Technical Report TR11-02 January 2011

Agricultural Experiment Station

Colorado State University

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

Plainsman Research Center 2010 Research Reports

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Funded by the Colorado Agricultural Experiment Station

in cooperation with the Plainsman Agri-Search Foundation

This Plainsman Research Center booklet is dedicated to:

Dennis Thompson

For his unparalleled 30 years of service to the Plainsman Research Center

Dennis spent his career making Plainsman better: more productive, more profitable, more practical, more relevant.

He leaves Plainsman in the best condition possible.

Thank you Dennis.

Plainsman Research Center, 2010 Research Reports

Content	Page
Wheat Studies	
Winter wheat variety performance trials	1
Dryland wheat strips for forage and grain yield	7
Long term residual P on dryland wheat	10
Sorghum Hybrid Performance Studies	
Dryland grain sorghum seeding rate and seed maturation at Brandon	14
Dryland grain sorghum hybrid performance at Brandon	19
Dryland grain sorghum hybrid performance at Walsh	23
Limited Sprinkler Irrigation Studies	
Limited sprinkler irrigated grain sorghum performance	27
Limited sprinkler irrigated corn hybrid performance	30
Corn Borer resistant and nonresistant hybrid comparison	33
Drought Alleviation Strategies for Corn	
Skip-Row planting and seeding rates for dryland corn and sorghum	35
Foliar treatments on drought stressed corn	38
Seed treatments on dryland corn	43
Rotations with N Fertilizer	
Long-term N effects on irrigated Sunflower-Corn rotations	45
Soil Compaction Measurements in Irrigated Sunflower-Corn Rotations	48
Long-term N effects on Wheat-Sunflower-Fallow rotation	51
Crop Rotation Studies	
Crop rotation sequencing	55
Dryland crop rotations	64
Dryland millet and wheat rotations	69
Proso Millet Studies	
Seedrow P Rates on Dryland Proso Millet	75
Proso millet planting dates and cultivars for ethanol production	77
Alternative Crops	
Irrigated mid and high oleic sunflower hybrid performance	92
Dry bean, row crop head and hand harvest comparison	94
Winter canola variety performance trials	96
Soil Moisture and Winter Survival of Winter Canola	99

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2010 Climatological Summary
Plainsman Research Center, Walsh, Colorado

Month	Temperature Max. F	Min. F	Max. Mean F	Min. Mean F	Mean F	Precip. In.	Greatest Day of Precip-atation	Snow-Fall In.	Greatest Snow Depth In.	Evapor-ation In.
Jan.	62	-7	46.6	16.7	31.7	0.56	0.56	5.00	5.00	
Feb.	59	10	41.1	20.0	30.6	0.55	0.29	6.00	2.50	
Mar.	87	19	56.2	28.0	42.1	1.81	0.67	6.50	3.00	
Apr.	88	23	69.0	38.7	53.9	0.78	0.24	T	T	3.35
May	93	29	75.4	44.3	59.9	1.25	0.36	0.00	0.00	10.03
Jun.	102	48	90.2	60.6	75.4	2.00	0.83	0.00	0.00	12.26
Jul.	101	57	91.8	63.6	77.7	3.65	1.15	0.00	0.00	10.16
Aug.	100	48	90.5	61.7	76.1	4.09	1.69	0.00	0.00	9.04
Sep.	99	42	87.8	54.6	71.2	1.79	1.79	0.00	0.00	10.16
Oct.	86	23	73.2	39.9	56.5	0.23	0.12	0.00	0.50	3.94
Nov.	79	7	58.5	26.5	42.5	0.06	0.06	T	T	
Dec.	72	3	50.3	21.9	36.1	0.25	0.13	3.00	1.50	
Total Annual			**69.22**	**39.71**	**54.48**	**17.02**		**20.50**		**58.94**

*** NOTE: Evaporation read mid April 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.

	2009	2010
Highest Temperature:	102 degrees on Jul. 13	102 degrees on Jun. 11
Lowest Temperature:	-6 degrees on Dec. 9 & 10	-7 degrees on Jan 8
Last freeze in spring:	32 degrees on Apr. 9	32 degrees on May 14
First freeze in fall:	30 degrees on Oct. 2	31 degrees on Oct. 26
2008 frost free season:	176 frost free days	165 frost free days
Avg. for 26 years:	19.95 inches	Avg for 27 years 19.84 inches

Maximum Wind:

Jan.	40 mph on 23rd	July.	41 mph on 19th
Feb.	40 mph on 15th	Aug.	36 mph on 29th
Mar.	44 mph on 28th	Sept.	40 mph on 21st
Apr.	50 mph on 14th	Oct.	45 mph on 26th
May	46 mph on 25th	Nov.	42 mph on 30th
Jun.	43 mph on 16th	Dec.	45 mph on 11th

2010 Eastern Colorado Winter Wheat Variety Performance Trials

Jerry Johnson and Scott Haley

Colorado State University provides unbiased and reliable information to Colorado wheat producers to help them make better wheat variety decisions. It provides excellent research faculty and staff, a focused breeding program, graduate and undergraduate students, and dedicated agricultural extension specialists. However, wheat improvement in Colorado would not be possible without the support and cooperation of the entire Colorado wheat industry. Ongoing and strong support for a public breeding program is critical because variety development and testing is a long process, especially under the highly variable climatic conditions in Colorado.

There is an increasing investment in wheat breeding by private seed companies in the Great Plains. WestBred has become a unit of Monsanto and AgriPro COKER has become part of Syngenta. Limagrain is poised to begin winter wheat breeding in Fort Collins this fall. More traits and adapted varieties or hybrids should be available to Colorado producers in the future.

Our wheat variety performance trials, and collaborative on-farm testing, represent the final stages of a wheat breeding program where promising experimental lines are tested under an increasingly broad range of environmental conditions. Variation in precipitation, as well as variable fall, winter, and spring temperature regimes, hail and spring freeze events, interact with disease and insect pests and variety maturity to affect wheat yields. As a consequence of large environmental variation, Colorado State University annually conducts a large number of performance trials, which serve to guide producer variety decisions and to assist our breeding program to more reliably select and advance the most promising lines toward release as new varieties.

