% Mature	Maturity Group[c]	Grain Color
		bu/ac	% of trial avg	lb/bu	plants/ac	in	days after planting		days after planting		
Gayland Ward Seed	GW Exp 9100	163.2	115	59.0	45,900	68	78	1974	127	ML	-
Dekalb	DKS45-23	158.2	111	59.1	53,400	62	75	1896	123	M	Bronze
Dekalb	DKS53-53	156.0	110	59.4	51,300	60	77	1948	127	ML	Bronze
Dekalb	DKS51-01	155.1	109	58.7	48,200	63	75	1896	123	M	Bronze
Alta Seeds	AG1203	152.6	108	58.7	47,900	57	70	1784	117	ME	Bronze
AgVenture	7R01	152.2	107	56.6	47,900	55	75	1896	122	M	Red
Gayland Ward Seed	GW 15G901	151.6	107	57.7	51,600	67	71	1807	119	ME	-
Dekalb	DKS38-16	150.1	106	60.7	52,700	63	69	1763	118	ME	Bronze
Gayland Ward Seed	GW Exp 9135	146.7	103	56.1	45,600	59	75	1896	123	M	-
Gayland Ward Seed	GW-1160	146.5	103	57.8	53,100	57	74	1871	121	M	Bronze
Scott Seed Co	502/15	144.6	102	56.5	49,300	58	78	1974	127	ML	Red
Gayland Ward Seed	GW Exp 9050	144.2	102	59.6	44,100	58	77	1948	128	ML	-
Scott Seed Co	545/15	143.7	101	56.6	45,600	56	75	1896	123	M	Red
Dyna-Gro Seed	GX16855	143.5	101	56.2	46,700	65	79	1992	128	ML	Red
Dyna-Gro Seed	GX16535	143.1	101	59.7	52,000	61	71	1807	117	ME	Bronze
Scott Seed Co	504/6	142.7	101	56.5	48,600	58	79	1992	129	ML	Red
Gayland Ward Seed	GW Exp 9066	140.4	99	58.6	44,100	64	75	1896	121	M	-
Dyna-Gro Seed	M60GB88	140.0	99	57.1	54,200	56	68	1743	115	ME	Bronze
Gayland Ward Seed	GW Exp 9134	138.9	98	57.9	41,100	66	75	1896	123	M	-
Dyna-Gro Seed	M60GB31	136.5	96	58.9	45,200	58	73	1849	119	ME	Bronze
Gayland Ward Seed	GW Exp 9092	136.3	96	56.0	50,900	64	72	1829	118	ME	-
Gayland Ward Seed	GW Exp 9127	134.4	95	57.8	51,900	62	70	1784	119	ME	-
Gayland Ward Seed	GW Exp 9139	134.2	95	58.6	43,700	53	75	1896	124	M	-
Gayland Ward Seed	GW Exp 9138	134.1	95	59.2	44,800	64	70	1784	118	ME	-
Alta Seeds	ADV G1150	131.1	92	57.8	51,600	53	74	1871	121	M	Bronze
Dyna-Gro Seed	GX16523	127.9	90	58.2	42,900	58	68	1743	115	ME	White
Scott Seed Co	505/5	123.1	87	59.6	52,400	54	58	1548	105	E	Red
Dyna-Gro Seed	M59GB57	122.9	87	59.6	55,800	48	58	1548	105	E	Bronze
Gayland Ward Seed	GW 15G926	120.3	85	57.6	41,800	66	76	1920	126	ML	-
Average		**141.9**		**58.1**	**48,400**	**60**	**73**	**1850**	**121**		
[d]LSD (P<0.20)		8.4									

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

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

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

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

Dryland Forage Sorghum Performance Trial at Walsh, 2017

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2800 sorghum heat units in a silt loam soil.

PLOT: Four rows with 30 in. row spacing, 50 ft. long. SEEDING DENSITY: 69,700 seed/a. PLANTED: June 5. HARVESTED: October 23.

PEST CONTROL: Preemergence Herbicides: Atrazine 1 lb/a, S-Metolachlor 24 oz/a. Post Emergence Herbicides: Huskie 16 oz/a, Atrazine 0.75 lb/a, AMS 1 lb/a. Cultivation: None. Insecticides: None.

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

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

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------no. of days--------		
June	1.20	619	14	3	25
July	4.64	870	23	3	56
August	5.18	641	3	0	87
September	3.52	528	9	0	117
October	1.05	128	0	0	127
Total	15.59	2786	49	6	127

[a]Growing season from June 6 (planting) to October 10 (first freeze, 29F).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination and plant stand. Weed control was very good. Sugarcane aphid populations were very light and below control threshold. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Record level silage yields.

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

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8"	8.2	0.5	1.6	8	5.0	524	0.6	10
8"-24"				11				
Comment	Alka	VLo	Hi	Mod	Lo	VHi	Lo	Marg

Iron was marginal.

Summary: Fertilization.

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

Yield Goal: 8 tons/a.
Actual Yield: 21.9 tons/a.

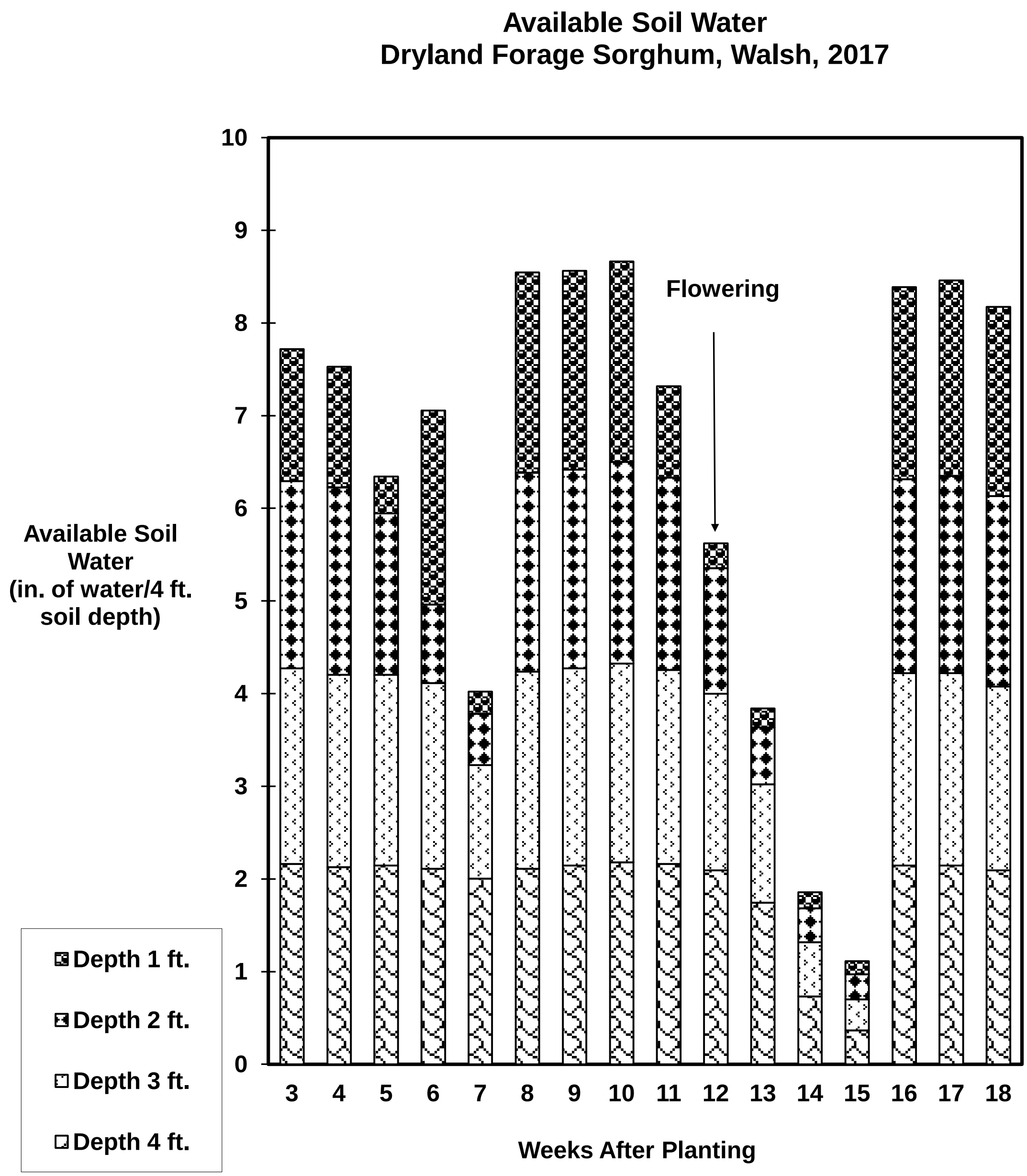


Fig. 3. Available soil water in dryland forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 15.59 in. Any increase in available soil water between weeks is from rain.

2017 Dryland Forage Sorghum Hybrid Performance Trial at Walsh

Brand	Hybrid	Forage Yield[a]	Yield	Stem Sugar	Harvest Density	Plant Height	Lodging	Days to Boot	Relative Maturity[b]	Forage Type[c]	Traits[d]
		tons/ac	% of test avg.	%	plants/ac	in	%	days after planting			
Alta Seeds	AF7401	27.9	127	11.1	51,900	76	0	89	L	FS	BMR-6, BD
Dyna-Gro Seed	705F	27.7	126	5.2	51,500	88	0	82	M	FS	-
Alta Seeds	AF8301	25.1	115	6.9	48,800	89	18	79	M	FS	BMR
Gayland Ward Seed	GW-2120 (sterile)	25.1	114	13.0	46,500	100	0	73	ME	FS	MS
Dyna-Gro Seed	F74FS23 BMR	24.7	113	10.4	53,800	119	0	84	M	FS	BMR
Alta Seeds	XF7302	22.9	104	11.4	48,800	66	0	91	L	FS	BMR-6, BD
Alta Seeds	XF7303	22.9	104	7.5	43,800	60	0	87	L	FS	BMR-6, BD
Dyna-Gro Seed	Fullgraze BMR	21.9	100	13.5	47,200	122	0	94	L	SS	BMR
Gayland Ward Seed	Sweet Forever BMR	21.9	100	14.8	46,900	119	7	88	PS	SS	BMR
Dyna-Gro Seed	F73FS10	21.2	96	11.5	45,300	104	35	71	ME	FS	-
Dyna-Gro Seed	F76FS77 BMR	21.1	96	14.0	46,100	72	0	91	L	FS	BMR, BD
Gayland Ward Seed	Nutri King BMR 6	21.0	96	8.5	48,400	110	0	60	E	SS	BMR-6, BD
Gayland Ward Seed	Super Sugar (delayed mat.)	20.9	95	11.4	52,700	120	0	87	L	SS	-
Gayland Ward Seed	GW-400 BMR (sterile)	20.6	94	13.7	49,200	116	5	70	ME	FS	BMR, MS
Gayland Ward Seed	Sweet Six BMR	20.0	91	13.0	51,900	120	0	60	E	SS	BMR, DS
Channel Seed	216-36DTGVT2PRIB	17.5	80	5.5	48,000	78	10	62	M	Corn	-
Alta Seeds	XF7103	17.1	78	6.8	43,800	67	0	68	ME	FS	BMR-6, BD
Dyna-Gro Seed	Danny Boy BMR	15.6	71	12.5	45,300	128	0	93	L	SS	BMR
Average		**21.9**		**10.6**	**48,328**	**97**	**4**	**79**			
[e]LSD (P<0.20)		3.6									

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

[b]Relative maturities are provided by the companies. E=early; ME=medium-early; M=medium; ML=medium-late; L=late; PS=photoperiod sensitive

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

[d]Traits are provided by the companies. Dashes mean conventional (no traits) or information isn't available. BD=brachytic dwarf; BMR=brown mid-rib; BMR-6=one of the three main brown mid-rib genes; DS=dry stalk; MS=male sterile

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

2017 Dryland Forage Sorghum Hybrid Performance Trial Feed Quality at Walsh

Brand	Hybrid	Forage Type[a]	RFQ	CP	ADF	NDF	NDFD	IVTDMD	TDN	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				percent						MCal/lb		
Alta Seeds	XF7303	FS	172	8.8	33.2	56.8	80	78.7	64.7	0.67	0.40	0.67
Dyna-Gro Seed	Fullgraze BMR	SS	163	8.4	34.8	58.8	75	78.7	62.9	0.64	0.38	0.65
Alta Seeds	AF7401	FS	160	12.2	33.2	57.5	76	77.5	64.7	0.67	0.40	0.67
Dyna-Gro Seed	Danny Boy BMR	SS	159	9.5	37.4	61.9	74	75.8	59.9	0.59	0.33	0.61
Alta Seeds	XF7103	FS	156	12.6	31.5	62.2	67	78.0	66.6	0.69	0.42	0.69
Dyna-Gro Seed	F76FS77 BMR	FS	155	8.1	35.6	61.0	73	73.1	62.0	0.63	0.36	0.64
Dyna-Gro Seed	F74FS23 BMR	FS	151	10.2	37.5	63.0	74	74.5	59.8	0.59	0.33	0.61
Gayland Ward Seed	Sweet Six BMR	SS	147	15.0	35.1	63.2	72	75.1	62.5	0.63	0.37	0.64
Gayland Ward Seed	Nutri King BMR 6	SS	146	14.9	35.8	62.6	73	77.2	61.7	0.62	0.36	0.63
Alta Seeds	XF7302	FS	140	10.4	34.6	62.6	57	70.2	63.1	0.64	0.38	0.65
Gayland Ward Seed	GW-400 BMR (sterile)	FS	137	13.5	38.9	64.0	72	75.4	58.2	0.57	0.31	0.59
Alta Seeds	AF8301	FS	135	11.1	36.5	63.2	64	69.7	60.9	0.61	0.35	0.62
Gayland Ward Seed	GW-2120 (sterile)	FS	134	12.7	37.8	62.6	65	72.9	59.4	0.59	0.33	0.61
Channel Seed	216-36DTGVT2PRIB	Corn	128	10.5	38.0	66.2	62	71.1	59.3	0.58	0.33	0.61
Dyna-Gro Seed	F73FS10	FS	128	13.7	39.4	65.4	65	70.4	57.7	0.56	0.30	0.59
Gayland Ward Seed	Super Sugar (DM)	SS	126	9.5	38.8	65.8	62	69.3	58.3	0.57	0.31	0.60
Dyna-Gro Seed	705F	FS	118	9.9	38.6	65.1	58	66.9	58.6	0.57	0.32	0.60
Gayland Ward Seed	Sweet Forever BMR	SS	118	8.7	41.6	69.8	64	70.7	55.2	0.52	0.27	0.56
Average			**143**	**11.1**	**36.6**	**62.9**	**69**	**73.6**	**60.9**	**0.61**	**0.35**	**0.62**

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

RFQ=relative forage quality; CP=crude protein; ADF=acid detergent fiber; NDF=neutral detergent fiber; NDFD=neutral detergent fiber digestibility; IVTDMD=in vitro total dry matter digestibility; TDN=total digestible nutrients; Main.=Maintenance; Lact.=Lactation.

Sprinkler Irrigation on Corn and Grain Sorghum, Walsh 2017

Kevin Larson, Brett Pettinger and Perry Jones

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

MATERIALS AND METHODS: We tested 12 corn hybrids and 14 grain sorghum hybrids under sprinkler irrigation. We planted the corn study on May 6 at 26,000 seeds/a, and the grain sorghum study on June 1 at 50,000 seeds/a. We fertilized both studies using a strip-till implement with 175 lb N/a to the corn and 125 lb N/a to the grain sorghum with 20 lb P_2O_5/a as 10-34-0, and at planting we seedrow applied an additional 20 lb P_2O_5/a, and 0.38 lb Zn/a. We applied 8 acre-in./a of water to the corn and to the grain sorghum we applied 6 acre-in./a of water using a sprinkler. The plot size was at least four 30 in. rows, 600 ft. long that we harvested with a self-propelled combine and weighed them in a digital weigh cart. Seed moisture was adjusted to 15.5% for corn and 14% for grain sorghum.

RESULTS: Yields and test weights for both corn and grain sorghum were good, despite having both of our generators breaking down and not irrigating from the middle of August to the end of the season. Timely and abundant rains (18.50 in/a from corn planting to the first freeze) contributed to high yields and test weights of these studies. June was the only dry month, May and July through September had well above average precipitation. August was cool with only three days above 90F. With our June 1 grain sorghum planting date, the grain sorghum hybrids were able to mature and produce high test weights in spite of the cool August.

DISCUSSION: Production was very good for both the irrigated corn and grain sorghum studies. Typical yield goals for these studies are 150 bu/a for corn and 90 bu/a for grain sorghum. To exceed our yield goal by more than 20 bu/a for both studies is quite good. Even though the grain yields were good, there were two factors that reduced overall production. First, stand establishment in the sprayer wheel tracks was poor. Second, both of our generators broke down and we were unable to irrigate past mid August. Fortunately, rainfall for the season was well above average and we were able to partially compensate for the lack of wheel track stand and lack of grain filling irrigation.

Sprinkler Irrigated Grain Sorghum Study at Walsh, 2017

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

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

RESULTS: The 14 grain sorghum hybrids tested averaged 119 bu/a. The yield ranged from 104 bu/a for Dyna-Gro 3838 to 129 bu/a for Channel Seed 7B30. Medium early and later maturing hybrids produced the highest yields.