2010 Trials

Dryland trials were planted in Lamar, Sheridan Lake, and Arapahoe in early September; in Burlington and Orchard in mid-September; and in Julesburg, Yuma, Akron, and Walsh in late September (due to unseasonably wet conditions in mid-September at the NE Colorado locations). Variety trial emergence was good across locations although cool, dry conditions in the fall led to slow growth and small plants going into winter. Moist spring conditions in most locations ensured good plant growth as well as creating good conditions for the spread of stripe rust. Rust, high temperatures and strong winds stripped the leaves from wheat plants prematurely at Walsh, Lamar, and Sheridan Lake. Even so, yields were above average at these locations. Two trials, at Genoa and Roggen, were lost to hail in June. A new race of stripe rust developed in the southern states and spread to Colorado in 2010. Many varieties previously resistant to stripe rust are now fully susceptible to the new race. Stripe rust infected all trials to different degrees and at different times. Seemingly, the late-planted locations at Julesburg, Yuma, and Akron were most affected by a late-season stripe rust infection following an especially wet period. Russian wheat aphid was not a problem in 2010.
The Irrigated Variety Performance Trials (IVPT) at Fort Collins and Rocky Ford were planted in mid-September while wet mid-September conditions made it impossible to plant at Haxtun until late September. The trial at Rocky Ford suffered from a severe infection of powdery mildew and lodging resulting from lush fall and spring growth, which led to low irrigated wheat yields. In spite of late planting, yields of some varieties at Haxtun still surpassed 100 bu/ac. The yields at Fort Collins were very good even though the trial may have benefited from more spring and summer irrigation. Stripe rust was most serious at Fort Collins but less so at Haxtun (due to fungicide application).

There were 40 different entries in the dryland performance trials (UVPT) and 32 entries in the irrigated performance trials (IVPT). All trials included a combination of public and private varieties and experimental lines from Colorado and surrounding states. All dryland and irrigated trials were planted in a randomized complete block design with three replicates. Plot size was approximately 180 ft_2 and all varieties were planted at 700,000 viable seeds per acre for dryland trials and 1.3 million viable seeds per acre for irrigated trials. Yields are corrected to 12% moisture. Test weight information was obtained from a combine equipped with a Harvest Master measuring system.

2010 Dryland Winter Wheat Variety Performance Trial at Walsh

Variety	Yield	Test Weight	Height
	bu/ac	lb/bu	in
Ripper	58.2	53.7	30
CO06424	57.6	58.4	31
CO050233-2	56.6	57.0	31
Jagger	56.5	56.5	32
CO050337-2	56.4	56.0	32
CO050322	55.7	55.6	30
Winterhawk	55.6	58.3	30
CO050173	55.2	59.8	32
Armour	55.0	54.2	30
Bill Brown	54.9	57.4	32
Danby	54.9	58.2	30
Thunder CL	54.6	54.3	28
CO050303-2	54.4	58.1	31
CO050175-1	54.4	57.1	33
CO050270	54.3	55.8	30
Hawken	54.2	57.3	29
TAM 112	54.1	56.5	31
CSU Blend09	53.7	56.2	30
Infinity CL	53.6	56.5	33
Snowmass	53.5	54.6	32
Settler CL	53.1	55.9	27
SY Gold	53.0	58.7	30
Smoky Hill	52.5	55.8	30
Protection	52.5	56.4	35
Above	52.3	57.8	29
Prairie Red	52.3	56.4	29
CO05W111	52.0	58.2	32
Duster	51.5	57.2	31
CO06052	51.3	57.4	31
Bond CL	51.3	55.6	33
CO04499	51.1	57.8	33
CO05W194	51.0	58.1	27
Keota	50.9	57.8	32
Camelot	50.5	56.9	33
Fuller	49.9	54.8	31
Everest	49.7	57.5	29
Hatcher	49.5	57.4	29
TAM 111	49.4	54.6	30
CO04393	49.2	55.0	31
Stout	49.0	52.8	30
Average	**53.1**	**56.6**	**30.7**

2010 Dryland Winter Wheat Variety Performance Trial at Lamar

Variety	Yield	Test Weight	Height
	bu/ac	lb/bu	in
Ripper	57.7	60.2	31
Bond CL	53.4	55.4	33
Snowmass	52.5	60.1	32
CO06424	52.5	60.1	32
Prairie Red	52.4	58.2	27
Infinity CL	51.2	59.9	31
Duster	50.9	61.2	34
Winterhawk	50.7	60.9	31
CO050322	50.6	59.8	29
Smoky Hill	49.9	60.6	29
CO050173	48.6	60.7	24
CO04393	48.4	59.9	31
CO05W111	48.0	60.6	30
Stout	47.8	60.2	31
Bill Brown	47.7	59.4	28
TAM 112	47.6	59.3	32
Settler CL	47.0	60.7	28
Armour	46.4	58.7	30
CO050175-1	46.4	60.7	31
CO050270	46.1	58.8	26
Camelot	45.7	56.8	34
Thunder CL	45.4	60.3	31
CO050303-2	45.3	60.0	30
CSU Blend09	44.7	59.6	30
Everest	44.7	60.9	33
CO04499	44.2	59.0	31
CO050337-2	44.2	59.6	30
Hatcher	43.8	59.3	29
Fuller	43.5	57.0	31
Protection	43.5	59.5	30
Keota	43.2	59.0	32
Above	42.8	58.2	33
CO050233-2	42.7	57.5	29
SY Gold	42.3	59.5	32
CO05W194	42.2	59.3	30
TAM 111	42.0	61.0	30
Danby	41.5	61.4	29
CO06052	41.5	60.1	31
Jagger	37.7	59.9	32
Hawken	35.5	62.3	28
Average	**46.3**	**59.6**	**30.4**

2010 Dryland Winter Wheat Variety Trial at Sheridan Lake

Variety	Yield	Test Weight	Height
	bu/ac	lb/bu	in
CO05W111	62.7	63.0	28
CO050322	60.6	61.7	28
CO06424	59.5	62.7	29
CO050303-2	59.4	63.9	30
CO050270	59.3	62.7	29
CO050337-2	58.7	62.7	29
Bill Brown	57.4	64.1	26
TAM 111	56.1	64.9	30
Ripper	54.5	63.3	27
Snowmass	53.8	65.5	32
Hatcher	53.3	63.7	28
CO050173	53.0	64.1	28
CO05W194	52.9	62.4	28
CSU Blend09	52.8	63.2	29
Infinity CL	51.8	63.6	31
CO050233-2	51.8	63.0	29
TAM 112	51.5	64.3	29
CO04393	51.4	63.6	29
Camelot	51.3	64.1	29
Smoky Hill	51.1	62.9	28
CO050175-1	50.6	64.2	33
Settler CL	50.5	62.8	26
Winterhawk	50.3	63.4	30
Duster	50.1	63.8	27
Bond CL	50.0	62.8	29
Stout	49.6	63.2	28
Danby	49.5	66.1	29
CO04499	49.2	63.0	32
Prairie Red	48.8	62.9	29
Above	48.5	62.7	28
Protection	47.7	60.6	29
Thunder CL	47.2	63.2	28
Hawken	46.8	64.3	26
Everest	46.1	64.3	26
Armour	46.0	62.6	26
SY Gold	45.2	63.4	30
CO06052	44.5	63.9	30
Keota	44.2	64.3	29
Fuller	43.6	63.4	30
Jagger	42.5	64.0	28
Average	**51.3**	**63.5**	**28.7**