PLOT: Four rows with 30 in. row spacing, at least 600 ft. long. SEEDING DENSITY: 50,000 seeds/a. PLANTED: June 1. HARVESTED: November 8 & 9.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 24 oz/a, Mesotrione 6.4 oz/a; Post Herbicides: Huskie 16 oz/a; Atrazine 0.75 lb/a. INSECTICIDE: None CULTIVATION: Once.

FIELD HISTORY: Previous Crop: Grain sorghum. FIELD PREPARATION: Disced 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--------			
June	1.20	0.00	707	14	3	30
July	4.64	4.00	870	23	3	61
August	5.18	2.00	641	3	0	92
September	3.52	0.00	528	9	0	122
October	1.05	0.00	128	0	0	132
Total	15.59	6.00	2874	49	6	132

\1 Growing season from June 1 (planting) to October 10 (freeze, 29F).
\2 Total in-season water from irrigation and precipitation was 21.59 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture for seed germination. Stand establishment was poor down sprayer track rows. Weed control was good. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Grain yields and test weights were good. We applied 6 in/a of irrigation and was not irrigated from mid August to harvest.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.3	0.5	1.6	9	4.7	610	1.1	14.1
8”-24”				9				
Comment	Alka	VLo	Hi	Mod	Lo	VHi	Marg	Adeq

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	13	20	1	0
Applied	125	40	0.4	0

Yield Goal: 90 bu/a.
Actual Yield: 119 bu/a.

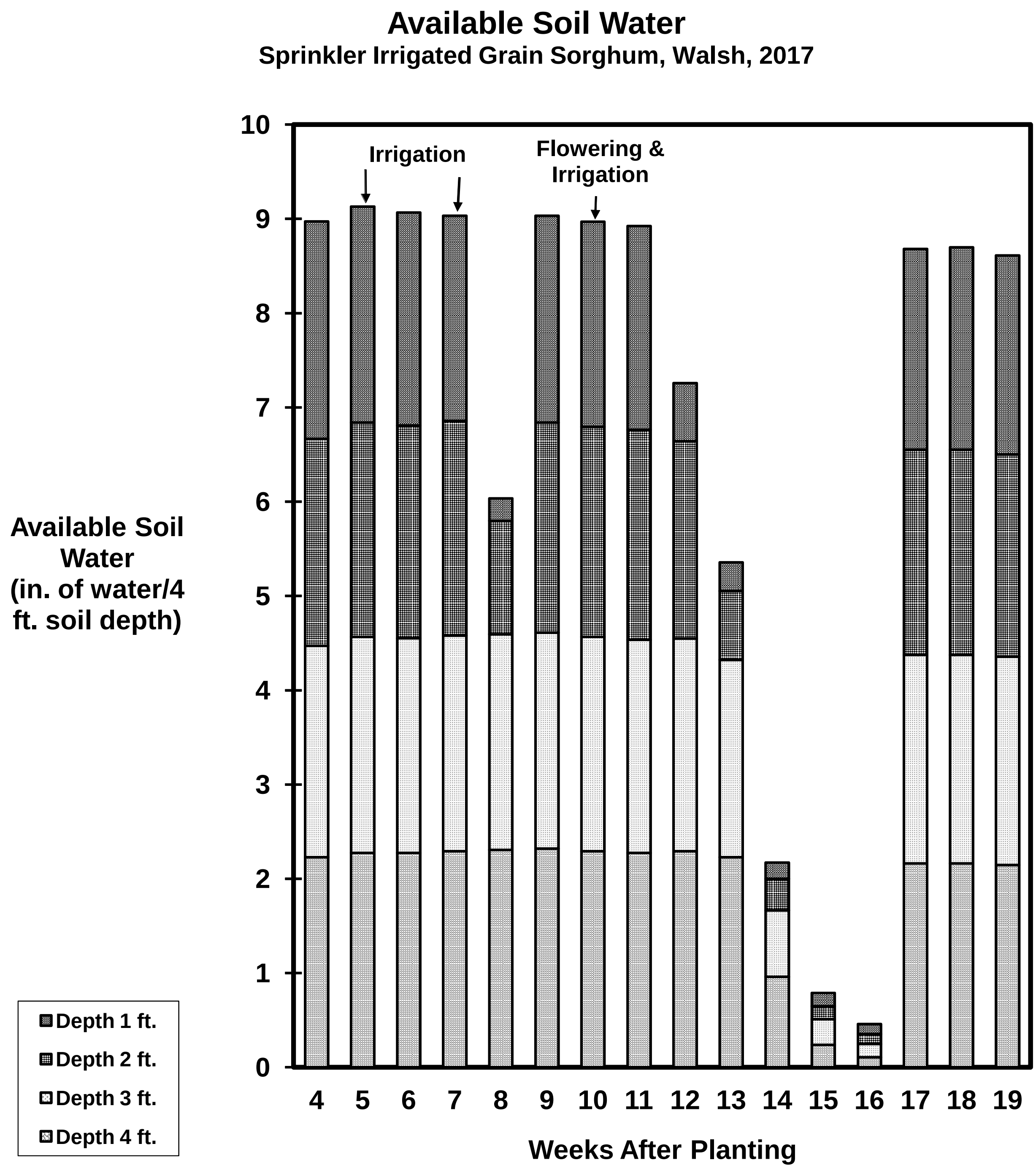


Fig. . Available soil water in limited sprinkler irrigation grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 15.59 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigated Grain Sorghum, Plainsman Research Center, Walsh, 2017.

Brand	Hybrid	Grain Yield	Seed Moisture Content	Test Weight	Plant Density	Plant Height	50% Flowering Date	50% Maturity Date
		bu/a	%	lb/bu	plants/a (1000X)	in		
Channel Seed	7B30	128.5	14.9	59.8	33.6	61	8/20	10/9
Channel Seed	6B60	128.4	14.8	59.4	36.8	61	8/13	9/28
Channel Seed	7B65	127.5	15.0	59.0	33.6	53	8/14	9/29
Alta Seeds	XG3203	126.7	15.7	57.3	34.8	65	8/23	10/6
Alta Seeds	AG1203	126.3	15.2	59.6	42.8	55	8/14	9/29
Pioneer Seed	85Y40	125.5	15.2	60.0	39.2	55	8/10	9/26
Alta Seeds	AG3201	122.3	15.0	58.9	34.8	58	8/22	10/7
Golden Acres	3960B	113.3	15.2	59.6	40.0	53	8/11	9/26
Pioneer Seed	86P20	113.3	15.2	59.6	44.8	51	8/1	9/15
Channel Seed	6B02	112.9	15.2	58.4	38.8	57	8/10	9/25
Alta Seeds	ADV G1150	112.5	15.3	58.4	32.4	52	8/12	9/27
Channel Seed	5B90	111.7	14.7	59.5	44.4	55	8/6	9/22
Channel Seed	5C42	106.7	15.4	58.0	40.8	55	8/9	9/24
Dyna-Gro Seed	3838	103.8	14.9	60.1	44.8	51	8/15	10/3
Average		118.5	15.1	59.1	38.7	56	8/12	9/28
LSD 0.20		10.9						

Planted: June 1; Harvested: November 8 and 9, 2017.
50% Flowering Date: minimum date on which a hybrid flowers on half of its population.
50% Maturity Date: minimum date on which a hybrid has mature seed on half of its population.
Sprinkler irrigated grain sorghum received 6 acre-in of applied water.
Yields are adjusted to 14.0% seed moisture content.

Sprinkler Irrigation Corn Study at Walsh, 2017

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

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

RESULTS: The average yield for all 12 hybrids tested was 179 bu/a. Three of the five seed firms (Channel, LG Seeds, and Mycogen Seeds) entered in this trial had at least one hybrid that produced above the trial average.

PLOT: Four rows with 30” row spacing, at least 600’ long. SEEDING DENSITY: 26,000 seeds/a. PLANTED: May 16. HARVESTED: November 16 and 17.

PEST CONTROL: Preemergence Herbicides: Atrazine 1lb/a, S-Metolachlor 24 oz/a, Mesotrione 6.4 oz/a; Post Herbicides: Glyphosate 32 oz/a, Dicamba 8 oz/a. CULTIVATION: Once. INSECTICIDE: Comite 54 oz/a for mites, Reveal 6.7 oz/a for grasshoppers.

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	2.91	0.00	191	1	0	15
June	1.20	2.00	619	14	3	45
July	4.64	4.00	870	23	3	76
August	5.18	2.00	641	3	0	107
September	3.52	0.00	528	9	0	137
October	1.05	0.00	128	0	0	147
Total	18.50	8.00	2977	50	6	147

\1 Growing season from May 16 (planting) to October 10 (freeze, 29F).
\2 Total in-season water from irrigation and precipitation was 26.50 in/a.
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture for seed germination. Stand establishment was poor down sprayer track rows. Weed control was good. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Grain yields and test weights were good. We applied 8 in/a of irrigation and was not irrigated from mid August to harvest.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.3	0.6	1.8	9	6.9	528	0.9	22.7
8”-24”				9				
Comment	Alka	VLo	Hi	Mod	Med	VHi	Lo	Adeq

Iron was marginal.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	S
	-------------------lb/a------------------			
Recommended	122	20	2	0
Applied	175	40	0.4	0

Yield Goal: 150 bu/a.
Actual Yield: 179 bu/a.

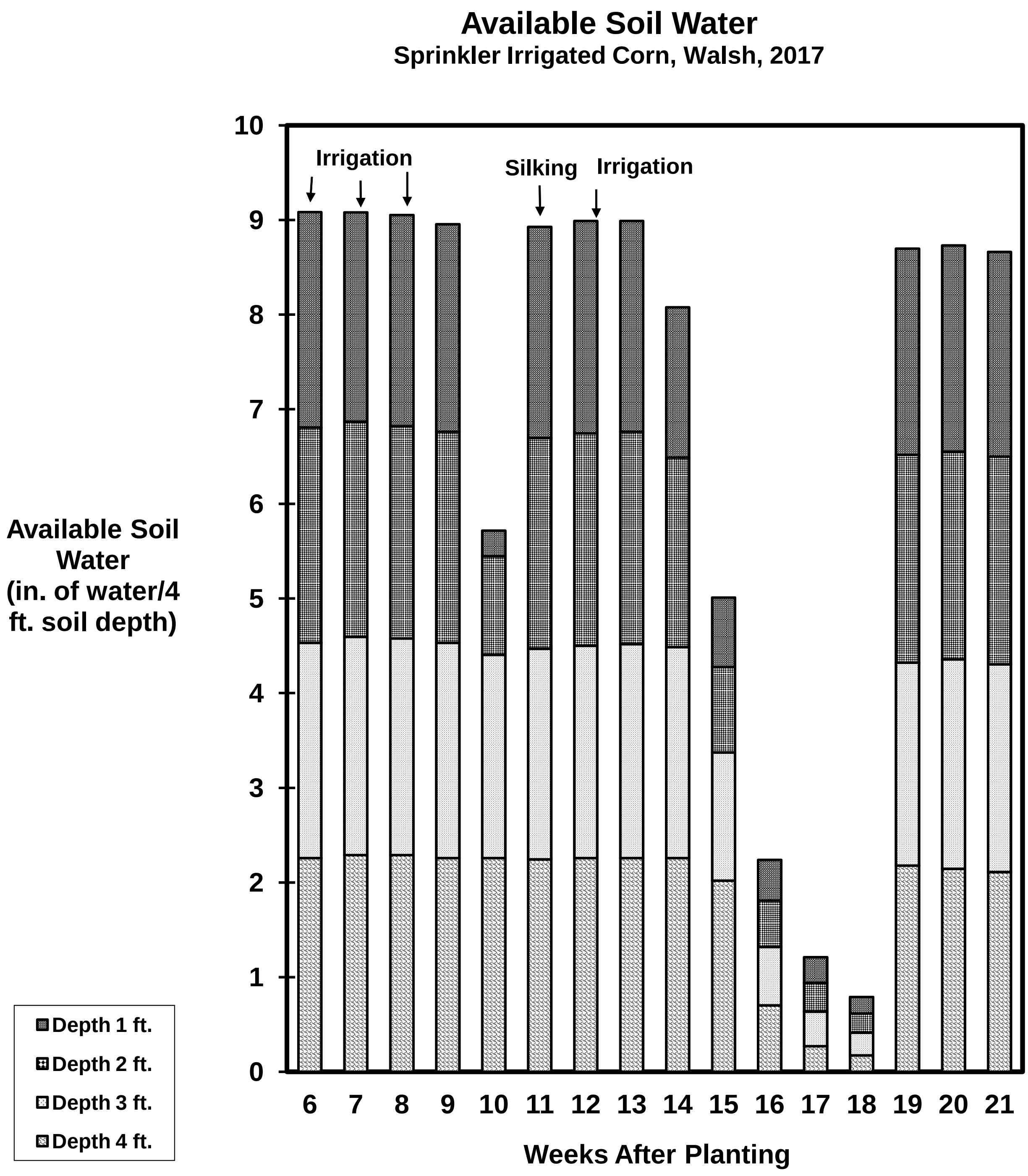


Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 18.50 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Sprinkler Irrigated Corn, Plainsman Research Center, 2017.

Brand	Hybrid	Grain Yield	Seed Moisture	Test Weight	Plant Density	50% Silking Date
		bu/a	%	lb/bu	plants/a (X 1000)	
LG Seeds	LG5618 STXRIB	191.7	13.0	60.6	25.2	27-Jul
LG Seeds	LG5606 STX	182.5	12.2	61.6	26.0	28-Jul
LG Seeds	LG5663 VT2RIB	182.3	12.6	61.3	24.8	29-Jul
Mycogen Seeds	2V709	182.0	12.8	58.3	25.6	27-Jul
LG Seeds	LG5643 STXRIB	181.3	13.1	59.9	24.6	30-Jul
Channel Seed	215-75 STXRIB	181.0	13.3	60.2	26.0	30-Jul
LG Seeds	LG5616-3000GT	178.7	12.4	60.3	25.2	28-Jul
Golden Acres	G4818 VT2RIB	178.1	12.6	59.6	25.4	27-Jul
Channel Seed	216-36 DGVT2PRIB	178.0	12.9	59.2	25.8	28-Jul
Pioneer Seed	1151AM	170.5	11.9	61.0	25.0	26-Jul
Channel Seed	214-00 DGVT2RIB	169.1	13.3	61.0	24.0	28-Jul
Channel Seed	211-97R (non Bt)	167.1	12.5	59.8	25.0	27-Jul
Average		178.5	12.7	60.2	25.2	27-Jul
LSD 0.20		4.4				

Planted: May 16; Harvested: November 16 and 17, 2017.
Grain Yield adjusted to 15.5% moisture content.
This corn trial received a total of 8 acre-in./acre of irrigation.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2017

Kevin Larson, Brett Pettinger and Perry Jones

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

RESULTS: Only 3% of the plant of the non Bt hybrid had first generation corn borer shot holes. There were no second generation corn borer stalk holes, or second generation corn borer lodging on any of the hybrids. Grain yields were good, averaging 179 bu/a.

DISCUSSION: There was only very minor first generation and no second generation corn borer damage. First generation corn borer damage has been quite low for years, and this year was no exception. The lack of second generation corn borer damage was due to the aerial application of Reveal to control grasshoppers, which also controlled the corn borer. Since there was only first generation corn borer damage to the non Bt hybrid and no corn borer damage to any of the Bt hybrids, all 11 hybrids Bt hybrids tested showed excellent resistance to first generation corn borer. The inclusion of Reveal controlled the second generation corn borers; therefore, no second generation corn borer resistance could be evaluated. In previous years, the low level of corn borer damage was attributable to our region’s extensive use of corn borer resistant hybrids. Even though we could not evaluated second generation damage, we still advocate the use of corn borer resistant hybrids. However, if these low infestation levels continue, it may be economical to replace some acreage with less expensive nonresistant corn borer hybrids. Growers can monitor the corn borer infestation levels in their refuges to indicate if switching is warranted. Corn borer resistant Bt hybrids continue to be a very effective tool against corn borer damage. Therefore, to keep Bt hybrids effective in controlling corn borer, always remember to plant nonresistant hybrids as a mating refuge or use Refuge In a Bag (RIB) seed mixtures to help delay corn borer resistance to the Bt events.

Sprinkler Irrigated Corn, Corn Borer Ratings, Plainsman Research Center, 2017.

Brand	Hybrid	Grain Yield	Test Weight	1st Gen. Shot Holes	2nd Gen. Plants Lodged	50% Silking Date
		bu/a	lb/bu	----plants/a----		
LG Seeds	LG5618 STXRIB	192	60.6	0	0	27-Jul
LG Seeds	LG5606 STX	183	61.6	0	0	28-Jul
LG Seeds	LG5663 VT2RIB	182	61.3	0	0	29-Jul
Mycogen Seeds	2V709	182	58.3	0	0	27-Jul
LG Seeds	LG5643 STXRIB	181	59.9	0	0	30-Jul
Channel Seed	215-75 STXRIB	181	60.2	0	0	30-Jul
LG Seeds	LG5616-3000GT	179	60.3	0	0	28-Jul
Golden Acres	G4818 VT2RIB	178	59.6	0	0	27-Jul
Channel Seed	216-36 DGVT2PRIB	178	59.2	0	0	28-Jul
Pioneer Seed	1151AM	171	61.0	0	0	26-Jul
Channel Seed	214-00 DGVT2RIB	169	61.0	0	0	28-Jul
Channel Seed	211-97R (non Bt)	167	59.8	3	0	27-Jul
Average		179	60	0.3	0.0	27-Jul
LSD 0.20		4.4		1.4		

Planted: May 16; Harvested: November 16 and 17, 2017.
Grain Yield adjusted to 15.5% moisture content.
Sprinkler irrigated corn received a total of 8 in./acre of applied water.

Sprinkler Full Irrigation Corn Study, Hume Farm at Walsh, 2017

COOPERATORS: Tim Hume, North Fork Farms, Matt Tedder, Tedder Ag Technologies; Brett Pettinger, Kevin Larson, Perry Jones, Plainsman Research Center, Walsh, Colorado.

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

RESULTS: The average yield for the three replicated Channel Seed corn hybrids tested was 216 bu/a. Both Channel Seed 216-36STXRIB and 217-92STXRIB hybrids produced significantly more yield than the Channel Seed 217-41STXRIB hybrid.

PLOT: Six rows with 30 in. row spacing, 1331 ft. long. SEEDING DENSITY: 35,000 seeds/a. PLANTED: May 27. HARVESTED: November 21.

PEST CONTROL: Preemergence Herbicides: Gramoxone, Balance Flexx, Atrazine, 2,4-D; Post Herbicides: Glyphosate, Dicamba, Laudis, Atrazine. CULTIVATION: None. INSECTICIDE: Comite for mites, Lamcap II for grasshoppers.

FIELD HISTORY: Previous Crop: Corn. FIELD PREPARATION: Strip-tilled.

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	1.85	55	0	0	4
June	1.20	619	14	3	34
July	4.64	870	23	3	65
August	5.18	641	3	0	96
September	3.52	528	9	0	126
October	1.05	128	0	0	136
Total	17.44	2841	49	6	136

\1 Growing season from May 16 (planting) to October 10 (freeze, 29F).
\3 GDD: Growing Degree Days for sorghum.
\4 DAP: Days After Planting.

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

FERTILIZATION: Strip tilled N at 225 lb/a, 10-34-0 at 9 gal/a, Zn at 0.5 lb/a; and seedrow at planting 10-34-0 at 5 gal/a, Zn at 0.5 lb/a.

COMMENTS: Planted in good soil moisture for seed germination and stand establishment. Weed control was good. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Grain yields and test weights were very good.

Sprinkler Full Irrigated Corn Hybrid Performance Trial, Hume Farm at Walsh, 2017.

Brand	Hybrid	Traits	RM	Grain Yield	Test Weight	Moisture Content
			day	bu/ac	lb/bu	%
Channel Seed	216-36STXRIB	SSRIB	116	223.3	59.0	12.8
Channel Seed	217-92STXRIB	SSRIB	117	222.3	57.8	13.9
Channel Seed	217-41STXRIB	SSRIB	117	201.8	58.8	13.6
Average				215.8	58.5	13.4
LSD 0.05				8.22		

Planted: May 27 at 35,000 seeds/acre.
Harvested: November 21, 2017.
Grain Yield adjusted to 15.5% seed moisture content.
RM, Relative Maturity, is the approximate days from planting to black layer.

Sprinkler Full Irrigation Corn Demonstration, Hume Farm at Walsh, 2017.

Firm	Hybrid	Traits	RM	Grain Yield	Seed Moisture	Test Weight
			day	bu/a	%	lb/bu
Channel Seed	217-41DGVT2PRIB	DGVT2PRIB	117	236.3	12.4	58.0
Channel Seed	215-75STXRIB	SSRIB	115	227.9	13.2	58.0
Channel Seed	213-19STXRIB	SSRIB	113	226.9	13.3	59.5
Channel Seed	214-00DGVT2PRIB	DGVT2PRIB	114	226.2	13.6	60.5
Channel Seed	211-35STXRIB	SSRIB	111	223.6	12.6	60.0
Channel Seed	212-48STXRIB	SSRIB	112	218.4	12.8	59.5
Channel Seed	214-45STXRIB	SSRIB	114	216.3	12.8	60.0
Channel Seed	218-44STXRIB	SSRIB	118	211.1	14.9	60.0
Average				223.3	13.2	59.4

Planted: May 27; Harvested: November 21, 2017.
Grain Yield adjusted to 15.5% moisture content.
RM, Relative Maturity, is the approximate days from planting to black layer.

Dryland Crop Rotation Study

Kevin Larson and Brett Pettinger

This is the thirteenth cropping year for our dryland rotation study. We established these rotations because of results from our dryland rotation sequencing study and growers' desire to include winter wheat in the rotations. The dryland rotation sequencing study was designed for spring crops, and the inclusion of winter wheat with its fall planting and early summer harvesting times would not fit into the design pattern of the sequencing study. To include winter wheat into a dryland rotation study, we began a new dryland rotation study with these three rotations in 2005: 1) Wheat-Sorghum-Fallow, 2) Wheat-Sunflower-Fallow, and 3) Sorghum-Millet. In 2006, we added a fourth rotation, Millet/Wheat-Fallow, to this rotation study. In 2015, we changed the Wheat-Sunflower-Fallow to Wheat-Corn-Fallow because the sunflower crops failed too often.

Materials and Methods

This is our eleventh harvest year in testing the following rotations: Wheat-Grain Sorghum-Fallow (W-S-F) and Sorghum-Millet (S-M). We added a fourth rotation of Millet/Wheat-Fallow (M/W-F) in 2006. In 2015, we changed the Wheat-Sunflower-Fallow rotation to Wheat-Corn-Fallow. In 2008 and 2011, no crops were harvested because of drought. We planted wheat, Byrd, at 50 lb/a on October 12, 2016; Proso millet, Huntsman, at 12 lb/a on June 12; grain sorghum, Alta AG1201, at 38,000 seeds/a on June 6; and corn, Pioneer 1151 AM, at 12,000 seeds/a on May 18, 2017. 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 (failed), glyphosate 32 oz/a to clean it up; millet, Stare Down 6.4 oz/a, LoVol 0.38 lb/a; grain sorghum, Sharpen 2.0 oz/a, Huskie 16 oz/a, atrazine 0.75 lb/a; corn, atrazine 0.75, mesotrione 6.4 oz/a, glyphosate 32 oz/a. For fallow, we applied glyphosate 32 oz/a, dicamba 6 oz/a, LoVol 10.7 oz/a two time, and one of these application we included Stare Down 6.4 oz/a to all the fallow plots to control glyphosate-resistant kochia. We harvested the crops with a self-propelled combine equipped with a digital scale: millet, September 14 to the M/W-F rotation only, the S-M rotation failed; grain sorghum, October 24; and corn, November 11. The wheat crop was not harvest because of dry planting conditions that caused the wheat to germinate and fail. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

This year, the annual rotation productions of the W-S-F rotation, 2236 lb/a, and the S-M rotation, 2229 lb/a were only separated by 7 lb/a. The productions for both rotations were due entirely to grain sorghum production, since there was no wheat harvested for any of the rotations, nor millet production for the S-M rotation. This year, the M/W-F and W-C-F rotations produced much less production, because the wheat crop germinated but failed to make a stand due to dry conditions and was not harvested; therefore, these two rotations relied solely on one crop for their total production, millet for the M/W-F rotation and corn for the W-C-F rotation. Both the corn and the millet crops were less productive than the grain sorghum crop.

Although the W-S-F rotation produced marginally higher annual rotation production than the S-M rotation, the S-M rotation produced slightly higher annual rotation variable net income than the W-S-F rotation. The higher income of the S-M rotation, $93.93/a, compared to the W-S-F rotation, $91.11/a, is due to S-M being a two-year rotation without a summer fallow period, whereas the W-S-F rotation is a three-year rotation with a summer fallow period. The W-C-F and M/W-F rotations produced considerably less income than the rotations containing grain sorghum, because the millet and corn crops were less productive than the grain sorghum crop. 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. This year because the wheat failed, all crop rotations were reliant on a single summer crop for their entire production. For example, the 2017 total production for the W-S-F rotation was 6709 lb/a. The crop rotational phases were: wheat, 0 lb/a; grain sorghum, 6709 lb/a; and, of course, no production for fallow. The annual rotation production was 2236 lb/a, which is one-third the total production because the W-S-F rotation takes three years to complete one rotation cycle.

The long term annual rotational income, after the last seven harvest years, favors the S-M rotation with $108.22/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 $78.73/a. The W-S-F rotation has extended fallow periods with a summer fallow preceding the wheat and a long winter fallow before the sorghum. During the recent dry years, the extended fallow periods of the W-S-F rotation have contributed to its higher production and income.

In past years, winter wheat performed better than the spring crops in both yield and income. However recently, the wheat crop failed in four of the last seven years: two times it was lost to hail, one year it winterkilled, and last year it was too dry and failed to emerge. Corn replaced sunflower in the W-Sunflower-F rotation because the sunflower crops failed six out of seven cropping years. With no wheat crop, rotations containing grain sorghum, millet and corn had higher incomes. This suggests that rotations that include adapted crops will spread income risk and may increase crop rotation revenue over multiple years.

Table .-Dryland Crop Rotation Study, Crop Production, 2017.

	Crop Production						
	--------2017 Crop--------					2017 Total Rotation Production	Annual Rotation Production
Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow		
	----------lb/a----------						
S-M	0	4458	0			4458	2229
W-S-F	0	6709			0	6709	2236
M/W-F	0		2102		0	2102	1051
W-C-F	0			4273	0	4273	1424
Average	0	5584	1051	4273	0	4386	1735
LSD 0.20	--	715.3	--				

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
The wheat in all rotations germed and died due to dry planting conditions.
The millet in the S-M rotation failed to make a stand and was not harvested.
This is the third year of W-C-F, previously it was W-Sunflower-F.

Table .-Dryland Crop Rotation Study, Variable Net Income, 2017.

	--------2017 Crop--------					2017 Total Crop Net Income	Annual Rotation Variable Net Income
Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow		
	----------$/a----------						
S-M		205.20	-17.34			187.86	93.93
W-S-F	-16.46	320.40			-30.61	273.33	91.11
M/W-F	-16.46		108.29		-30.61	61.22	30.61
W-C-F	-16.46			181.25	-30.61	134.18	44.73
Average	-16.46	262.80	45.48	181.25	-30.61	164.15	65.09

Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Net Income divided by the number of years to complete one rotation cycle.
The wheat crop was not harvested because conditions were too dry to emerge.
The millet in the S-M failed to make a stand and was not harvested.

Table .-Dryland Crop Rotation Study, Walsh, 2017.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		------------------	------------------	$/a	------------------	------------------	------------------
Wheat	50 lb	7.08	9.38	0 bu	3.75/bu	0.00	-16.46
M/W-F				0.0	3.75	0.00	-16.46
W-C-F				0.0	3.75	0.00	-16.46
W-S-F				0.0	3.75	0.00	-16.46
Millet	12 lb	4.20	13.14	37.5 bu	3.35/bu	62.81	45.47
S-M				0.0	3.35	0.00	-17.34
M/W-F				37.5	3.35	125.63	108.29
Grain Sorghum	38,000 seeds	7.26	31.74	100.6 bu	3.00/bu	301.80	262.80
S-M				81.4	3.00	244.20	205.20
W-S-F				119.8	3.00	359.40	320.40
Corn	12,000 seeds	52.50	25.67	76.3 bu	3.40/bu	259.42	181.25
W-C-F				76.3	3.40	259.42	181.25
Fallow	---	---	30.61	---	---	-30.61	-30.61
Average			22.11			118.68	88.49

Planted: Grain Sorghum, Alta AG1201 at 38,000 seeds/a on June 6; Millet, Huntsman at 12 lb/a on June 12; and Corn, Pioneer 1151 AM at 12,000 seeds/a on May 18; Wheat, Byrd at 50 lb/a on October 10, 2016.
Harvested: Wheat, failed, not harvested; Grain Sorghum, October 24; Corn, November 14.
Wheat too dry to emerge, not harvest. Millet in S-M was not harvested due to poor stand.
Weed control cost is herbicide cost and $6.50/a application cost for each application.

Table .-Dryland Crop Rotation Study, Annual Rotation Income, 2010 to 2017.

Rotation	Annual Rotation Variable Net Income 2010	2012	2013	2014	2015	2016	2017	Total Crop Net Income	Average Annual Rotation Variable Net Income
	---$/a---								
S-M	262.97	98.38	27.79	105.98	117.98	50.52	93.93	757.54	108.22
W-S-F	198.75	39.81	56.60	56.59	18.81	89.46	91.11	551.13	78.73
M/W-F	135.55	52.97	41.67	-21.87	-2.02	53.43	30.61	290.35	41.48
W-Sun-F	99.95	-32.88	8.17	-32.93	--	--	--	42.31	8.46
W-C-F					18.09	81.16	44.73	143.98	71.99
Average	174.31	39.57	33.55	26.94	38.21	68.64	65.09	446.32	77.22

No crops were harvested in 2008 and 2011 because of drought.
The 2012 (hail), 2014 (winterkill), 2015 (hail), 2017 (too dry, no emergence) wheat crops were not harvested.
The sunflower crops were not harvested in 2006, 2009, 2012, 2013, and 2014.
The 2016 millet crop was not harvested because of poor stand.
The 2017 millet crop in the S-M rotation failed to make a stand.
In 2015 corn replaced sunflower in the W-Sun-F rotation.
Variable Net Income is gross income minus seed cost and weed control cost.
Annual Rotation Variable Net Income is Total Crop Variable Net Income divided by years to complete one rotational cycle.

Four-Year (W-C-M-F) and Three-Year (W-S-F) Rotation Comparison

Kevin Larson, Brett Pettinger and Perry Jones

Wheat-Fallow (W-F), with tillage to control weeds in the fallow period, was the standard crop rotation in Eastern Colorado until the 1990's, when the adoption of no-till farming practices began to predominate. These no-till practices retain crop residues that reduced soil erosion and conserved water. With more water available for crop use, no-till practices allowed more extensive and successful crop rotations than W-F (Anderson, Bowman, Nielson, Vigil, Aiken, and Benjamin, 1999). Three-year and four-year crop rotations, such as, Wheat-Sorghum-Fallow (W-S-F), Wheat-Corn-Fallow (W-C-F), Wheat-Millet-Fallow (W-M-F), Wheat-Corn-Millet-Fallow (W-C-M-F), and Wheat-Corn-Sunflower-Fallow (W-C-Sun-F) began to emerge. Randy Anderson reported that some of these three-year and four-year rotations were much more effective in controlling weeds than others (Anderson, 2005). In rotations where one cool-season crop was followed by one warm-season crop (1 cool crop: 1 warm crop), such as winter wheat-millet, were compared to four-year rotations of two cool-season crops followed by two warm season crops (2 cool crops: 2 warms crops), he found over multiple rotation cycles that weeds increased in the 1 cool crop: 1 warm crop rotations and declined in the rotations of 2 cool crops: 2 warm crops. Because of the reduction in weeds and associated weed control savings, Anderson recommended using rotations of two cool-season crops followed by two warm season crops, such as W-C-M-F (Anderson considers fallow as a cool-season or warm-season crop alternative). After growers read of the potential production and weed control savings by switching to rotations of 2 cool crops: 2 warm crops, they suggested that we conduct a study to investigate if the W-C-M-F rotation would provide more income than our well adapted W-S-F rotation.

This is the first summer cropping year for our dryland W-C-M-F and W-S-F rotation comparison study. In fact, this rotation study is so new that the first year of winter wheat for the rotations was just planted in the fall of 2017; therefore this year, we can only compare the production of summer crops for the rotations. To make rotation comparisons on a yearly basis, we planted all phases of the rotations. For example, each crop (including fallow) of the W-C-M-F rotation is present every year. Each year, there are four study plots for the W-C-M-F rotation: one plot of wheat, one plot of corn, one plot of millet, and one plot of fallow. By having all rotation phases each year, we can annually compare multi-year rotations.

Materials and Methods

This is our first summer crop harvest year in comparing the following rotations: Wheat-Corn-Millet-Fallow (W-C-M-F) and Wheat-Grain Sorghum-Fallow (W-S-F). We planted: proso millet, Huntsman, at 12 lb/a on June 12; grain sorghum, Alta AG1201, at 38,000 seeds/a on June 6; and corn, Pioneer 1151 AM, at 12,000 seeds/a on May 18, 2017. We planted wheat, Snowmass, at 50 lb/a on October 10, 2017, but it will not be harvested until 2018, therefore it will not be part of our evaluation this year. This year, all the crops followed dryland corn. 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: millet, Stare Down 6.4 oz/a, LoVol 0.38 lb/a;

grain sorghum, Sharpen 2.0 oz/a, glyphosate 32 oz/a, Huskie 16 oz/a, atrazine 0.75 lb/a; corn, atrazine 0.75, mesotrione 6.4 oz/a, glyphosate 32 oz/a. For fallow, we applied glyphosate 32 oz/a, dicamba 6 oz/a, LoVol 0.5 lb/a two times, and one of these application we included Stare Down 6.4 oz/a to all the fallow plots to control glyphosate-resistant kochia. We harvested the crops with a self-propelled combine equipped with a digital scale: millet, September 14; grain sorghum, October 24; and corn, November 14. The wheat crop will not be harvested until next year. We sampled the grain for test weights and moistures, and use moisture-adjusted grain yields for comparisons: millet, 14%; grain sorghum, 14%; and corn, 15.5%. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

This year without a harvested wheat crop, the annual rotation productions of the W-S-F and the W-C-M-F rotations were quite similar, 1766 lb/a for W-S-F and 1714 lb/a for W-C-M-F. This is somewhat unexpected since the grain sorghum crop was the only crop harvested in the three-year rotation for W-S-F, whereas, both millet and corn were included in the four-year rotation for W-C-M-F. Both the corn and the millet crops were slightly less productive, on an annual rotation basis, than the grain sorghum crop.