2009-2010 Dryland Winter Wheat Summary

Origin[a] and Release Year	Variety[b]	Market Class[c]	2-Yr Average[d] Yield	2-Yr Average[d] Test Weight
			bu/ac	lb/bu
NE 2008	Settler CL	HRW	58.9	60.2
CSU exp	CO04393	HRW	58.8	60.5
CSU exp	CSU Blend09	HRW	58.7	59.8
CSU 2009	Snowmass	**HWW**	58.3	60.9
TX/A 2002	TAM 111	HRW	58.2	61.3
CSU 2006	Ripper	HRW	58.1	59.4
CSU 2004	Bond CL	HRW	58.1	58.8
WB 2007	Winterhawk	HRW	58.0	61.4
CSU 2007	Bill Brown	HRW	57.6	60.7
CSU exp	CO04499	HRW	57.6	60.8
CSU 2004	Hatcher	HRW	57.4	60.4
CSU-TX 2001	Above	HRW	57.3	60.0
TX/W 2005	TAM 112	HRW	57.2	61.2
NE 2004	Infinity CL	HRW	56.8	60.3
KSU 2005	Danby	**HWW**	56.0	61.6
NE 2008	Camelot	HRW	55.9	60.3
CSU 1998	Prairie Red	HRW	55.8	59.4
AP 2009	SY Gold	HRW	55.8	60.8
WB 2008	Armour	HRW	55.8	59.3
CSU 2008	Thunder CL	**HWW**	55.8	59.7
OK 2006	Duster	HRW	55.8	60.3
WB 2006	Smoky Hill	HRW	55.2	60.2
AP 2006	Hawken	HRW	54.7	60.3
WB 2005	Keota	HRW	54.3	60.1
KSU 2006	Fuller	HRW	53.5	59.7
KSU 1994	Jagger	HRW	52.4	60.1
		Average	56.6	60.3

[a]Variety origin code: CSU=Colorado State University; CSU-TX=Colorado State University/Texas A&M University; WB=WestBred, LLC; AP=AgriPro COKER; TX/A=Texas A&M release, marketed by AgriPro COKER; TX/W=Texas A&M release, marketed by Watley Seed Co.; KSU=Kansas State University; NE=University of Nebraska; OK=Oklahoma State University

[b]Varieties ranked according to average 2-yr yield

[c]Market class: HRW=Hard Red Winter Wheat; HWW=Hard White Winter Wheat

[d]2-yr average yield and test weight are based on nine 2010 trials and ten 2009 trials

2008-2010 Dryland Winter Wheat Summary

			3-Yr Average[d]	
Origin[a] and Release Year	Variety[b]	Market Class[c]	Yield	Test Weight
			bu/ac	lb/bu
NE 2008	Settler CL	HRW	56.5	60.3
CSU 2006	Ripper	HRW	55.9	59.5
CSU 2009	Snowmass	**HWW**	55.8	60.8
WB 2007	Winterhawk	HRW	55.1	61.5
CSU 2007	Bill Brown	HRW	54.8	60.8
TX/A 2002	TAM 111	HRW	54.6	61.2
CSU-TX 2001	Above	HRW	54.5	60.0
CSU 2004	Hatcher	HRW	54.4	60.7
CSU 2004	Bond CL	HRW	54.4	59.3
TX/W 2005	TAM 112	HRW	54.2	61.0
NE 2004	Infinity CL	HRW	53.8	60.4
NE 2008	Camelot	HRW	53.0	60.5
OK 2006	Duster	HRW	52.8	60.4
CSU 1998	Prairie Red	HRW	52.7	59.7
WB 2006	Smoky Hill	HRW	52.7	60.6
KSU 2005	Danby	**HWW**	52.4	61.8
AP 2006	Hawken	HRW	52.3	60.6
CSU 2008	Thunder CL	**HWW**	51.8	60.0
WB 2005	Keota	HRW	51.5	60.0
KSU 2006	Fuller	HRW	51.1	60.1
KSU 1994	Jagger	HRW	50.0	60.0
		Average	53.5	60.4

[a]Variety origin code: CSU=Colorado State University; CSU-TX=Colorado State University/Texas A&M University; WB=WestBred, LLC; AP=AgriPro COKER; TX/A=Texas A&M release, marketed by AgriPro COKER; TX/W=Texas A&M release, marketed by Watley Seed Co.; KSU=Kansas State University; NE=University of Nebraska; OK=Oklahoma State University

[b]Varieties ranked according to average 3-yr yield

[c]Market class: HRW=Hard Red Winter Wheat; HWW=Hard White Winter Wheat

[d]3-yr average yield and test weight are based on nine 2010 trials, ten 2009 trials, and six 2008 trials

Dryland Wheat Strips for Forage and Grain Yield at Walsh, 2010

K. Larson, D. Thompson, D. Harn, and C. Thompson

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

MATERIALS AND METHODS: Fifteen wheat varieties were planted on September 30, 2009 at 50 lb seed/a in 20 ft. by 800 ft. strips with two replications. We applied 50 lb N/a with a sweep and seedrow applied 5 gal/a of 10-34-0 (20 lb P_2O_5, 6 lb N/a). Ally Extra 0.3 oz/a and 2,4-D 0.38 lb/a was sprayed for weed control. Two 2 ft. by 2.5 ft. forage samples were taken at jointing (April 6) and at boot (May 10). We measure the forage for fresh weight, oven-dried the samples, and recorded dry weight at 15% moisture content. Strip Rust was observed, but it came late in the season and no fungicide was applied. We harvested the plots on June 30 with a self-propelled combine and weighed them in a digital weigh cart. Grain yields were adjusted to 12% seed moisture content.

RESULTS: Grain yields were good, averaging 44 bu/a. Less 5 bu/a separated the highest yielding variety, Armour, from the lowest yielding variety, Bond CL. Armour had the highest grain yield, 46.4 bu/a, but it was not significantly higher than 10 other varieties tested. Hawken had the highest forage yield at jointing, and Bond CL had the highest forage yield at boot. Surprisingly, Hawken and Bond CL had the two lowest grain yields. Armour had the second highest dry weight at jointing and the fourth highest dry wet at boot. Five varieties had higher three-year grain yield averages than the trial averages. The variety with the highest three-year average yield was Bond CL.

DISCUSSION: My choice for the best overall dual-purpose wheat variety is Armour. Amour produced the highest grain yield, second highest forage yield at jointing, and the fourth highest forage yield at boot. The early forage yields, particularly the boot forage yield, indicated that Bond CL was on track for the best overall dual-purpose wheat; however, at grain harvest, Bond CL had the lowest yield. I do not know the reason for its low yield, but the range from highest to lowest yielding was small.

Grain yields of the last three years have been much below (2008), and near the average (2009), and higher than the Baca County average (2010). Four wheat varieties, TAM 111, Ankor, Ripper, and Bill Brown had average or above average grain yields each year of the last three seasons. Producing average or above average yields in response our wide ranging seasonal conditions shows that these four varieties are well adapted for our environment. TAM 111, Ankor, Ripper, and Bill Brown would be good varietal choices regardless of year-to-year precipitation fluctuations.

Table .Dryland Wheat Strips, Forage and Grain Yield at Walsh, 2010.

Variety	Jointing		Boot		Plant		Test	Grain
	Fresh Wt.	Dry Wt.	Fresh Wt.	Dry Wt.	Height	Residue	Weight	Yield
	-----------------------lb/a-----------------------				in	lb/a	lb/bu	bu/a
Armour	9745	2025	27686	8323	30	3470	59	46.4
TAM 112	7604	1735	29597	8231	30	4215	61	46.1
Bill Brown	7105	1602	38512	8902	30	3487	61	45.5
Winterhawk	5605	1322	23346	7014	30	3738	62	45.5
TAM 111	8146	1810	26543	7860	31	4152	61	45.1
NuDakota	6934	1496	23788	7238	28	3480	57	44.6
Hatcher	9744	1974	27628	8151	28	3958	58	44.6
Ripper	8962	1883	25977	7455	31	3600	58	44.5
Snowmass	5971	1395	23538	7360	32	3667	60	44.3
Ankor	5366	1241	25708	7240	31	3379	60	43.5
Jagalene	7136	1720	21300	6103	32	3335	61	43.3
Danby	7377	1661	23288	7123	31	3363	62	42.9
TAM 110	7377	1625	26515	7643	31	3434	60	42.5
Hawken	10146	2269	24537	7872	27	3282	59	42.0
Bond CL	8953	1946	31201	9108	32	3751	59	41.6
Average	7745	1714	26611	7708	30	3621	60	44.2
LSD 0.05	2778.7	483.2	2911.0	816.5		826.2		3.32

Planted: September 30, 2009; 50 lb seed/a; 5 gal/a 10-34-0.
Harvested: June 30, 2010 and Grain Yield adjusted to 12% seed moisture content.
Jointing sample taken April 6, 2110.
Boot sample taken May 10, 2010.
Wet Weight is reported at field moisture.
Dry Weight is adjusted to 15% moisture content.
Residue is reported at field moisture.

Table .--Summary: Dryland Wheat Strips Variety Performance Tests at Walsh, 2007-2009.

		Grain Yield					Yield as % of Trial Average				
Firm	Variety	2008	2009	2010	2-Year Avg	3-Year Avg	2008	2009	2010	2-Year Avg	3-Year Avg
		--------------------bu/a-----------------------					------------------------%------------------------				
AGSECO	TAM 110	3	23	43	33	23	60	92	98	95	83
AgriPro	TAM 111	6	26	45	36	26	120	104	102	103	109
AgriPro	Jagalene	3	20	43	32	22	60	80	98	89	79
AgriPro	NuDakota	5	--	45	25	--	60	--	102	81	--
AgriPro	Hawken	--	22	42	32	--	--	80	95	88	--
Colorado State	Hatcher	3	27	45	36	25	60	108	102	105	90
Colorado State	Prairie Red	5	27	--	16	--	100	108	--	104	--
Colorado State	Ankor	6	26	44	35	25	120	104	100	102	108
Colorado State	Bond CL	8	28	42	35	26	160	112	95	104	122
Colorado State	Ripper	5	27	45	36	26	100	108	102	105	103
Colorado State	Bill Brown	5	25	46	36	25	100	100	105	102	102
Kansas State	Danby	3	25	43	34	24	60	100	98	99	86
Watley	TAM 112	4	25	46	36	25	80	100	105	102	95
Westbred	Winterhawk	--	23	46	35	--	--	100	105	102	--
Westbred	Keota	5	24	--	15	--	100	96	--	98	--
Average		5	25	44	35	25					

Grain Yields were adjusted to 12.0 % seed moisture content.

Residual P on Dryland Wheat, Long Term Study at Manter, 2010

Kevin Larson and Lyndell Herron

PURPOSE: To determine the long-term effects from a one-time application of P rates on dryland wheat yields and income.

RESULTS: The highest producing P treatment was 92 lb P_2O_5/a with 49.6 bu/a, 5.2 bu/a higher yield than the 0 P check. Regression analysis shows that there is a trend upward with higher P rates producing higher yields. After five wheat crops, all P rates produced positive total net returns compared to the 0 P check: 23 lb P_2O_5/a with \$38.86/a, 46 lb P_2O_5/a with \$41.23/a, 69 lb P_2O_5/a with \$20.27/a, 92 lb P_2O_5/a with \$38.40/a, and 115 lb P_2O_5/a with \$43.37/a, using wheat prices of \$3.50/bu for 2002, \$3.20/bu for 2004, \$4.75/bu for 2006, \$8.00/bu for 2008, \$6.50/bu, and 10-34-0 cost of \$210/ton.

DISCUSSION: This is the fifth wheat crop after we applied the one-time P fertilizer rates. For the first wheat crop following the P application, the yield response from the 46 lb P_2O_5/a rate had already paid for itself (\$0.15/a return from \$14.35/a yield increase minus \$14.20/a P cost). By the second wheat crop, the two lowest P rates, 23 and 46 lb P_2O_5/a, produced positive net returns. For the third wheat crop, the highest net income of \$3.33/a occurred with the 69 P_2O_5/a treatment. For the fourth wheat crop, all P treatments produced positive net incomes compared to the 0 P check. For the fifth wheat crop, all P rates produced similar total net returns around \$40/a, except 69 lb P_2O_5/a, which returned about half as much as the other P rates. For the third crop year, there was no yield difference between the 0 P check and the 23 P_2O_5/a rate; however, for the fourth crop year and fifth crop year the 23 lb P_2O_5/a treatment produced 2.6 bu/a and 1.6 bu/a more, respectively, than the 0 P check. It has taken five wheat crops to produce similar net returns from all P applied treatments. However, the yield response of the lower P rates appears to be flat, while the yield response of the higher P rates appears to be increasing. If yields continue to response to residual P from these P rates, a heavy one-time application of P may be more profitable than smaller annual P applications.

MATERIALS AND METHODS: For the one time P rate application, Lyndell Herron chiseled on 50 lb N/a (as NH_3) with six phosphate fertilizer treatments: 0, 5.7, 11.4, 17.2, 22.9, and 28.6 gal/a of 10-34-0 (0, 23, 46, 69, 92, and 115 lb P_2O_5/a), using a 30 ft. dual placement N and P chisel applicator with 18 in. spaced shanks on July 13, 2001. Each treatment was replicated twice. Herron planted Akron or Ankor for the first three years and Danby in 2007 and 2009 at 35 lb seeds/a in the 60 ft. by 680 ft. plots around late-September to early-October for 2001, 2003, 2005, 2007, and 2009. We harvested the plots on June 18 for 2002, June 25 for 2004, June 19 for 2006, July 3, 2008, and June 29 for 2010 with a self-propelled combine and weighed them in a digital weigh cart. Seed yields were adjusted to 12% seed moisture.