Although the W-S-F rotation produced marginally higher annual rotation production than the W-C-M-F rotation, the W-C-M-F rotation produced slightly higher annual rotation variable net income than the W-S-F rotation. This income difference was less than $1/a. The higher income of the W-C-M-F rotation, $71.98/a, compared to the W-S-F rotation, $71.40/a, is due to the corn and millet crops of the W-C-M-F rotation being more valuable than the grain sorghum crop of the W-S-F rotation. 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. This year because there was no wheat crop, all crop rotations were reliant on summer crops for their entire production. For example, the 2017 total production for the W-S-F rotation was 5298 lb/a. The crop rotational phases were: wheat, 0 lb/a; grain sorghum, 5298 lb/a; and, of course, no production for fallow. The annual rotation production was 1766 lb/a, which is one-third the total production because the W-S-F rotation takes three years to complete one rotation cycle.

Since this is a new rotation comparison study and not all rotational crops have been harvested, no long term rotational effects can be evaluated.

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Dryland WCMF and WSF Rotation Comparison Study, Crop Production, 2017.

Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow	2017 Total Rotation Production	Annual Rotation Production
	Crop Production --2017 Crop--						
	--lb/a--						
W-S-F	0	5298			0	5298	1766
W-C-M-F	0		2382	4474	0	6856	1714
Average	0	5298	2382	4474	0	6077	1740

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
This is a new rotational study. Wheat planted October 10, 2017 for 2018 harvest.
All these crops were planted in corn stubble.

Dryland WCMF and WSF Rotation Comparison Study, Variable Net Income, 2017.

Rotation	Wheat	Grain Sorghum	Millet	Corn	Fallow	2017 Total Crop Net Income	Annual Rotation Variable Net Income
	--2017 Crop--						
	--$/a--						
W-S-F	0.00	244.80			-30.61	214.19	71.40
W-C-M-F	0.00		125.04	193.49	-30.61	287.92	71.98
Average	0.00	244.80	125.04	193.49	-30.61	251.06	71.69

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.
New rotation study. No wheat crop for 2017.

Table .-WCMF and WSF Rotation Comparison Study, Walsh, 2017.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		------------	------------	------------	$/a	------------	------------
Wheat	50 lb			0 bu	3.75/bu	0.00	0.00
W-C-M-F				0.0	3.75	0.00	0.00
W-S-F				0.0	3.75	0.00	0.00
Corn	12,000 seeds	52.50	25.67	79.9 bu	3.40/bu	271.66	193.49
W-C-M-F				79.9	3.40	271.66	193.49
Millet	12 lb	4.20	13.14	42.5 bu	3.35/bu	142.38	125.04
W-C-M-F				42.5	3.35	142.38	125.04
Grain Sorghum	38,000 seeds	7.26	31.74	94.6 bu	3.00/bu	283.80	244.80
W-S-F				94.6	3.00	283.80	244.80
Fallow	---	---	30.61	---	---	-30.61	-30.61
Average			20.23			133.45	106.54

Planted: Grain Sorghum, Alta AG1201 at 38,000 seeds/a on June 6; Millet, Huntsman at 12 lb/a on June 12; and Corn, Pioneer 1151 AM at 12,000 seeds/a on May 18; Wheat, (new rotation) Snowmass at 50 lb/a on October 10, 2017 for 2018 harvest.
Harvested: Wheat, new rotation, no 2017 crop; Grain Sorghum, October 24; Corn, November 14.
Weed control cost is herbicide cost and $6.50/a application cost for each application.

Dryland Millet and Wheat Rotation Study

Kevin Larson, Brett Pettinger and Perry Jones

This was the eleventh 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 tenth 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 12, 2016 and Proso millet, Huntsman, at 12 lb/a on June 12, 2017. We applied 50 lb N/a to the study site. Before planting we sprayed two applications of glyphosate at 32 oz/a, dicamba 6.0 oz/a, and LoVol 0.5 lb/a and applied Sharpen 2.0 oz/a once to the fallow plots to control glyphosate resistant kochia. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, the wheat failed so we applied glyphosate 32 oz/a as a clean up; millet, Staredown 6.4 oz/a and 2,4-D ester 6 oz/a; and fallow, glyphosate 32 oz/a, dicamba 6 oz/a and LoVol 0.5 lb/a two times. There was not wheat harvested. We harvested the millet on September 14 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14% moisture content for the millet. 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. There was no wheat harvested in 2017, because it was too dry to emerge.

Results and Discussion

The wheat did not produce a crop because it was planted in dry soil. Enough moisture fell to germinate the wheat seed, but there was insufficient moisture for growth and emergence and the sprouted wheat seed died. The proso millet yields were good, averaging 45 bu/a. There was moisture at millet planting, so the stands were good, and abundant rains fell during the season, so yields were high. This year because of the wheat failure, only rotations with millet produced positive annual rotation variable net incomes. The M-M rotation, which has a millet crop each year, had the highest income of $102.90/a. The W/M-F rotation had significantly higher yield than the M-M rotation, but it generated a much lower income than the M-M rotation. The higher annual rotation variable net income of the M-M rotation compared to the W/M-F rotation is because the M-M rotation has income from a millet crop each year without a summer fallow period and the W/M-F rotation income is spread over two years because it has a summer fallow period.

For the eleven years that we have conducted this study, we have had multiple crop failures and missed plantings, therefore rotational affects are, at best, difficult to generalize and quantify. This year, millet yields were very good, but the wheat crop failed due to dry conditions that caused lack of emergence. Over the past eight harvest years, the continuous wheat (W-W) rotation provided the highest average net return of $32.94/a. For the past eight harvest years, and acknowledging crop failures and missed plantings, less than $6/a separate the top four rotations: W-W, W-M-F, W/M-F, and M-M. The remaining two rotations, W-F and M/W-F, averaged about half as much annual income over the last eight harvest years as the W-W rotation. Last year, wheat yields were very good, but millet yields were reduced by a late planting date. In 2015, both wheat and millet yields were low. The wheat yields were low because a hailstorm caused considerable lodging and seed shattering. The millet yields were low because of a late planting date. In 2014, late planting dates for both wheat and millet reduced yields (and the M-M rotation failed to establish a stand). In 2013, dry conditions reduced yields of both wheat and millet crops, and we failed to plant millet in the W/M-F rotation. In 2012, millet was the only crop harvested because the wheat crop was completely lost to hail, and we failed to plant millet in the M/W-F and W/M-F rotations. In 2011, we had wheat production, but no millet production; therefore, we were able to plant and harvest only the wheat for in all phases of the rotations containing wheat. In 2010, there was sufficient precipitation to plant and harvest all wheat and millet crops in all rotations. The W-W rotation had the highest annual rotation variable net income in 2010. In 2009, adequate spring and summer moisture produced good yields for most crops with the wheat and millet producing similar yields. No crops were harvested in 2008 because of drought. Winter wheat performed better than millet in both yield and income in 2007. In 2007, it was too dry for the millet planted immediately after wheat harvest (millet in the W/M-F) to establish a stand. We missed planting wheat in the M/W-F rotation in 2008. In 2009, we did not plant millet in the W/M-F rotation because of delayed volunteer wheat control.

There appears to be no relationship between fallow length and yields and incomes of the wheat and millet rotations in this study. The rotation with the highest annual rotation variable net income after the past eight 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 eight 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, 2017.

Rotation	Wheat	Millet	Fallow	2017 Total Rotation Production	Annual Rotation Production
	-----------2017 Crop----------				
	-------------------------lb/a----------------------------				
W-F	0			0	0
W-W	0			0	0
W-M-F	0	2576		2576	859
M/W-F	0	2682		2682	1341
W/M-F	0	2833		2833	1417
M-M		2016		2016	2016
Average	0	2527		1685	939
LSD 0.20		718.0			

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

Table .Dryland Millet-Wheat Rotation, Variable Net Income, 2017.

Rotation	Wheat	Millet	Fallow	2017 Total Crop Net Income	Annual Rotation Variable Net Income
	-----------2017 Crop----------				
	-------------------------$/a----------------------------				
W-F	-16.46		-25.44	-41.90	-20.95
W-W	-16.46			-16.46	-16.46
W-M-F	-16.46	136.40	-25.44	94.50	31.50
M/W-F	-25.84	142.77	-25.44	91.49	45.74
W/M-F	-16.46	151.81	-25.44	109.91	54.96
M-M		102.90		102.90	102.90
Average	-18.34	133.47	-25.44	56.74	32.95

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.
Wheat crop failed, conditions too dry for seed emergence.

Table .-Dryland Millet and Wheat Rotation Study, Walsh, 2017.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
	lb/a	$/a	$/a	bu/a	$/bu	$/a	$/a
<u>Wheat</u>							
W-F	50	7.08	9.38	0.0	3.75	0.00	-16.46
W-W	50	7.08	9.38	0.0	3.75	0.00	-16.46
W-M-F	50	7.08	9.38	0.0	3.75	0.00	-16.46
M/W-F	50	7.08	18.76	0.0	3.75	0.00	-25.84
W/M-F	50	7.08	9.38	0.0	3.75	0.00	-16.46
Wheat Average	**50**	**7.08**	**11.26**	**0.0**	3.75	**0.00**	**-18.34**
<u>Millet</u>							
M-M	12	4.20	13.50	36.0	3.35	120.60	102.90
W-M-F	12	4.20	13.50	46.0	3.35	154.10	136.40
M/W-F	12	4.20	13.50	47.9	3.35	160.47	142.77
W/M-F	12	4.20	13.50	50.6	3.35	169.51	151.81
Millet Average	**12**	**4.20**	13.50	**45.1**	3.35	**151.17**	**133.47**
Fallow	---	---	25.44	---	---	0.00	-25.44
Average			12.25			0.00	29.90

Planted: Millet, Huntsman at 12 lb/a on June 12; Wheat, Byrd at 50 lb/a on October 12, 2016.
Harvested: Millet on September 14; Wheat was too dry to emerge and was not harvested.
Wheat herbicides: Glyphosate 32 oz/a for failed wheat clean up;
Wheat herbicide cost: $2.88/a
Millet herbicides: Staredown 6.4 oz/a, 2,4-D ester 6 oz/a: Millet herbicide cost: $6.00/a
Fallow herbicides: glyphosate 32 oz/a, 2,4-D 0.5 lb/a, dicamba 6 oz/a;
Fallow herbicide cost: $6.22/a per application (two applications, $6.50/a per application)
Applied Sharpen 2.0 oz/a to control kochia. Kochia control cost: $12.11/a
Wheat in M/W-F additional herbicide: glyphosate 32 oz/a cost $2.88/a.
Weed control cost is herbicide cost and $6.50/a application cost for each application.

Table .Millet-Wheat Rotation, Annual Rotation Income, 2010 to 2017.

Rot-ation	Annual Rotation Variable Net Income 2010	2011	2012	2013	2014	2015	2016	2017	Total Crop Var. Net Income	Avg. Annual Rot. Var. Net Income
	$/a									
W-W	170.76	78.46	-19.04	-26.02	-25.42	12.23	56.06	-16.46	230.57	32.94
W-M-F	116.42	37.05	-1.65	12.05	-21.12	11.03	34.04	31.50	219.33	31.33
W/M-F	118.77	59.48	-21.47	-23.58	-12.48	-24.78	61.89	54.96	212.80	30.40
M-M	93.66	-23.30	47.39	-0.56	-23.09	4.21	-12.02	102.90	189.19	27.03
W-F	112.08	63.66	-21.47	-27.93	-15.78	-13.01	57.92	-20.95	134.52	19.22
M/W-F	123.45	-34.96	-25.79	-1.95	-24.21	-2.00	26.80	45.74	107.10	15.30
Avg.	122.52	30.07	-7.00	-11.33	-20.35	-2.05	37.45	32.95	182.25	26.04

No millet was harvested in 2011 because of drought.
No wheat was harvested in 2012 (hail) and 2017 (too dry to emerge).
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, Brett Pettinger and Perry Jones

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 or canola at 5 lb/a, hairy vetch at 30 lb/a, and Spring N Mix at 58 lb/a (lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a). We planted winter cover crops: triticale at 60 lb/a or wheat at 50 lb/a, rapeseed or canola at 5 lb/a, hairy vetch at 30 lb/a, Winter N Mix at 43 lb/a (hairy vetch, 8 lb/a; winter pea, 8 lb/a; sweet clover, 2 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudan grass, 3 lb/a). All cover crop seeds were from Green Cover Seed in Bladen, Nebraska. Our three N rates were 0, 25, and 50 lb/a stream applied as 28-0-0 or 32-0-0. No N was applied to the cover crop plots. After establishing the rotations, all phases of each rotation were present each year. We inserted gypsum blocks at 6 in., 18 in., and 30 in. depths to measure soil water use by the cover crops.

This year, we harvested grain sorghum, but not wheat because the wheat germinated and died due to dry conditions at planting and emergence. The cover crops prior to sorghum planting also died due to dry conditions at planting and emergence. Last year was the first time that the winter and spring cover crops survived and we were able to harvest both grain sorghum and wheat crops. In previous years, either the cover crops did not survive, or the wheat crop was lost to hail or was winterkilled. We planted the W-F winter cover crops on August 24, 2015 after wheat harvest. We sprayed a mix of glyphosate, 2,4-D and dicamba to terminate the cover crops and control weeds in the N plots on April 4, 2016. For the wheat phase of the W-S-F rotation, we planted the spring cover crops in the W-S-F rotation on March 3, 2016 during the fallow period after sorghum harvest. On June 15, 2016, we terminated the spring cover crops and controlled weeds in the N plots with an application of glyphosate, 2,4-D, dicamba and Comet (for kochia control). We planted both the W-S-F and the W-F wheat on October 12, 2016 with Byrd at 50 lb/a and seedrow applied 10-34-0 at 5 gal/a at planting, but the wheat failed to emerge. We planted the winter cover crops prior to sorghum planting in the W-S-F rotation on August 15, 2016 into wheat stubble, but the winter cover crops failed to emerge. We sprayed a tank mix of glyphosate, 2,4-D and dicamba to clean up cover crops and to control weeds in the N plots. We planted Alta AG1201 at 38,000 seeds/a on June 6, 2017 and seedrow applied 5 gal 10-34-0/a at planting into the failed cover crops. For in-season broadleaf weed control in the grain sorghum crop, we applied a tank mix of Huskie, atrazine, AMS and surfactant.

There was no wheat crop to harvest in 2017. We harvested the W-S-F grain sorghum on October 25, 2017 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14.0% seed moisture content for grain sorghum.

Results and Discussion

Grain Sorghum Phase, W-S-F Rotation

The winter cover crops preceding the grain sorghum failed because of dry conditions at planting. However, the expense for planting the cover crops and for applying the N to the N treatments was deducted from the gross grain sorghum sales, because these operations were already performed.

The treatment with the highest grain sorghum yield was the 25 lb N/a treatment with 119.7 bu/a, which was significantly higher than any of the cover crop tested and was significantly higher than the 0 N treatment. Of the failed cover crops, the wheat treatment produced significantly more grain yield than the rapeseed treatment. There was no significant yield difference between the 0 N treatment and the wheat treatment. The rapeseed treatment had the lowest grain sorghum yield, 99.1 bu/a; however, it was not significantly lower than the hairy vetch and the winter N mix treatments. The grain sorghum yields were very high, averaging 108.5 bu/a for all the failed cover crops and N treatments, because 15.59 inches rains fell from planting to first freeze. The grain sorghum crop did not directly follow cover crops this year; however, the grain sorghum crop did follow the cover crops from previous years. Therefore, the grain sorghum yields may reflect residual effects of past cover crop stands.

Wheat, W-F Rotation

Precipitation from planting to termination of the winter cover crops (seven months, September 2015 through March 2016) for wheat in the W-F rotation was 6.88 in. After seven months of growth, the average dry matter production of the cover crops was 1759 lb/a. The cover crops forage yields ranged from 1509 lb/a for Winter N Mix to 1913 lb/a for rapeseed. There was a significant forage difference between the rapeseed treatment and the Winter N Mix treatment at the 0.20 alpha level.

When terminated after seven months of growth, the cover crops preceding wheat planting had these changes in available soil water (at termination minus at planting): -1.11 in. for triticale, -0.80 in. for rapeseed, -2.41 in. for hairy vetch, and -2.21 in. for Winter N Mix of soil water to a depth of three feet. The fallow 0N check (at termination minus at planting) gained +3.54 in. in soil water to a depth of three feet during the same seven month period. During the seven months of cover crop growth, all the cover crops used more available soil water than the fallow 0N check. Therefore, subtracting soil water stored by the cover crops from soil water used during no-till fallow equals the water use cost of cover crops. The water use cost to a soil water depth of three feet was: 4.65 in. for triticale, 4.34 in. for rapeseed, 5.94 in. for hairy vetch, and 5.75 in. for Winter N Mix.

The wheat failed in the W-F rotation because of dry soil conditions at planting and emergence; therefore, no wheat was harvested and only expenses for planting the cover crops and N treatments were recorded.