In 2001, we randomly sampled the soil at 6 to 8 sites at 0 to 8 in. and 8 to 24 in. depths and sent them to the Colorado State University Laboratory for analysis. The soil was Silty Clay for both depths. The soil test recommendation for our 35 bu/a yield goal was 0 lb N/a and 40 lb P_2O_5/a; no other nutrients were required. The soil test analysis is as follows:

Table .-Soil Analysis.

Depth	pH	Salts mmhos/cm	OM %	N	P	K	Zn	Fe	Mn	Cu
				-----------------------------------			ppm			--------------------------------
0-8”	7.8	0.8	1.3	11	2.1	390	0.6	5.1	15	2.5
8-24”				17						

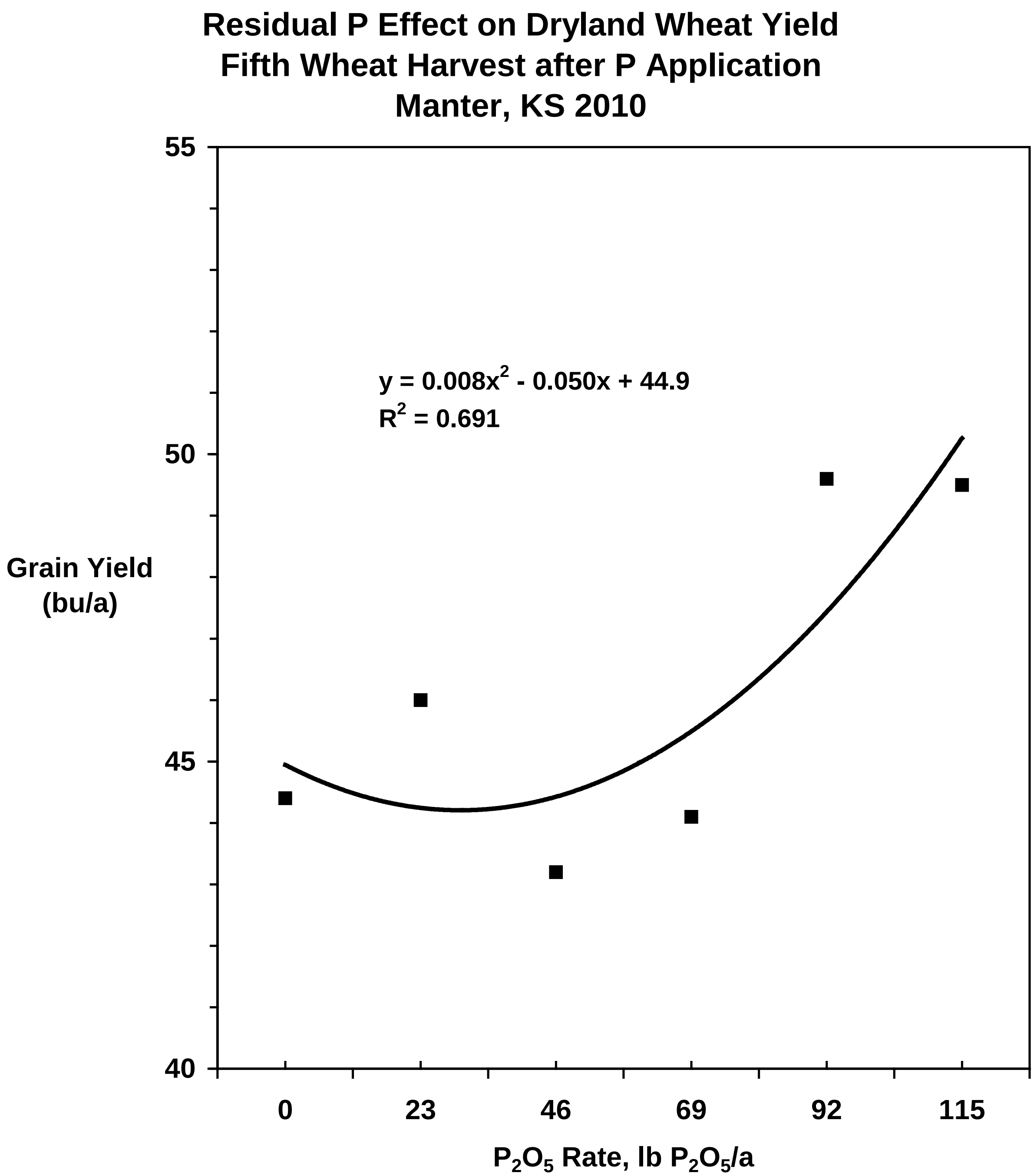

Fig. . Yield of long term P on dryland wheat, fifth wheat crop after P application, at Manter. P treatment are 0, 23, 46, 69, 92, and 115 lb P_2O_5/a applied with a chisel with shanks 18 in. apart to a 6 in. depth on July 13, 2001. Grain yields were adjusted to 12% seed moisture content.