Wheat Phase, W-S-F Rotation

Precipitation from planting to termination of the spring cover crops (three and one half months, March 2016 through mid-June 2016) for the wheat phase of the W-S-F rotation was 7.09 in. This high precipitation amount for the three month period was due mainly to the 4.92 inches of rain that occurred in April. After three months of growth, the average dry matter production of the cover crops was 3444 lb/a. The cover crops dry matter yields ranged from 2505 lb/a for hairy vetch to 4556 lb/a for oats and the forage yield difference between oats and hairy vetch was significant at the 0.20 alpha level.

When terminated after three and one half months of growth, the cover crops preceding wheat planting used: 4.87 in. for oats, 2.60 in. for rapeseed, 2.68 in. for hairy vetch, and 3.34 in. for Spring N Mix of available soil water (at termination minus at planting) to a depth of three feet. The fallow 0N check (at termination minus at planting) stored +0.22 in. in soil water to a depth of three feet during the same three and one half month period. During the three and one half months of cover crop growth, all the cover crops used more available soil water than the fallow 0N check. Therefore, subtracting soil water used by the cover crops from soil water stored during no-till fallow equals the water use cost of cover crops. The water use cost to a soil water depth of three feet was: 5.09 in. for oats, 2.82 in. for rapeseed, 2.90 in. for hairy vetch, and 3.56 in. for Winter N Mix.

The wheat failed in the W-S-F rotation because of dry soil conditions at planting and emergence; therefore, no wheat was harvested and only expenses for planting the cover crops and N treatments were recorded.

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Table .-Cover Crop Study, Grain Sorghum (W-S-F) after Winter Cover Crop, Walsh, 2017.

Treatment	Grain Sorghum Yield	Test Wt.	Cover Dry Matter	Cover N	Fixed N	Treatment Cost	Fixed N Income	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	lb/a	$/a	$/a	$/a
Rapeseed	99.1	57	0	0.0		16.75		231.00
Wheat	107.1	57	0	0.0		19.08		248.67
Hairy Vetch	103.3	57	0	0.0	0.0	69.00	0.00	189.25
Winter N Mix	102.7	57	0	0.0		46.25		210.50
0 N	112.5	56				0.00		281.25
25 N	119.7	56				17.00		282.25
50 N	115.1	56				27.50		260.25
Average	108.5	57	0	0.0		27.94		243.31
LSD 0.20	5.92		0					

Cover crops planted: August 15, 2016.
Cover crops failed due to dry germinating conditions.
Grain sorghum planted: June 6; Harvested: October 25, 2017.
Cover crop seeding rate: Winter N Mix, 43 lb/a; hairy vetch, 30 lb/a; rapeseed, 5 lb/a; wheat, 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; wheat, $7.08/a.
N fertilizer cost: 28-0-0, $0.42/lb.
Treatment application cost: cover crop planting, $12/a; N application, $6.50/a.
Grain sorghum price: $3.00/a.

Table .-Cover Crop Study, Wheat (W-F) after Winter Cover Crop, Walsh, 2017.

Treatment	Wheat Yield	Test Wt.	Cover Dry Matter	Cover N	Fixed N	Treatment Cost	Fixed N Income	Variable Net Income
	bu/a	lb/bu	lb/a	lb/a	lb/a	$/a	$/a	$/a
Rapeseed	0.0	0	1913	0.0		16.75		-16.75
Triticale	0.0	0	1826	0.0		28.80		-28.80
Hairy Vetch	0.0	0	1789	0.0	0.0	69.00	0.00	-69.00
Winter N Mix	0.0	0	1509	0.0		46.25		-46.25
0 N	0.0	0				0.00		0.00
25 N	0.0	0				18.50		-18.50
50 N	0.0	0				31.00		-31.00
Average	0.0	0	1759	0.0		30.04		-30.04
LSD 0.20	0.0		299.6					

Cover crops planted: August 24, 2015.
Cover crops terminated: April 4, 2016.
Wheat planted: October 12, 2016; wheat failed, too dry to emerge.
Cover crop seeding rate: Winter N Mix, 43 lb/a; hairy vetch, 30 lb/a; rapeseed, 5 lb/a; triticale, 50 lb/a.
Winter N Mix: hairy vetch, 8 lb/a; sweet clover, 2 lb/a; winter forage pea, 8 lb/a; triticale, 20 lb/a; rapeseed, 2 lb/a; sorghum sudangrass BMR, 3 lb/a.
Cover seed cost: Winter N Mix, $34.25/a; hairy vetch, $57/a; rapeseed, $4.75/a; triticale, $16.80/a.
N fertilizer cost: 28-0-0, $0.50/lb.
Treatment application cost: cover crop planting, $12/a; N application, $6/a.
Wheat price: $3.75/a.

Table .-Cover Crop Study, Wheat (W-S-F) after Spring Cover Crop, Walsh, 2017.

Treatment	Wheat Yield	Test Weight	Cover Dry Matter	Treatment Cost	Variable Net Income
	bu/a	lb/bu	lb/a	$/a	$/a
Oats	0.0	0.0	4556	24.60	-24.60
Rapeseed	0.0	0.0	3384	16.75	-16.75
Spring N Mix	0.0	0.0	3330	41.65	-41.65
Hairy Vetch	0.0	0.0	2505	69.00	-69.00
0 N	0.0	0.0		0.00	0.00
25 N	0.0	0.0		18.50	-18.50
50 N	0.0	0.0		31.00	-31.00
Average	0.0	0.0	3444	28.79	-28.79
LSD 0.20	0.00		1271		

Spring cover crops planted: March 3, 2016, spring cover for wheat in W-S-F; spring cover terminated: June 15, 2016.
Wheat planted: October 12, 2016; wheat failed, not harvested.
Spring cover crop seeding rate: Spring N Mix, 58 lb/a; hairy vetch , 30 lb/a; rapeseed, 5 lb/a; oats, 60 lb/a.
Spring N Mix: lentil, 10 lb/a; common vetch, 6 lb/a; spring forage pea, 15 lb/a; oats, 20 lb/a; rapeseed, 2 lb/a; flax, 5 lb/a.
Cover seed cost: Spring N Mix, $29.65/a; hairy vetch, $57/a; rapeseed, $4.75/a; oats, $12.60/a.
N fertilizer cost: 28-0-0, $0.50/lb.
Treatment application cost: cover crop planting, $12/a;
N application, $6/a.
Wheat price: $3.75/a.

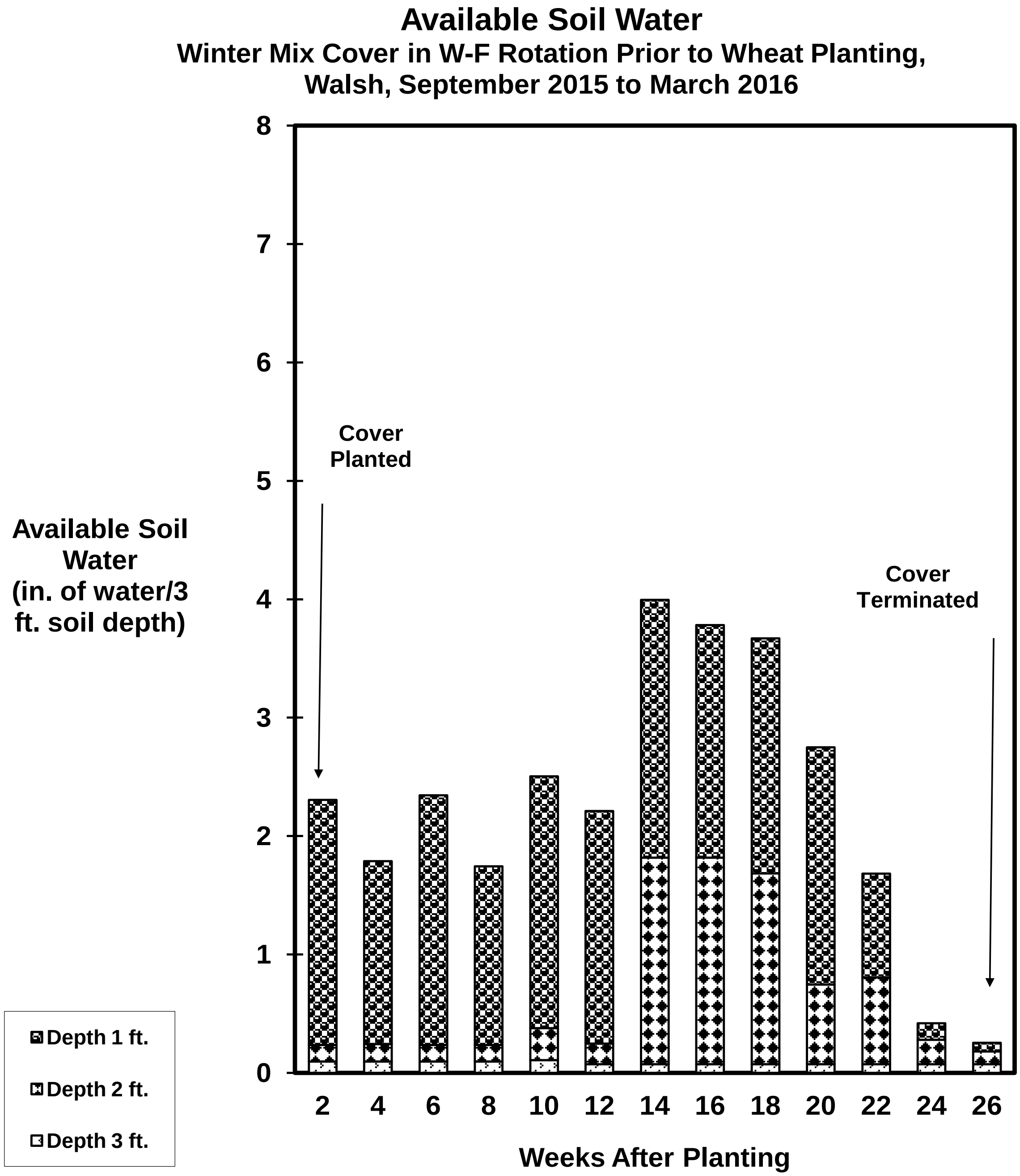

Fig. . Available soil water of winter mix cover in W-F Rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 6.88 in. Any increase in available soil water between weeks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

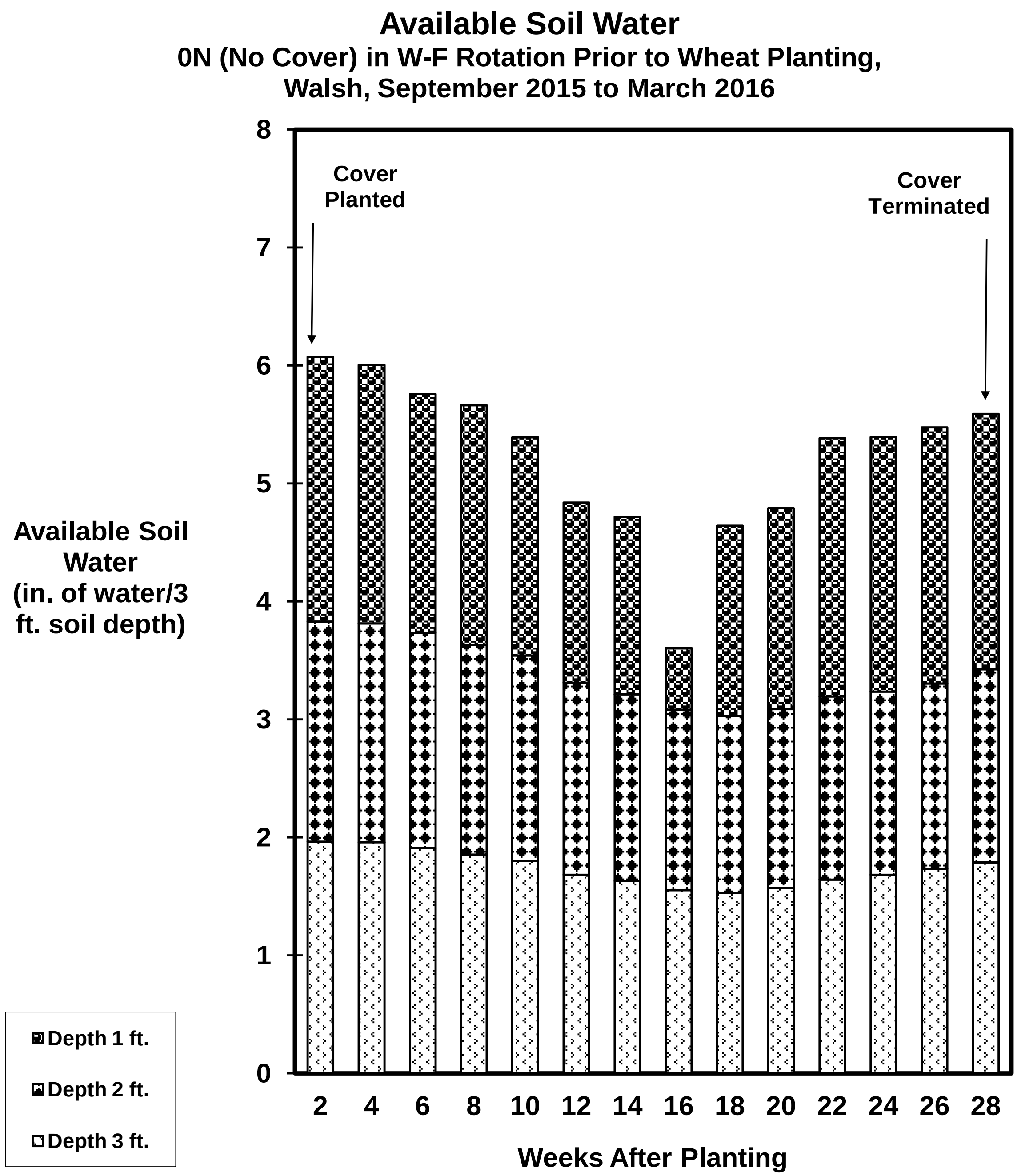

Fig. . Available soil water of 0N (no cover) in W-F Rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 6.88 in. Any increase in available soil water between weeks is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

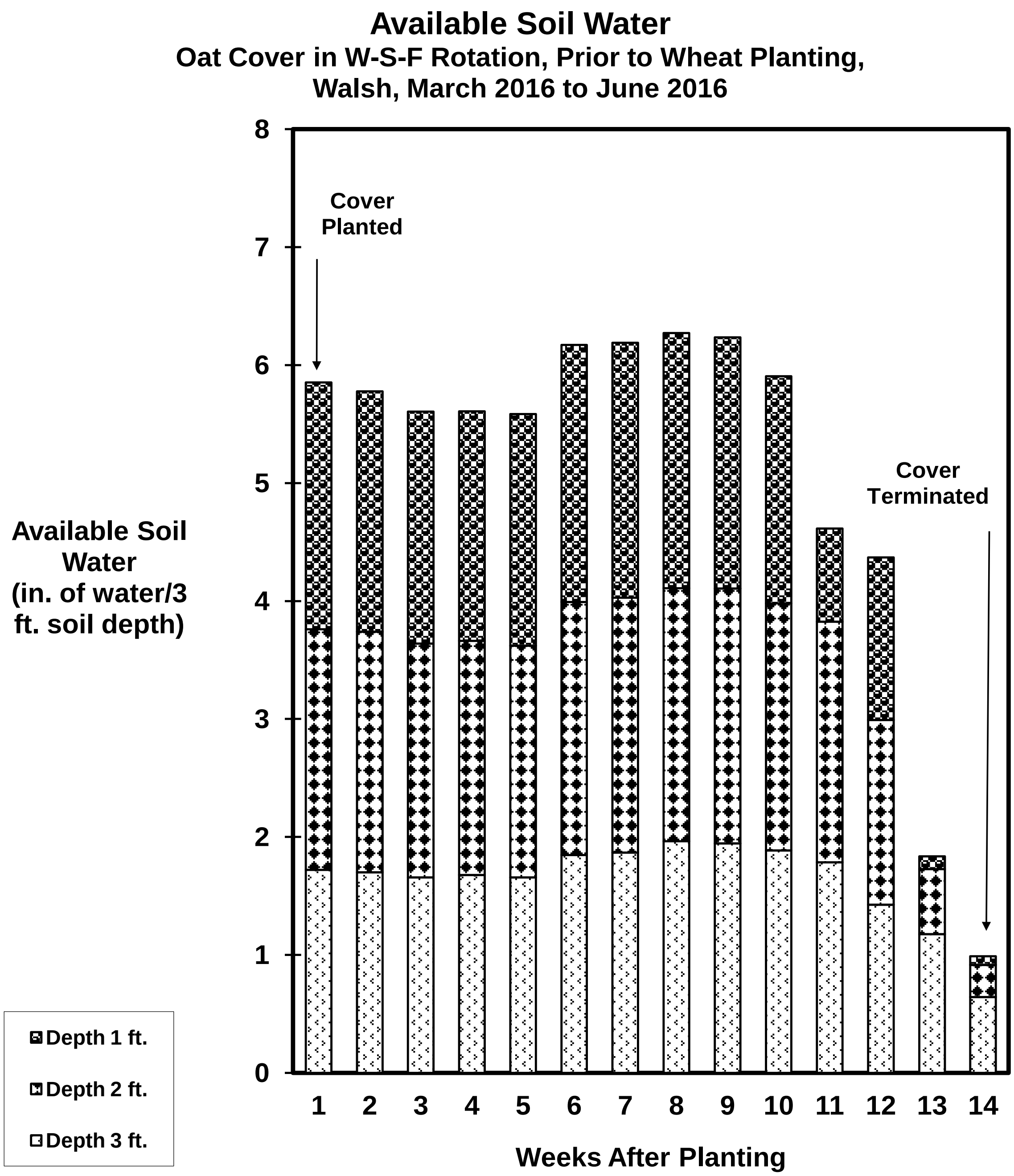

Fig. . Available soil water of oats cover in W-S-F rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.09 in. Any increase in available soil water between weeks is from rain.

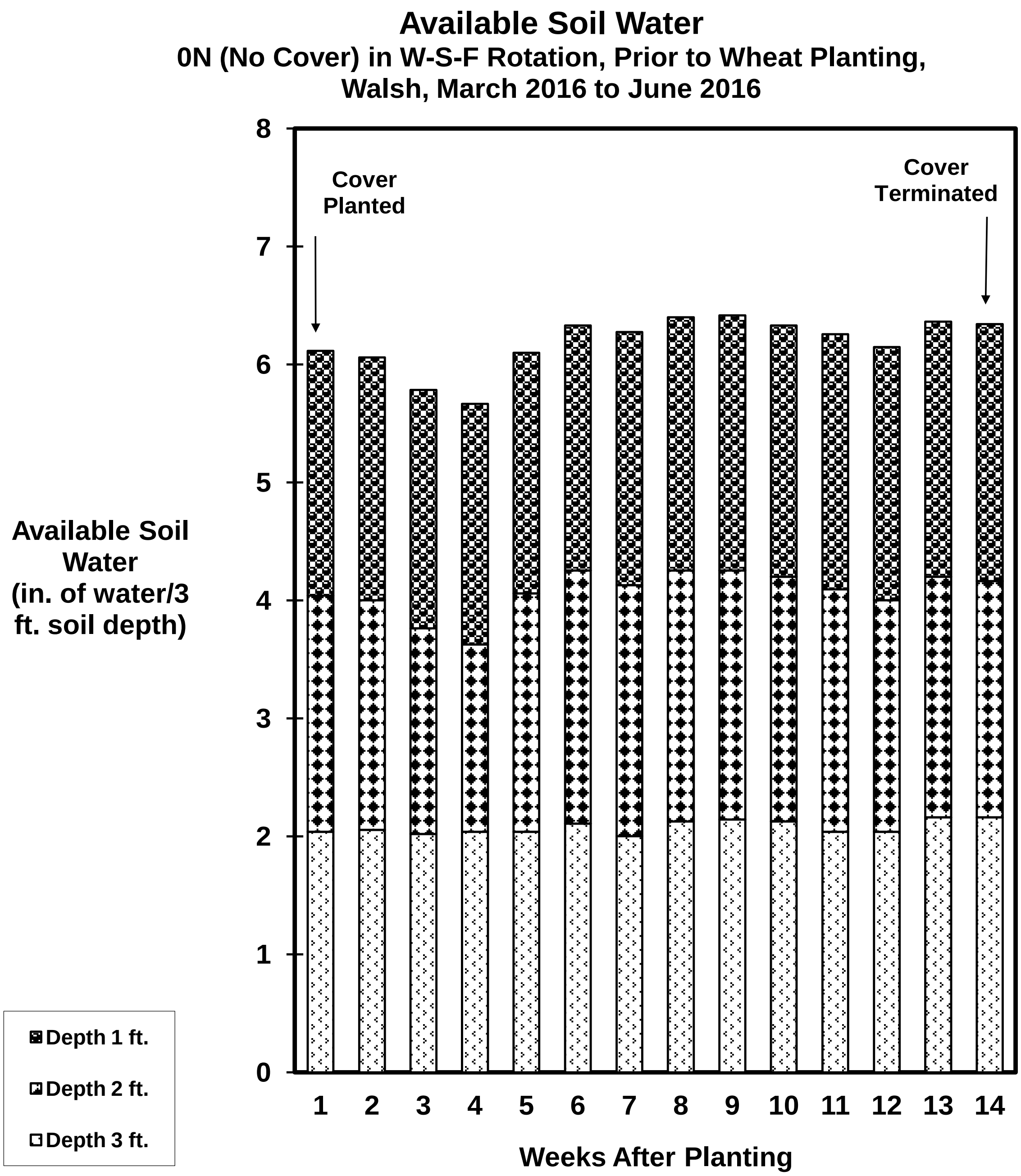

Fig. . Available soil water of 0N (no cover) in W-S-F rotation prior to wheat planting at Walsh. Gypsum block measurements taken to 3 ft. with 1 ft. increments. Total rainfall at Walsh from cover crop planting to cover crop termination was 7.09 in. Any increase in available soil water between weeks is from rain.

Strip Till and No Till Comparison for Dryland Grain Sorghum Production

Kevin Larson, Brett Pettinger and Perry Jones

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

Materials and Methods

We conducted this dryland grain sorghum study at the Plainsman Research Center on a site in which the previous crop was wheat. For the strip till treatment, we applied anhydrous N at 50 lb N/a and 10-34-0 at 5 gal/a in eight, 30 in. rows to a depth of 6 in. on April 20, 2017. For the no till treatment, we surface applied liquid 28-0-0 in streams 20 in. apart at 50 lb N/a on April 24, 2017 and seedrow applied 10-34-0 at 5 gal/a at planting. We planted Alta AG1201 at 38,000 seeds/a on June 9, 2017 with a John Deere vacuum planter with eight, 30 in. rows. For pre-emergence weed control we applied metolachlor at 24 oz/a, mesotrione 6.4 oz/a and atrazine at 1.0 lb/a, and for post emergence weed control, we applied: 2,4-D amine. We harvested the 60 ft. wide by 1200 ft. long grain sorghum plots on November 4, 2017 with a self-propelled combine and weighed them in a digital scale cart. Grain samples were collected for seed moistures and test weights. Grain yields were adjusted to 14% seed moisture content.

Results and Discussion

The strip till treatment produced 15 bu/a more than the no till treatment and this yield difference was significant at the 0.20 alpha level. The cost of 50 lb/a of N fertilizer was $6.00/a less expensive for strip till using anhydrous N than for no till using liquid N (anhydrous cost was $500/ton and liquid 28-0-0 cost was $235/ton); however, custom application cost of strip till was $8.50/a more than boom application for no till ($15/a for strip till and $6.50/a for no till). Since the cost of 10-34-0 at 5 gal/a was the same for both treatments, and no application cost was charged for the phosphate fertilizer because applications were performed with the anhydrous N during the strip till operation, or with the seed at planting for no till, this equated to a marginal ($2.50/a) difference in total variable cost between the no till and strip till treatments. The variable net income of strip till was $42.50/a more than no till, primarily due to the higher grain yield of no till (15 bu/a @ $3.00/bu). The production cost of dryland grain sorghum using typical N fertilizer rates is nearly equivalent for strip till and no till. The yield advantage of strip till compared to no till under our dryland conditions made strip till dryland grain sorghum production more profitable than no till. This is the first year that strip till produced higher dryland grain sorghum yields and variable net incomes than no till. The previous two years of this study no till produced higher yields and net incomes than strip till. This year, the reason strip till produced significantly higher yields than no till is because of plant stands. The plant stands were much more uniform with strip till than no till. There were large gaps between plants in the rows of the no till planted sorghum. Last year, we had a bumper wheat crop, which left excessive amounts of wheat stubble. Strip tilling before planting removed the matted wheat stubble, which afforded better depth control and better sorghum seed to soil contact than no till. Our planter was ill-equipped to handle the matted wheat stubble, particularly where the combine ran, and the no till system frequently balled up, leaving areas of the seedrows under planted.

Table .-No Till and Strip Till Comparison on Dryland Grain Sorghum at Walsh, 2017.

Tillage Treatment	Grain Yield	Test Wt.	Flowering Date	N Fertilizer	N Fertilizer Cost	Application Cost	Total Variable Treatment Cost	Variable Net Income
	bu/ac	lb/bu		type	$/50 lb N	$/ac	$/ac	$/ac
No Till	80.7	53.6	20-Aug	Liquid (28-0-0)	21.00	6.50	27.50	214.60
Strip Till	95.7	54.4	18-Aug	Anhydrous (82-0-0)	15.00	15.00	30.00	257.10
Average	88.2	54.0	19-Aug		18.00	10.75	28.75	235.85
LSD (0.20)	9.23	0.41						

Strip till: anhydrous N applied April 20, 2017 on 30 in. row spacing at a depth of 6 in.
No till: surface applied liquid 28-0-0 on April 24, 2017 in streams 20 in. apart.
Liquid 10-34-0 at 5 gal/ac was applied with the anhydrous N for the strip till treatment and with the seed at planting for the no till treatment.
Anhydrous cost: $500/ton; 28-0-0 cost $235/ton.
Grain sorghum price: $3.00/bu.
Planted Alta AG1201 on June 9 and harvested on November 4, 2017.

Narrow Row Air Seeder and Conventional Row Vacuum Planter Comparison for Grain Sorghum Production

Perry Jones, Brett Pettinger and Kevin Larson

Currently there are two major planting systems for seeding grain sorghum in our area: air seeder with narrow rows (10 in. spacings) and vacuum planter with conventional rows (30 in. spacings). There are advantages for both systems. The advantages for the air seeder are that it increases planted acres and the narrow rows suppress weeds. The advantages for the vacuum planter are precision placement of seeds and the ability to cultivate between rows and harvest lodged plants. We conducted this study because growers were curious if there might be a yield advantage between the planting systems.

Materials and Methods

We used a wheat stubble site with a thick mat of wheat residue for this dryland grain sorghum planting study. We compared a 36-row, John Deere 1990 CCS air seeder with 10 in. row spacings and an eight-row, John Deere 7300 vacuum planter with 30 in. row spacings. For both treatments, we surface applied liquid 28-0-0 in streams 20 in. apart at 50 lb N/a on April 24, 2017. For phosphate fertilization for the air seeder, we applied 10-34-0 at 5 gal/a with a double disced drill on 10 in. spacing prior to planting. For the vacuum planter, we seedrow applied 10-34-0 at 5 gal/a at planting. We planted Alta AG1201 on June 14 at 38,000 seeds/a for the vacuum planter and at least 45,000 seeds/a for the air seeder. For pre-emergence weed control, we applied metolachlor at 24 oz/a, mesotrione at 6.4 oz/a and atrazine at 1.0 lb/a, and for post emergence weed control, we applied: 2,4-D amine. We cultivated the conventional row vacuum planter treatment, but not the narrow row air seeder treatment. We harvested the 60 ft. wide by 1200 ft. long grain sorghum plots on November 20 and 22, 2017 with a self-propelled combine and weighed them in a digital scale cart. Grain samples were collected for seed moistures and test weights. Grain yields were adjusted to 14% seed moisture content.

Results and Discussion

The dryland grain sorghum planted with the narrow row (10 in. spacing) air seeder produced 21.3 bu/a more than the vacuum planter with 30 in. row spacing. The air seeder also had 1.5 lb/bu higher test weight than the vacuum planter. There are two plausible reasons that contributed to the air seeder yielding 21.3 bu/a more than the vacuum planter. First, we notice that the stand of the vacuum planter had large gaps down planted rows; whereas, the air seeder had solid stands. At harvest, the air seeder treatment looked like a sea of heads. The reason there were planting gaps in the vacuum planter treatment was because the double disc vacuum planter had problems planting in the matted wheat stubble. The vacuum planter kept balling up, particularly when planting between the combine wheel tracks. However, the single disc air seeder readily penetrated the matted wheat stubble and produced much more uniform placement of seeds.

The second reason the air seeder produced higher yields than the vacuum planter was because of weed control. The air seeder with its narrow seed rows and more uniform plant stands shaded out the weeds, while the vacuum planter with its wide rows and large plant stand gaps provided inadequate weed suppression. The weeds (mostly sandbur) flourished in the vacuum planter treatment, so much so, that we had to cultivate the vacuum planter treatment.

Not only did the air seeder produce significantly more yield than the vacuum planter, the narrow row air seeder also suppressed weeds. Because the air seeder suppressed sandburs so well, next year we are going to use the air seeder to plant grain sorghum seed in some of Plainsman's sandbur infested fields.

Table .-Narrow Row Air Seeder and Conventional Row Vacuum Planter Comparison for Grain Sorghum Production, Walsh, 2017.

Planter Type	Row Spacing Arragement	Grain Sorghum Yield	Test Weight	Moisture Content	Flowering Date
		bu/ac	lb/bu	%	
Air Seeder	10 in. single disc	89.2	52.3	12.0	23-Aug
Vacuum Planter	30 in. double disc	67.9	50.8	11.6	24-Aug
Average		78.6	51.6	11.8	24-Aug
LSD (0.20)		10.6	0.84		

Planted: both air seeder and vacuum planter treatments on June 14.
Alta AG1201, at 38,000 seeds/acre for vacuum planter and at least 45,000 seeds/acre for air seeder.
Harvested November 20 and 22.
Planters: John Deere 1990 CCS Air Seeder; John Deere 7300 Vacuum Planter.

Twin Row and Single Row Spacing Comparison for W-S-F Production

Brett Pettinger, Perry Jones, and Kevin Larson

To conduct a recent dryland wheat row spacing study, in which we tested five row spacing arrangements of 6 in., 7.5 in., 12 in., 15 in., and twin 7.5 in. (two rows 7.5 in. apart, centered on 30 in., with a 22.5 in. space between the outside rows), we used two different cone planters. The cone planter we used to achieve the 7.5 in., 15 in., and twin 7.5 in. row spacings was our small plot, twin row, row crop planter that had eight planter row units in a 7.5 in. twin row arrangement. By using GPS guidance to offset planting rows, we were able to achieve the necessary row spacing configurations. For example, to get uniform 7.5 in. spacing, we used the twin row, row crop planter to make the initial planting pass and then we shifted over and placed the 7.5 in. twin rows in the unplanted space and planted between the original 7.5 in. twin row pass, thus creating uniformly spaced 7.5 in. spacing. We included the twin 7.5 in. treatment because we thought growers would find it humorous, and because it was easy to identify even without a plot map. At our wheat field days, we were surprised by the positive reaction to the twin 7.5 in. treatment. Many growers felt that, even if the 7.5 in. twin did not produce the highest wheat yield, if next season, we planted grain sorghum in 7.5 in. twin rows in the 22.5 in. gap between the twin row wheat stubble that the additional grain sorghum yield would more than compensate for the lower wheat yield. True to grower experiences about achieving relatively high yields from partial plant stand failures that resembled twin row planted wheat. There were no significant grain yield differences in the wheat row spacing study between the twin row wheat spacing and any of the other wheat row spacings, except for the 12 in. row spacing which produced significantly higher grain yield than any of the other row spacings. Because of growers' research suggestions for this twin row system, we developed this twin row study for Wheat-Sorghum-Fallow rotation production to compare twin row and conventional single row spacing arrangements.

Materials and Methods

We tested three row spacing arrangements: 1) twin 7.5 in. rows (two rows 7.5 in. apart, centered on 30 in., with a 22.5 in. space between the outside rows) for twin rows of both wheat and grain sorghum; 2) single rows with uniform 10 in. spacing for single row wheat; and 3) single rows with uniform 30 in. spacing for single row grain sorghum. Our row spacing and crop sequencing treatments in Wheat-Sorghum-Fallow (W-S-F) rotation were 1) twin 7.5 in. rows of wheat followed by twin 7.5 in. rows of grain sorghum planted in the unplanted areas (22.5 in. gaps) between the twin row wheat stubble, (Twin W:Twin GS); 2) twin 7.5 in. rows of wheat followed by single uniformly spaced 30 in. rows of grain sorghum planted between the twin rows and in the unplanted areas (22.5 in. gaps) between the wheat stubble, (Twin W:Single GS); and 3) single uniformly spaced 10 in. rows of wheat followed by single uniformly spaced 30 in. rows of grain sorghum planted in the single uniformly spaced 10 in. rows of wheat stubble, (Single W:Single GS). For the twin row planting, we used our newly fabricated 20 ft., double disc, twin row planter with 8 sets of 7.5 in. twin rows, which the fabrication team (Brett and Perry) call, the "Great Plains Buffalo Tye Deere Twin Row Planter" for obvious reasons. For the uniform 10 in. spacing single row wheat planting, we used a 20 ft.

United Farm Tools double disc drill with 10 in. spacing. For the uniform 30 in. spacing single row grain sorghum planting, we used a 20 ft. John Deere 7300 vacuum planter with eight rows spaced 30 in. apart. This is our first grain sorghum crop harvest year in comparing the twin rows and single uniform rows of the Wheat-Grain Sorghum-Fallow (W-S-F) rotation. We planted grain sorghum, Alta AG1201, at 38,000 seeds/a on June 2. We planted wheat, Snowmass, at 50 lb/a on October 10, 2017, but it will not be harvested until 2018, therefore it will not be part of our evaluation this year. This year, all the grain sorghum crops followed drilled 10 in. spacing wheat stubble. We applied 50 lb/a of N to the study site and seedrow applied 10-34-0 at 5 gal/a at planting. Before planting we sprayed one application of glyphosate at 32 oz/a, LoVol at 0.5 lb/a, and dicamba 6 oz/a. For in-season weed control for the grain sorghum, we applied pre-emergence: Sharpen 2.0 oz/a and glyphosate 32 oz/a, and post emergence: Huskie 16 oz/a and atrazine 0.75 lb/a. For fallow, we applied glyphosate 32 oz/a, dicamba 6 oz/a, LoVol 0.5 lb/a two times, and one of these application we included Stare Down 6.4 oz/a to all the fallow plots to control glyphosate-resistant kochia. We harvested the grain sorghum crop with a self-propelled combine equipped with a digital scale on October 24. The wheat crop will not be harvested until next year. We sampled the grain for test weights and moistures, and used 14% moisture-adjusted grain yields for comparisons. We recorded cost of production and yields in order to determine treatment revenues.