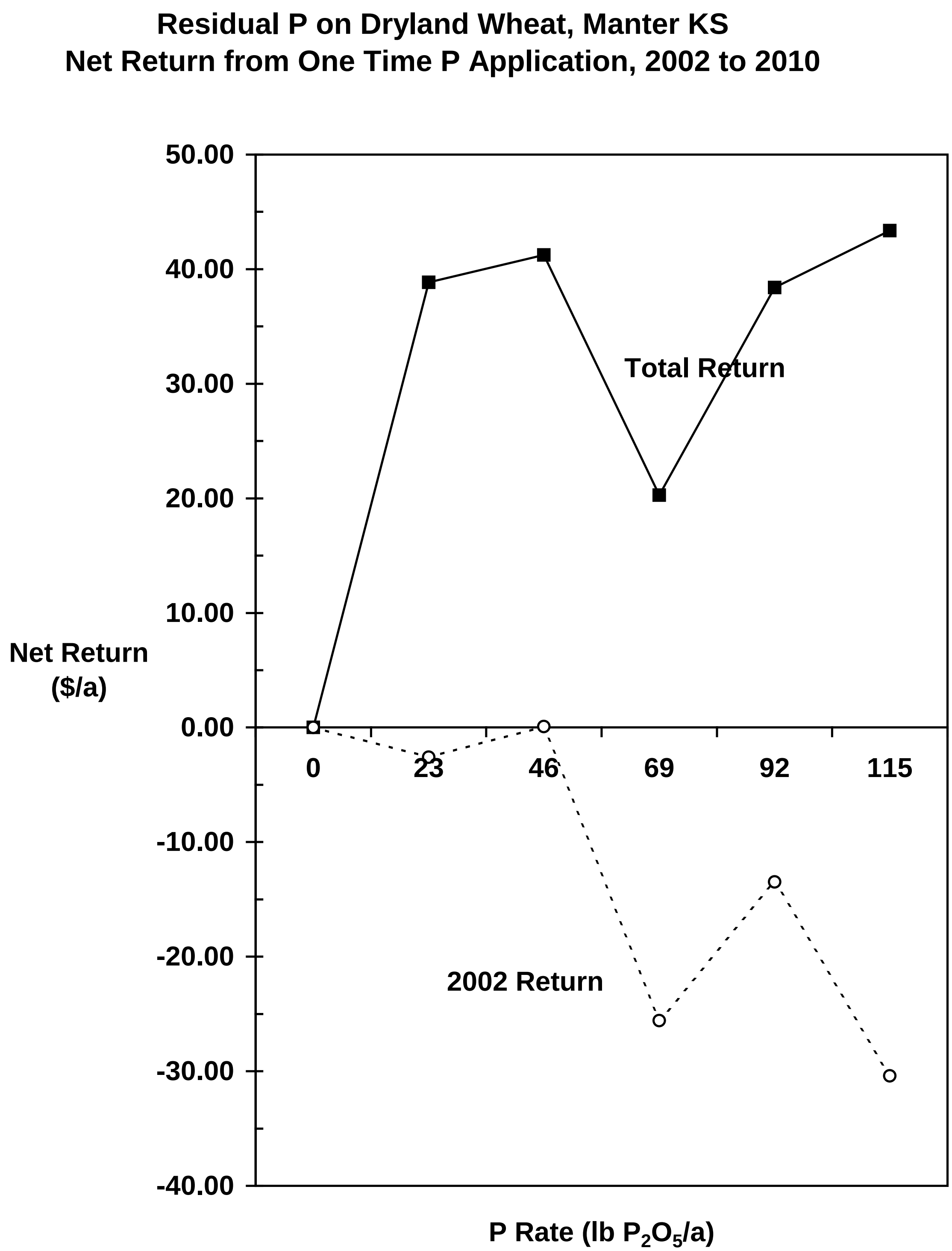

Fig. . Net return of long term P on dryland wheat, fifth wheat crop after single P application, at Manter. P treatments were 0, 23, 46, 69, 92, and 115 lb P_2O_5/a applied with a chisel with shanks 18 in. apart to a 6 in. depth on July 13, 2001. Total return is sum from 2002 to 2010 wheat crops.

Dryland Grain Sorghum Seeding Rate and Seed Maturation, Brandon, 2010

Kevin Larson and Dennis Thompson

In Eastern Colorado, dryland seeding rates vary greatly from 20,000 to 60,000 seeds/a. Lower seeding rates are typically used in the extreme southeastern part of the state where the growing season is longer, and higher seeding rates are used northward where the growing season is shorter. With lower seeding rates, abundant tillering is expected, whereas with higher seeding rates single headed plants are desired. We have observed that the main head on a sorghum plant matures earlier and more uniformly than its tillers. To determine if there are yield and maturation benefits from increased seeding rates at a short season site, we tested a wide range of seeding rates using an early maturing, low tillering, grain sorghum hybrid.

Materials and Methods

The six seeding rates we tested were 20, 30, 40, 50, 60, and 70 seeds/a X 1000 (16,000 seeds/lb). We planted on June 4 with a four-row cone planter on 30 in. row spacing. The grain sorghum hybrid was Mycogen 1G557. The site was fertilized with 90 lb N/a and 5 gal/a 10-24-0, 6 S, 0.1 Zn. Weed control was achieved with pre and post emergence herbicides (pre, glyphosate 32 oz/a, Dual 1.33 pts/a, atrazine 0.9 lb/a; post, 2,4-D amine 0.5 lb/a applied with drops). We harvested the study on October 28 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 14% moisture content.

Results and Discussion

The highest yielding seeding rate was 50,000 seeds/a, which developed 26,700 plants/a. The optimum seeding rate was 50,000 seeds/a. The high seeding rate optimum is partly attributable to earlier and more uniform seed maturation from increased numbers of single headed plants. Time to maturation was shortened with increased seeding rates. For each 10,000 seeds/a increment, between 20,000 and 70,000 seeds/a, maturation time was shortened by nearly one day. A seeding rate of 70,000 seeds/a matured almost 5 days earlier than a seeding rate of 20,000 seeds/a. The reason this occurred was because of reduced tillering. High seeding densities produce more single headed plants than lower seeding densities, and single headed plants mature earlier and more uniformly than plants with multiple tillers.

Shortening maturation time by increasing seeding rates is a tool sorghum growers can utilize when planting late, or when planting in short season conditions. However, there may be a detrimental side effect from higher seeding rates, because increased seeding rates, 40,000 seeds/a and higher, corresponded to increased lodging. Plant lodging increased from about 20% with 20,000 to 30,000 seeds/a to about 40% with 40,000 to 70,000 seeds/a. Although this lodging effect may not be as evident with all hybrids, because some hybrids are known to lodge less than other hybrids, lodging would be more likely to occur with higher seeding rates. Higher seeding rates group plant together causing them to be taller with smaller diameter stalks. Obviously, sorghum plants with smaller diameter stalks would have a tendency to lodge more easily.

Table .-Dryland Grain Sorghum Seeding Rate Study at Brandon, 2010.

Seeding Rate	Plant Density	Flowering Date	Maturation Date	Plant Height	Plant Lodging	Test Weight	Grain Yield
seeds/a (X1000)	plants/a (X1000)			In	%	lb/bu	bu/a
20	13.2	8/7	9/24	41	20	58	50
30	17.0	8/6	9/23.5	41	18	57	71
40	20.9	8/7	9/22	41	37	57	62
50	26.7	8/6	9/21	42	39	57	80
60	31.4	8/7	9/20	42	36	58	66
70	38.4	8/6	9/20	44	39	57	71
Average	24.6	8/7	9/22	42	32	57	67

Planted: June 4; Harvested: October 28, 2010.
Grain Sorghum Hybrid: Mycogen 1G557.
Grain yields were adjusted to 14% seed moisture content.

Table 1.-Dryland Grain Sorghum Seeding Rate Study at Brandon, 2009.

Seeding Rate	Plant Density	Flowering Date	Maturation Date	Plant Height	Plant Lodging	Test Weight	Grain Yield
seeds/a (X1000)	plants/a (X1000)			In	%	lb/bu	bu/a
20	14.0	8/9	10/2	35	10	57	60
30	16.9	8/9	10/1	37	18	58	67
40	23.9	8/9	9/30	36	16	58	72
50	30.2	8/9	9/25	39	25	59	69
60	36.6	8/9	9/24	38	37	58	75
70	43.4	8/9	9/23	40	43	59	69
Average	27.5	8/9	9/28	38	25	58	69

Planted: June 5; Harvested: November 20, 2009.
Grain Sorghum Hybrid: Mycogen 1G557.
Grain yields were adjusted to 14% seed moisture content.