Results and Discussion

Grain sorghum yields were excellent, averaging 113 bu/a for all row arrangements. The high yields were due to well timed rains throughout the growing season, which totaled 15.59 in from June (planting) to the first freeze in October. This year without a harvested wheat crop, the annual row spacing productions of the W-S-F rotation were quite similar, 2124 lb/a for Twin W:Single GS, 2115 lb/a for Twin W:Twin GS, and 2096 lb/a for Single W:Single GS. This is not surprising since the grain sorghum crop for all row spacing arrangements was planted in uniformly spaced 10 in. row wheat stubble. The only relevant comparison was twin row grain sorghum compared to single row grain and no more than 1 bu/a separated them. This indicates that there is no yield advantage or disadvantage between twin row planted grain sorghum and single row planted grain sorghum.

The income difference between all row spacing arrangements was $1/a or less. 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. This year because there was no wheat crop, all crop rotations were reliant on grain sorghum crops for their entire production. For example, the 2017 total production for the Single W:Single GS in the W-S-F rotation was 6289 lb/a. The crop rotational phases were: wheat, 0 lb/a; grain sorghum, 6289 lb/a; and, of course, no production for fallow. The annual rotation production was 2096 lb/a, which is one-third the total production because the W-S-F rotation takes three years to complete one rotation cycle.

Since this is a new row spacing arrangement comparison study and not all rotational crops have been harvested, no long term rotational effects can be evaluated.

Table .-TwinRow and Single Row Spacing for W-S-F, 2017

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		-------------------------------------$/a---					
Wheat	50 lb			0 bu	3.75/bu	0.00	0.00
Twin W:Twin GS				0.0	3.75	0.00	0.00
Twin W:Single GS				0.0	3.75	0.00	0.00
Single W:Single GS				0.0	3.75	0.00	0.00
Grain Sorghum	38,000 seeds	7.26	31.74	113.1 bu	3.00/bu	339.40	300.40
Twin W:Twin GS				113.3	3.00	339.90	300.90
Twin W:Single GS				113.8	3.00	341.40	302.40
Single W:Single GS				112.3	3.00	336.90	297.90
Fallow	---	---	30.61	---	---	-30.61	-30.61
Average			20.78			102.93	89.93

Planted: Grain Sorghum, Alta AG1201 at 38,000 seeds/a on June 6.
Wheat, (new rotation) Snowmass at 50 lb/a on October 10, 2017 for 2018 harvest.
Harvested: Wheat, new rotation, no 2017 crop; Grain Sorghum, October 24.
Weed control cost is herbicide cost and $6.50/a application cost for each application.

Twin Row and Single Row Spacing for W-S-F, Crop Production, 2017

Crop	Row Arrangement & Spacing	-------2017 Crop------- Wheat	Grain Sorghum	Fallow	2017 Total Rotation Production	Annual Rotation Production
		--------------------lb/a---------------------				
1 Wheat:	Twin, 7.5 in.	0		--	6345	2115
1 Grain Sorghum	Twin, 7.5 in.		6345			
2 Wheat:	Twin, 7.5 in	0		--	6373	2124
2 Grain Sorghum	Single, 30 in.		6373			
3 Wheat:	Single, 10 in.	0		--	6289	2096
3 Grain Sorghum	Single, 30 in.		6289			
Average		0	6336	--	6336	2112
LSD 0.20			286.9			

Annual Rotation Production is Total Rotation Production divided by the number of years to complete one rotation cycle.
This is a new rotational study. Wheat planted October 10, 2017 for 2018 harvest.
The 2017 grain sorghum crop was planted in 10 in. spaced wheat stubble.

Twin Row and Single Row Spacing in W-S-F, Variable Net Income, 2017.

Crop	Row Arrangement & Spacing	-------2017 Crop------- Wheat	Grain Sorghum	Fallow	2017 Total Crop Net Income	Annual Rotation Variable Net Income
		-------------------------	----------	$/a ------	--------------	-------------
1 Wheat:	Twin, 7.5 in.	0.00		-30.61	270.29	90.10
1 Grain Sorghum	Twin, 7.5 in.		300.90			
2 Wheat:	Twin, 7.5 in	0.00		-30.61	271.79	90.60
2 Grain Sorghum	Single, 30 in.		302.40			
3 Wheat:	Single, 10 in.	0.00		-30.61	267.29	89.10
3 Grain Sorghum	Single, 30 in.		297.90			
Average		0.00	300.40	-30.61	269.79	89.93

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.
New rotation study. No wheat crop for 2017.

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

Kevin Larson, Brett Pettinger and Perry Jones

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

Materials and Methods

We conducted this dryland Wheat-Sorghum-Fallow rotation study at the Plainsman Research Center in which the previous crop rotation was Wheat-Sunflower-Fallow rotation. The kochia population on this site became glyphosate resistant after extensive reliance on glyphosate for weed control for the 10-year duration of the no till Wheat-Sunflower-Fallow rotation study. The kochia controlling treatments for 2017 were: 1) Valor 2.5 oz/a; 2) dicamba 16 oz/a, atrazine 1.0 lb/a; 3) dicamba 16 oz/a; and 4) dicamba 16 oz/a plus a single sweep plow tillage operation. The application date for the herbicide treatments in 2017 was: February 21, 2017. For the sweep plow tillage portion of treatment 4, we swept on May 22, 2017. A rescue weed control application consisting of Sharpen 2.0 oz/a, Staredown 6.4 oz/a, glyphosate 32 oz/a, HSMSO 64 oz/100 gal of water, AMS 15 lb/100 gal of water was applied on May 18, 2017 to treatment 3. A second rescue weed control application consisting of Staredown 6.4 oz/a, glyphosate 32 oz/a, 2,4-D 0.5 lb/a, AMS 1 lb/a was applied on June 6, 2017 to treatments 1 and 2. The kochia controlling treatments for 2016 were: 1) Valor 2.5 oz/a, glyphosate 32 oz/a, HSMSO 8 oz/a; 2) dicamba 16 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a; 3) dicamba 6 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a; and 4) dicamba 6 oz/a, glyphosate 32 oz/a, 2,4-D ester 0.5 lb/a, plus a single sweep plow tillage operation. The application dates for the treatments in 2016 were: March 20, 2016 for treatment 1; March 25, 2016 for the 2, 3 and 4 herbicide treatments; and May 26, 2016 for the sweep plow tillage portion of treatment 4. A rescue weed control application consisting of Sharpen 2.0 oz/a, Staredown 6.4 oz/a, glyphosate 32 oz/a, HSMSO 64 oz/100 gal of water, AMS 15 lb/100 gal of water was applied on June 10, 2016 to treatments 2 and 3. We planted Pioneer 86P20 at 38,000 seeds/a on June 13, 2017. We planted proso millet in the failed wheat plots with Huntsman at 12 lb/a on June 14, 2017. A post emergence application of Huskie 16 oz/a, atrazine 0.75 lb/a, AMS 2 lb/a was applied to all grain sorghum treatments. A post application of Staredown 6.4 oz/a and 2,4-D 0.38 lb/a. was applied to all proso millet treatments. For fertilization, we surface streamed 50 lb N/a to the entire site and we seedrow applied at planting 10-34-0 at 5 gal/a to both the grain sorghum and failed wheat crops. We harvested the 20 ft. wide by 1000 ft. long grain plots of grain sorghum on October 26, 2017 and the proso millet plots on September 15, 2017 with a self-propelled combine and weighed them in a digital scale cart. Grain samples were collected for seed moistures and test weights. Grain yields were adjusted to 14.0% seed moisture content for both grain sorghum and proso millet.

Results and Discussion

Prior to sorghum planting, we had to rescue all of the herbicide treatments because they all had weeds appear. The dicamba at 16 oz/a treatment was the first we had to rescue because kochia broke through the treatment; therefore, we used a mix with Sharpen, an effective (and expensive) post emergence kochia control rescue treatment. We had to apply an herbicide rescue treatment to both the Valor at 2.5 oz/a and the dicamba and atrazine mix to control mainly Russian thistle before sorghum planting. Without the need to include Sharpen in the mix, the rescue treatment for the Valor and the dicamba and atrazine mix was much less expensive than the rescue treatment used for the dicamba alone treatment. The tillage treatment with the dicamba at 16 oz/a followed by a single sweep plow operation provided very good kochia control.

Surprisingly, the dicamba at 16 oz/a treatment had the highest grain sorghum yield, and it was significantly higher than the Valor and the tillage treatments ($P>0.20$). The dicamba alone treatment probably had the highest grain yield because we added Sharpen to the rescue treatment to effectively control kochia post emergent.   Grain sorghum yields ranged from 63 bu/a for the tillage treatment to 85 bu/a for the dicamba alone treatment. The dicamba and atrazine treatment had the highest variable net income of $218/a, even though its yield was 2 bu/a less than the dicamba alone treatment, because the dicamba alone had a more extensive and expensive rescue treatment.

The wheat crop germinated but failed to emerge because the conditions were too dry. We planted proso millet in the failed wheat. The Valor and the tillage treatments produced similarly millet yields (21 bu/a), but they were not significantly higher than the dicamba at 16 oz/a and the dicamba at 6 oz/a treatments. Since the Valor treatment and the tillage treatment had similar treatment costs and millet yields, they produced nearly identical variable net incomes of about $48.45/a. The Valor treatment and the tillage treatment provided in excess of $24/a more than the dicamba treatments, because both the dicamba treatments require an expensive rescue treatment to rid them of kochia.

Table .--Herbicide and Single Tillage Control of Kochia in W-S-F Rotation, Grain Sorghum Crop, Walsh, 2017.

Treatment	Product Dosage	Dosage Unit	Application Date	Seed Moisture %	Test Weight lb/bu	Grain Yield bu/a	Treatment Cost $/a	Rescue Treatment Cost $/a	Variable Net Income $/a
1 Valor	2.5	oz/a	2/21/2017	14.5	55.6	79.8	17.07	16.28	206.05
2 Dicamba	16	oz/a	2/21/2017	13.8	56.1	82.9	14.20	16.28	218.22
2 Atrazine	1	lb/a	"						
3 Dicamba	16	oz/a	2/21/2017	13.8	56.5	84.6	11.50	28.39	213.91
4 Tillage (sweep plow)			5/22/2017	16.0	53.2	62.8	21.50		166.90
4 Dicamba	16	oz/a	2/21/2017						
Average				14.5	55.4	77.5	16.07	20.32	201.27
LSD 0.20						4.25			

Planted: June 13, 2017, grain sorghum hybrid: Pioneer 86P20 at 38,000 seeds/a.
Herbicide treatments applied: February 21, 2017 to 20 ft. by 1000 ft. with 2 replications, prior to kochia emergence.
Treatment cost is herbicide cost plus application cost at $6.50/a. Sweep plow cost is $10/a.
Rescue treatment applied May 18, 2017 to treatment 3 (dicamba 16 oz/a treatment).
The rescue treatment was: Sharpen 2.0 oz/a, Staredown 6.4 oz/a, Glyphosate 32 oz/a, 2,4-D 0.5 lb/a, HSMSO 64 oz per 100 gal. water, AMS 1 lb/a. Rescue treatment herbicide cost, $21.89/a.
Another rescue treatment applied June 6, 2017 to treatments 1 and 2 (Valor and dicamba/atrazine treatments).
The rescue treatment was: Staredown 6.4 oz/a, Glyphosate 32 oz/a, 2,4-D 0.5 lb/a, AMS 1 lb/a. Cost $9.78/a.
Variable Net Income: gross income (grain yield x $3.00/bu) minus treatment cost.
Grain sorghum price: $3.00/bu.

Table .--Herbicide and Single Tillage Control of Kochia in W-S-F Rotation, Millet Crop in Failed Wheat, Walsh, 2017.

Treatment	Product Dosage	Dosage Unit	Application Date	Seed Moisture %	Test Weight lb/bu	Grain Yield bu/a	Treatment Cost $/a	Rescue Treatment Cost $/a	Variable Net Income $/a
1 Valor	2.5	oz/a	3/20/2016	14.7	59.0	21.1	22.23		48.46
1 Glyphosate	32	oz/a	"						
1 HSMSO	8	oz/a	"						
2 Dicamba	16	oz/a	3/25/2016	15.8	59.3	20.4	16.42	27.94	23.98
2 Glyphosate	32	oz/a	"						
2 2,4-D ester	0.5	lb/a	"						
3 Dicamba	6	oz/a	3/25/2016	15.8	59.3	18.5	12.92	27.94	21.12
3 Glyphosate	32	oz/a	"						
3 2,4-D ester	0.5	lb/a	"						
4 Tillage (sweep plow)			5/26/2016	15.1	58.8	21.3	22.92		48.44
4 Dicamba	6	oz/a	3/25/2016						
4 Glyphosate	32	lb/a	"						
4 2,4-D ester	0.5	lb/a	"						
Average				15.4	59.1	20.3	18.62	27.94	35.50
LSD 0.20						3.88			

Planted: June 14, 2017, Huntsman at 12 lb/a.
Treatments applied: 20 ft. by 1000 ft. with 2 replications, prior to kochia emergence.
Treatment cost is herbicide cost plus application cost at $6/a. Sweep plow cost is $10/a.
Rescue treatment applied June 10, 2016 to treatments 2 and 3 (dicamba 6 and 16 oz/a treatments).
The rescue treatment was: Sharpen 2.0 oz/a, Staredown 6.4 oz/a, Glyphosate 32 oz/a, HSMSO 64 oz per 100 gal. water, AMS 15 lb per 100 gal. of water. Rescue treatment herbicide cost, $21.94/a.
All treatments were sprayed with Glyphosate 32 oz/a, Staredown 6.4 oz/a, 2,4-D 0.5 lb/a, AMS 1 lb/a to control failed wheat and weeds. Cost: $9.78/a
Variable Net Income: gross income (grain yield x $3.35/bu) minus treatment cost. Proso millet price: $3.35/bu.

Sugarcane Aphid Management: Avoidance (Planting Dates), Tolerance (Grain Sorghum Hybrids) and Control (Insecticide)

Kevin Larson, Brett Pettinger and Perry Jones

Sugarcane Aphid (SCA) appeared in Southeastern Colorado late in the 2016 sorghum season. This late-season infestation of SCA caused considerable grain sorghum harvesting problems by plugging combine sieves with sorghum harvest dust glued by aphid honeydew to all internal threshing parts. SCAs have been a problem in Texas and other southern states since their arrival in 2013. Fortunately, the United Sorghum Checkoff Program invests in research to manage SCA and has accrued numerous SCA management recommendations, such as, planting early to avoid SCA, insecticides to control SCA, and a list of SCA tolerant sorghum hybrids (Brent Bean, United Sorghum Checkoff Program, 2016). Based on the recommendations compiled by Brent Bean, Agronomist for the United Sorghum Checkoff Program, we conducted this study to manage SCA by comparing planting dates (early and late), insecticide (with and without Sivanto), and grain sorghum hybrids (SCA tolerant and SCA susceptible, early and medium-early hybrids).

Materials and Methods

For this SCA management study, we used a Split-Split Plot design with four replications. The main plots were planting dates, PD1 (May 25) and PD2 (June 14); the subplots were unsprayed and sprayed insecticide for SCA control, Sivanto at 7 oz/ac; and the sub-subplots consisted of four grain sorghum hybrids: two SCA tolerant and two susceptible grain sorghum hybrids, Alta AG1201 (SCA tolerant, early maturing hybrid), Mycogen 1G557 (SCA susceptible, early maturing hybrid), Dekalb DKS37-07 (SCA tolerant, medium-early maturing hybrid), and Channel 6B60 (SCA susceptible, medium-early maturing hybrid). We conducted this dryland grain sorghum study at the Plainsman Agri-Search Foundation farm at Walsh on a site in which the previous crop was wheat. We strip tilled anhydrous N at 50 lb N/a and 10-34-0 at 5 gal/a in 30 in. rows to a depth of 6 in. on April 20, 2017. For pre-emergence weed control we applied metolachlor at 24 oz/a, mesotrione 6.4 oz/a and atrazine at 1.0 lb/a, and for post emergence weed control, we applied: 2,4-D amine, mainly for Devil's Claw control. We cultivated once for sandbur control. All grain sorghum hybrids were planted at 38,000 seeds/ac on 30 in. row spacing. We planted the early planting date (PD1) on May 25 and the late planting date (PD2) on June 14. Every week from mid-July until late September, we inspected 20 plants from each treatment plot for SCAs. SCA populations never reached the critical threshold (25% of plants with 50 SCAs on a single leaf) to trigger insecticide application. However, we applied Sivanto at 7 oz/a to all four hybrids in the PD1 Spray block on September 1, 2107, when the earliest maturing hybrid, Mycogen 1G557, reached the hard dough stage. No SCA-controlling insecticide was applied to the PD2 Spray block. We harvested the 10 ft. wide by 50 ft. long grain sorghum plots on November 3, 2017 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

From our weekly 20-plant samplings for SCA, we first detected SCAs on August 15 with aphids found on all planting dates and all hybrids. The highest SCA infestation level that we recorded during weekly 20-plant samplings was on August 21 with Dekalb DKS37-07, the SCA tolerant, medium-early grain sorghum hybrid, in the PD2 treatment (June 14 planting date) with 20% of its plants reaching colonies of about 25 aphids on a single leaf per plant. This SCA infestation was below our critical threshold of 25% of plants with 50 SCAs on a single leaf needed to trigger insecticide application. By the following week, the SCA colonies had decreased and no insecticide treatment was applied to the PD2 Spray treatment. The reason for the decline in SCA colonies may be attributed to the wet (5.18 in. of rain), cool (only 3 days above 90F) August that slowed the reproductive rate of the aphids and allowed predation and parasitism by beneficial insects to control SCA populations. This beneficial insect control of SCAs was particularly evident by the large number of parasitic wasp mummies that remained at the former aphid colonies.

When the earliest maturing hybrid, Mycogen 1G557, reached the hard dough stage, we applied Sivanto at 7 oz/a to all four hybrids for the PD1 (May 25) planting date Spray treatment. Although the PD1 Spray treatment was not highly infested by SCAs, this insecticide application controlled the aphids throughout the next three weeks, as there were no SCAs detected for the remainder of our weekly samplings.

SCAs were not the critical factor in determining grain sorghum yields, because their infestations rates were so low. Since the SCA populations did not exceed our critical threshold on any of the hybrids in either of the plantings dates, it was not surprising that the grain yields of the Unsprayed and Sivanto Sprayed treatments were not significantly different. Nonetheless, the grain yield between the earlier planting date, May 25, and the later planting date, June 14, was very highly significant. The May 25 planting date produced 128 bu/ac and the June 14 planting date produced 86 bu/ac, when combining all hybrids and spray treatment yields together. Again, the 42 bu/ac yield difference between the planting dates was not due to SCA infestation, but was probably due to the cool August temperatures that particularly slowed plant development and maturation of the June 14 planting date. The grain sorghum hybrids produced excellent yields, averaging 107 bu/ac. Channel 6B60, one of the medium-early hybrids, produced significantly more yield than any of the other hybrids tested, 122 bu/ac. Both medium-early hybrids, Channel 6B60 and Dekalb DKS37-07, yielded significantly more than the two early maturing hybrids, Alta AG1201 and Mycogen 1G557. Together the two early maturing hybrids averaged 98 bu/ac and less than 1 bu/ac separated them.

There was a very highly significant interaction between the hybrids and the planting dates. This interaction was caused by the minor yield decrease (14 bu/ac) of Mycogen 1G557, an early maturing hybrid, and the large yield drop (59 bu/ac) of Channel 6B60, a medium-early hybrid, when planted May 25 compared to June 14. The other two hybrids, Alta AG1201 (an early maturing hybrid) and Dekalb DKS37-07 (a medium-early hybrid) had intermediate yield declines when planted May 25 compared to June 14.

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Sugarcane Aphid Management, Weekly Sorghum Plant Sampling at Walsh, 2017.

		Plants with SCA, 1 to 25 Aphids per Leaf per Plant					
Firm	Hybrid	15-Aug	21-Aug	26-Aug	4-Sep	13-Sep	21-Sep
		-----------------20 plant sample----------------					
PD1, May 25, Unsprayed							
Alta Seeds	AG1201	2	6	3	0	0	0
Mycogen Seeds	1G557	3	7	5	2	0	1
Dekalb	DKS37-07	6	8	7	6	2	0
Channel Seed	6B60	7	13	8	2	0	1
PD1 Unsprayed Average		**5**	**9**	**6**	**3**	**1**	**1**
PD1, May 25, Sprayed							
Alta Seeds	AG1201	7	9	5	0	0	0
Mycogen Seeds	1G557	15	12	10	0	0	0
Dekalb	DKS37-07	4	6	6	0	0	0
Channel Seed	6B60	3	6	8	0	0	0
PD1, Sprayed Average		**7**	**8**	**7**	**0**	**0**	**0**
PD2, June 14, Unsprayed							
Alta Seeds	AG1201	8	16	9	10	4	3
Mycogen Seeds	1G557	11	16	13	9	3	2
Dekalb	DKS37-07	8	14	11	6	4	1
Channel Seed	6B60	5	12	10	5	4	6
PD2, Unsprayed Average		**8**	**15**	**11**	**8**	**4**	**3**

Planting Dates: PD1, May 25, 2017; PD2, June 14, 2017 at 40,000 seeds/ac.
Applied Sivanto at 7 oz/a on September 1, 2017 only to PD1 Spray treatment.

Sugarcane Aphid Management, Insecticide Spray at Walsh, 2017.

Insecticide Spray	Grain Yield		Test Weight	Grain Moisture	Plant Height
	bu/ac		lb/bu	%	in
Sprayed, Sept. 1	107.8	a	60.8	11.4	49
Unsprayed	105.4	a	58.9	12.1	49
Average	106.6		59.9	11.8	49
LSD 0.05	7.48				

Sivanto at 7 oz/ac was applied on September 1, 2017.
Only PD1 was sprayed, PD2 was not sprayed.
Grain yields, test weights, grain moistures, and plant heights are combined values of hybrids and planting dates.

Sugarcane Aphid Management, Planting Date at Walsh, 2017.

Planting Date	Grain Yield		Test Weight	Grain Moisture	Plant Height
	bu/ac		lb/bu	%	in
PD1, May 25	127.6	a	60.8	11.4	50
PD2, June 14	85.6	b	58.9	12.1	49
Average	106.6		59.9	11.8	50
LSD 0.05	8.80				

Planting Dates: PD1, May 25, 2017; PD2, June 14, 2017 at 40,000 seeds/ac.
Grain yields, test weights, grain moistures, and plant heights are combined values of hybrids and spray treatments.

Sugarcane Aphid Management, Grain Sorghum Hybrids at Walsh, 2017.

Firm	Hybrid	SCA Tolerant	Grain Yield		Test Weight	Maturity Class	Plant Height
			bu/ac		lb/bu		in
Alta Seeds	AG1201	Yes	98.0	a	58.80	Early	43
Mycogen Seeds	1G557	No	97.2	a	59.80	Early	45
Dekalb	DKS37-07	Yes	109.0	b	61.00	Medium Early	52
Channel Seed	6B60	No	122.2	c	59.70	Medium Early	56
Average			106.6		59.83		49
LSD 0.05			4.45				

Planting Dates: PD1, May 25, 2017; PD2, June 14, 2017 at 40,000 seeds/ac.
Harvested: November 3, 2017.
Grain yields, test weights, and plant heights are combined averages of planting dates and spray treatments.

Sugarcane Aphid Management, Hybrid X Planting Date Interaction at Walsh, 2017.

Firm	Hybrid	PD1 Grain Yield	PD2 Grain Yield	Grain Yield Diff.	PD1 Test Wt.	PD2 Test Wt.	PD1 Flower Date	PD 2 Flower Date	PD1 Plant Ht.	PD2 Plant Ht.
		bu/ac	bu/ac	bu/ac	lb/bu	lb/bu			in	in
Alta Seeds	AG1201	116.7	79.3	37.4	59.5	58.2	30-Jul	24-Aug	43	44
Mycogen Seeds	1G557	103.3	88.7	14.6	60.5	59.0	28-Jul	20-Aug	46	45
Dekalb	DKS37-07	135.9	81.3	27.3	62.3	59.7	7-Aug	31-Aug	52	52
Channel Seed	6B60	151.6	92.5	59.1	60.9	58.6	10-Aug	29-Aug	58	54
Average		126.9	85.5	34.6	60.8	58.9	3-Aug	26-Aug	50	49

The Hybrid X Planting Date interaction for grain yield was very highly significant, $P < 0.0001$.

Planting Dates: PD1, May 25, 2017; PD2, June 14, 2017 at 40,000 seeds/ac.
Harvested: November 3, 2017.
Grain yields, test weights, and plant heights are combined averages of spray treatments.

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 were 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 sixth cropping season, we treated both the chemical and tillage treatments the same starting in March, 2015. The chemical treatment for the fallow periods, we sprayed glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2 lb/a three times prior to the wheat and grain sorghum crops for the W-S-F rotation and five times for the W-F rotation. For pre-emergence weed control in the grain sorghum crop, we applied a tank mix of metolachlor 24 oz/a, mesotrione 6.4 oz/a, and atrazine 1.0 lb/a. The wheat crop failed due to dry conditions during emergence, therefore, we applied glyphosate 32 oz/a as a clean up. For N fertilization, we streamed 28-0-0 at 50 lb N/a on 20 in. spacing. We planted wheat, Byrd at 50 lb/a and seedrow applied 5 gal 10-34-0/a, on October 12, 2016. For the sorghum crop, we planted Alta AG1201 at 38,000 seeds/a on June 6, 2017 and seedrow applied 5 gal 10-34-0/a at planting. The wheat failed and was not harvested. We harvested the grain sorghum on October 25, 2017 with a self-propelled combine equipped with a digital scale. Yields were adjusted to 14% seed moisture content for grain sorghum.

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, only two wheat crops have been harvested, but this is our sixth harvested grain sorghum crop. The first wheat crop, following our initial burn down or tillage to control the perennial grasses, and the 2016 wheat crop have been our only harvested wheat crops.

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

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

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

In 2015, grain sorghum was the only crop harvested because the wheat crop was severely damaged by hail. The chemical treatment produced 10.1 bu/a more grain sorghum yield than the tillage treatment. There were fewer chemical and tillage operations, resulting in $4.52/a higher chemical treatment cost. However, the higher grain yield of the chemical treatment more than compensated for its higher treatment cost by producing $28.31/a more income than the tillage treatment.

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

This year, we harvested only the grain sorghum crop. The chemical and tillage treatments were treated the same, since we suspended the tillage operations last year. Grain sorghum yields were very high averaging 111.7 bu/a and only 1.2 bu/a separated the chemical and old tillage treatments. With similar yields and the same treatment cost, there was only $3.60 difference between the treatments in variable net income. These minor yield and income differences verify that suspending tillage operations requires only one or two years for full yield recovery.

Total rotational variable net income (rotational income minus CRP conversion cost and treatment maintenance cost) for the first six years of this study (2012 to 2017) produced negative incomes for the W-F rotation, -$43/a for the chemical treatment and -$30/a for the tillage treatment. The negative incomes for the W-F rotation are due to harvesting only two wheat crops in six years. By 2013, after the second grain sorghum crop, the W-S-F rotation was producing positive rotational variable net incomes. Grain sorghum production accounted for nearly all of the total rotational variable net incomes from 2012 to 2017, $130/a for chemical treatment and $110/a for tillage treatment. After six years of this CRP crop conversion study, the chemical treatment produced an average of $8/a more than the tillage treatment.

Reference Cited

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

Table .Long Term CRP Conversion After Using Tillage or Chemical, Sixth Season, Wheat-Sorghum-Fallow, Grain Sorghum Crop, Walsh, 2017.

CRP Conversion	Rotation	Test Weight	Grain Sorghum Yield	Gross Income	Treatment Cost	Variable Net Income
		lb/bu	bu/a	$/a	$/a	$/a
Tillage	W-S-F	57.5	111.1	333.30	67.28	266.02
Chemical	W-S-F	57.3	112.3	336.90	67.28	269.62
Average		57.4	111.7	335.10	67.28	267.82
LSD 0.20			17.55			

Fallow chemical: glyphosate 32 oz/a, dicamba 6 oz/a, 2,4-D 10 oz/a, AMS 2 lb/a applied two times.
Fallow chemical cost: $6.74/a and $6.50/a for each application.
Preplant chemical: metolachlor 24 oz/a, mesotrione 6.4 oz/a, atrazine 1.0 lb/a.
Preplant chemical cost: $21.06/a and $6.50/a for application.
Tillage and no till treated the same.
N fertilizer applied at 50 lb/a as 28-0-0.
Grain sorghum, Alta AG1201, planted at 38,000 seeds/a and seedrow applied 5 gal 10-34-0/a at planting.
Grain sorghum planted on June 6; harvested on October 25, 2017.
Grain sorghum price: $3.00/bu.
Variable Net Income is Gross Income minus Treatment Cost.

Table .-CRP Conversion, Chemical and Tillage Comparison, Annual Rotational Income, 2012 to 2017.

Rotation & Conv. Treatment	Conver-sion Cost	Variable Net Income 2012	2013	2014	2015	2016	2017	2012-17 Total Rotation Net Income	Average Annual Rotation Variable Net Income
		--------------$/a--------------							
Chemical									
W-S-F	113.10	-34.80	86.04	200.11	47.94	213.66	269.62	782.57	130.43
W-F	113.10	--	-102.23	-80.80	-57.04	90.90	-66.20	-215.37	-43.07
Tillage									
W-S-F	84.00	-34.63	50.50	149.63	19.63	209.91	266.02	661.06	110.18
W-F	84.00	--	-97.88	-60.00	-40.52	113.10	-66.20	-151.50	-30.30
Average		-34.72	-15.89	52.24	-7.50	156.89	100.81	269.19	41.81

The first wheat crop was 2013. There was no wheat harvested in 2014 (winterkill), 2015 (hail), and 2017 (too dry, poor emergence).
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.

Dryland Galena Genetics Soybean Variety Performance Trial at Walsh, 2017

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

PURPOSE: To identify high yielding non GMO soybean varieties under dryland conditions with 2750 heat units in a silty loam soil.

RESULTS: The dryland soybean variety trial averaged 21.1 bu/a with a seed production range from 16.3 bu/a for 20G15 to 25.0 bu/a for 18G15B.

PLOT: Four rows with 30 in. row spacing, 100 ft. long. SEEDING DENSITY: 90,000 seeds/a. PLANTED: June 2. HARVESTED: September 22 and October 3, 2017.

PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, mesotrione 6.4 oz/a. Post Emergence Herbicides: Select 16 oz/a, COC 32 oz/a. CULTIVATION: None. INSECTICIDES: None.

FIELD HISTORY: Last Crop: Wheat. FIELD PREPARATION: Strip till.

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

Month	Rainfall	GDD[b]	>90 F	>100 F	DAP[c]
	In		--------No. of Days--------		
June	1.20	670	14	3	28
July	4.64	870	23	3	59
August	5.18	641	3	0	90
September	3.52	528	9	0	120
October	0.00	48	0	0	123
Total	14.54	2757	49	6	123

[a]Growing season from June 2 (planting) to October 3 (harvest).
[b]GDD: Growing Degree Days for sorghum.
[c]DAP: Days After Planting.

COMMENTS: Planted in good soil moisture. Weed control was very good with sandburs controlled post emergence. The growing season precipitation was well above average. June was dry and July through October was wet. August was cool with only three days above 90F. Seed yields were quite good considering that it was a dryland trial.

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

Summary: Soil Analysis from Drip Site.

Depth	pH	Salts	OM	N	P	K	Zn	S
		mmhos/cm	%	----------------ppm----------------				
0-8”	8.2	0.5	1.6	8	5.0	524	0.6	10
8”-24”				9				
Comment	Alka	Vlo	Hi	Mod	Lo	VHi	Lo	Adeq

Iron was marginal.

Summary: Fertilization for Drip Site.

Fertilizer	N	P_2O_5	Zn	S
	--------------------lb/a------------------			
Recommended	0	20	1	0
Applied	50	20	0	0

Yield Goal: 15 bu/a.
Actual Yield: 21 bu/a.

Dryland Galena Genetics Soybean Variety Trial, Walsh, CO, 2017.

Galena Genetics Variety	Seed Yield	Seed Moisture	Test Weight	Plant Density	50% Flowering Date
	bu/a	%	lb/bu	plants/a (X 1000)	
18G15B	25.0	12.9	54.1	74.3	16-Jul
21G15B	23.9	7.8	55.3	68.5	17-Jul
24E171	23.3	7.9	55.7	75.9	17-Jul
19G16	23.0	7.6	56.3	58.1	18-Jul
19E161	22.7	8.4	55.8	73.6	19-Jul
21E161	22.6	14.0	54.3	76.7	17-Jul
25E171	22.1	12.0	54.7	68.9	19-Jul
22E171	22.0	16.0	55.4	77.4	17-Jul
21E161B	21.8	14.4	54.7	77.4	17-Jul
23E173	21.5	8.2	54.9	71.6	18-Jul
23G15	21.4	13.9	54.3	84.4	17-Jul
20G16	20.6	13.3	55.4	73.6	18-Jul
22E172	20.5	13.6	54.0	70.1	17-Jul
23E171	20.1	12.9	54.7	77.1	18-Jul
18G15	20.0	12.7	55.0	79.8	16-Jul
20E171	18.4	14.8	54.4	80.9	19-Jul
23E172	18.1	15.0	54.7	69.3	18-Jul
16G15	17.7	13.5	54.3	81.3	15-Jul
20G15	16.3	15.4	55.2	73.2	17-Jul
Average	21.1	12.3	54.9	74.3	17-Jul
LSD 0.05	5.81				
LSD 0.20	3.76				

Planted: June 2; Harvested: September 22 and October 3, 2017.
Seed Yield adjusted to 13.0% moisture content.