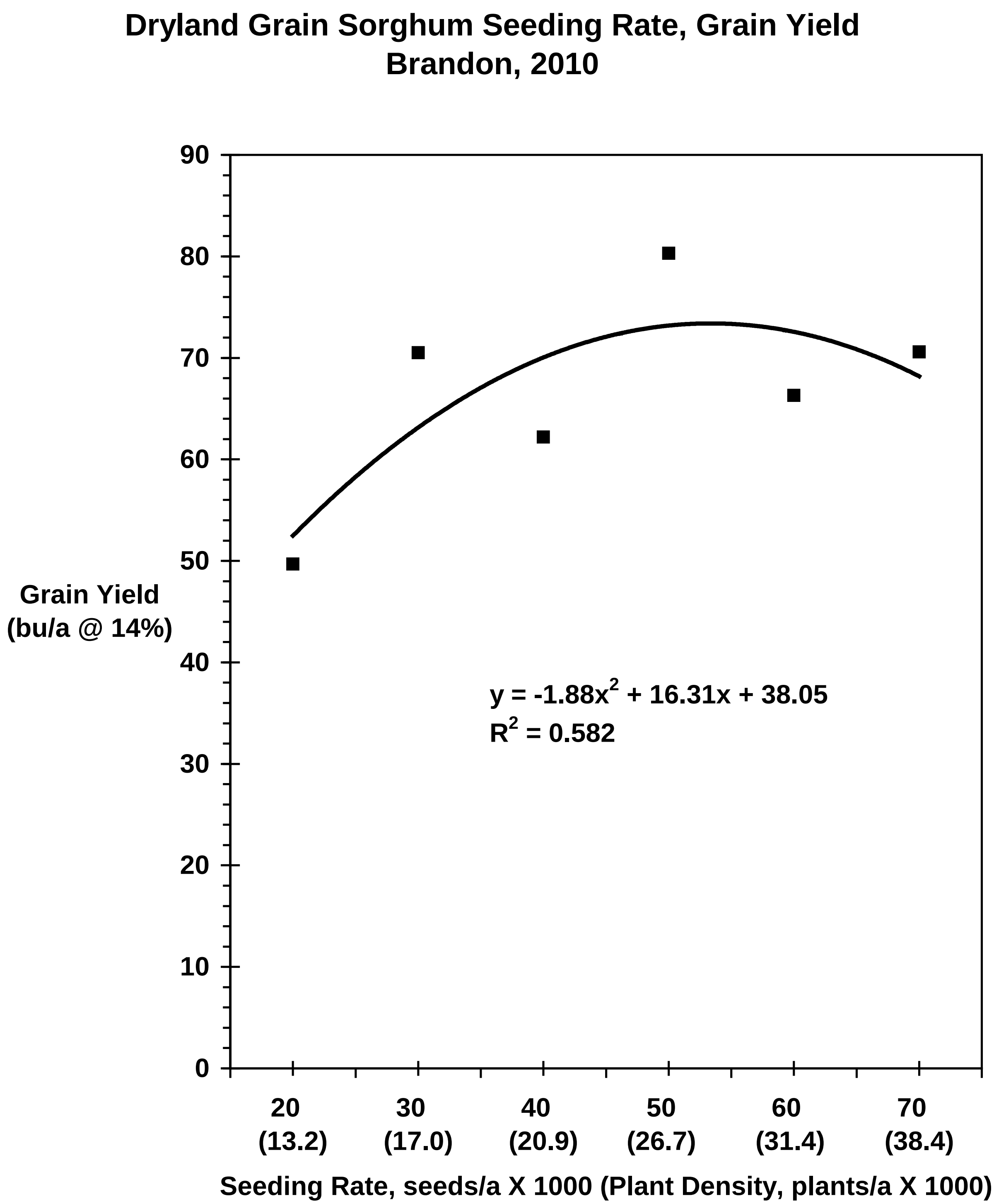

Fig. 1. Grain yield of dryland grain sorghum seeding rate study at Brandon. Seeding rates were 20, 30, 40, 50, 60, and 70 seeds/a X1000. The hybrid was Mycogen 1G557 planted on June 4, 2010.

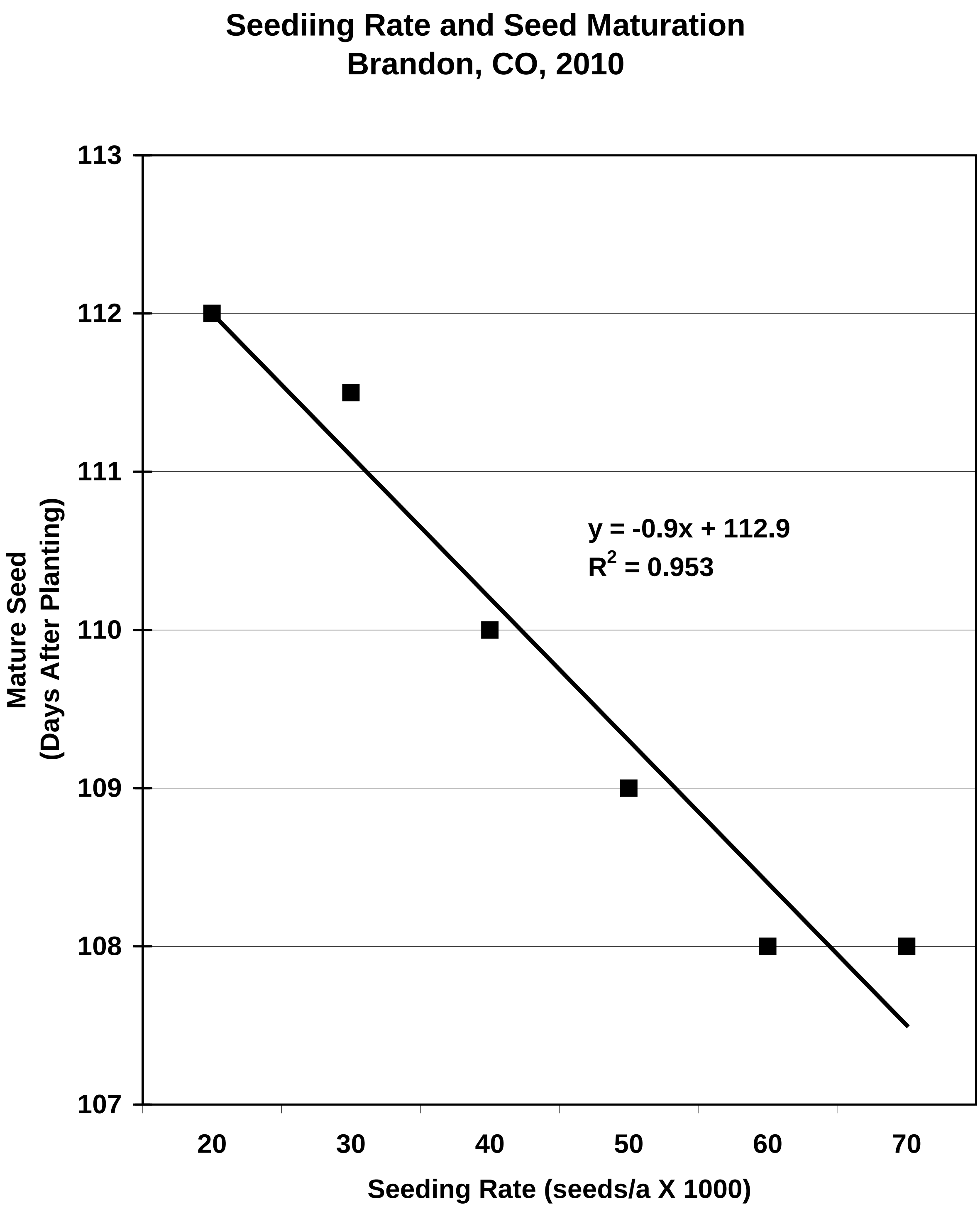

Fig. 2. Dryland grain sorghum seeding rate and days to seed maturation at Brandon. The seeding rates were 20, 30, 40, 50, 60, and 70 seeds/a (X1000). The grain sorghum hybrid was Mycogen 1G577.

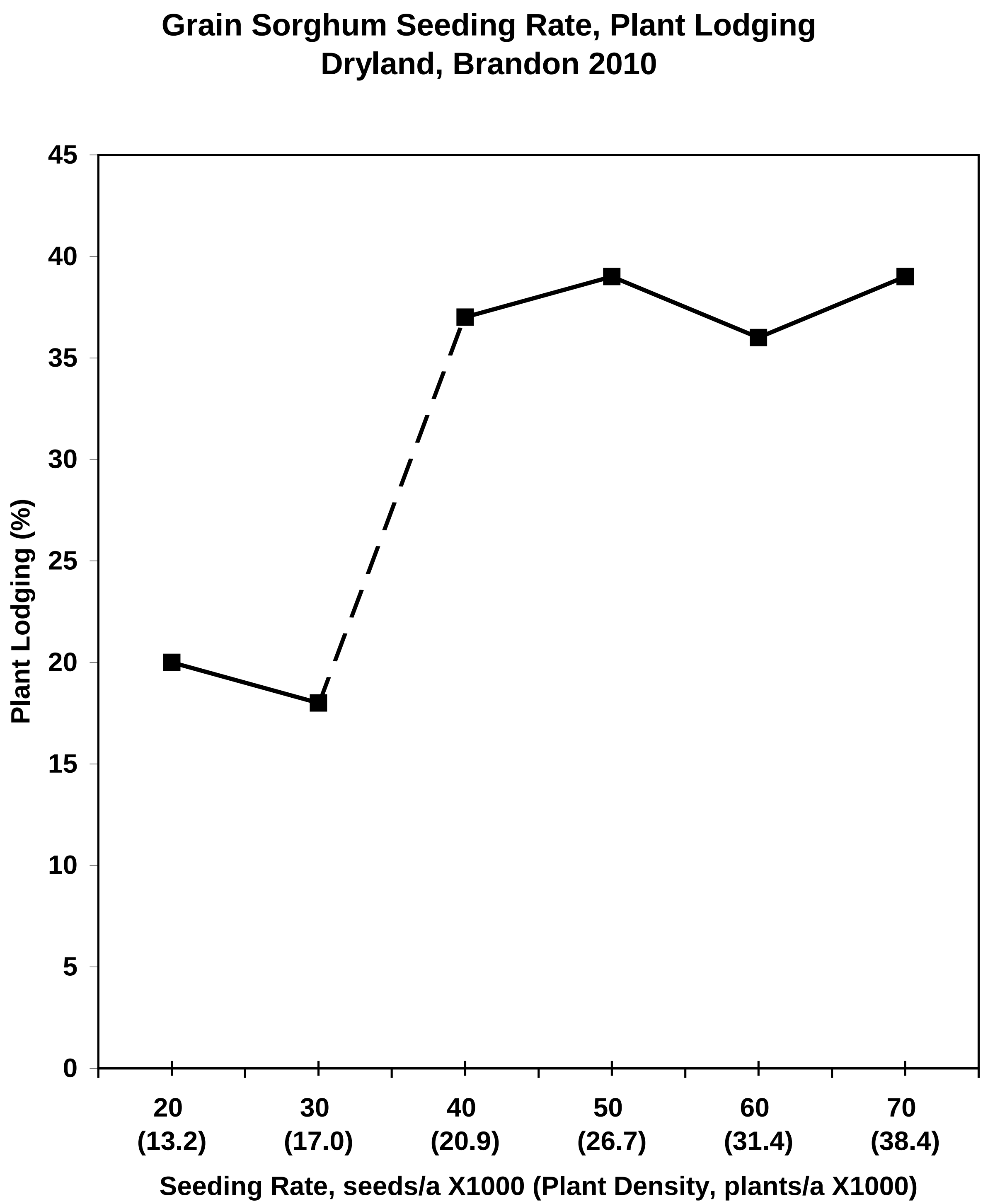

Fig. . Plant lodging of dryland grain sorghum seeding rate study at Brandon. The seeding rates were: 20, 30, 40, 50, 60, and 70 seeds/a X1000. The grain sorghum hybrid was Mycogen 1G557 planted on June 4, 2010.

Dryland Grain Sorghum Hybrid Performance Trial at Brandon, 2010

COOPERATORS: Burl Scherler, Sand Creek, Inc., Brandon, Colorado, and Kevin Larson, Superintendent, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To identify high yielding hybrids under dryland conditions with 3000 sorghum heat units in Silty Loam soil.

PLOT: Four rows with 30” row spacing, 50’ long. SEEDING DENSITY: 43,600 seed/a. PLANTED: June 4. HARVESTED: October 28.

EMERGENCE DATE: 12 days after planting. SOIL TEMP: 74 F.

PEST CONTROL: Preemergence Herbicides: Glyphosate 32 oz/a, Atrazine 0.9 lb/a, Dual 21 oz/a. Post Emergence Herbicides: 2,4-D amine (with drops). CULTIVATION: None. INSECTICIDES: None.

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
June	0.81	643	16	4	26
July	5.60	828	22	4	57
August	1.90	785	23	0	88
September	0.61	589	12	0	118
October	0.06	181	0	0	132
Total	8.98	3026	73	4	132

\1 Growing season from June 4 (planting) to October 14 (first freeze, 29 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

COMMENTS: Planted in fair soil moisture. Weed control was very good. Near normal precipitation for the growing season, however, July was wet and June and September were dry. No greenbug infestation. Five hybrids had greater than 40% lodging. Yields and test weights were good.

SOIL: Silty Loam for 0-8” and Silty Loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.7	0.8	1.9	10	4.0	355	0.8	2.9
8”-24”				11				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Lo	Lo

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	0	20	2	0
Applied	90	20	0	0

Yield Goal: 50 bu/a.
Actual Yield: 66 bu/a.

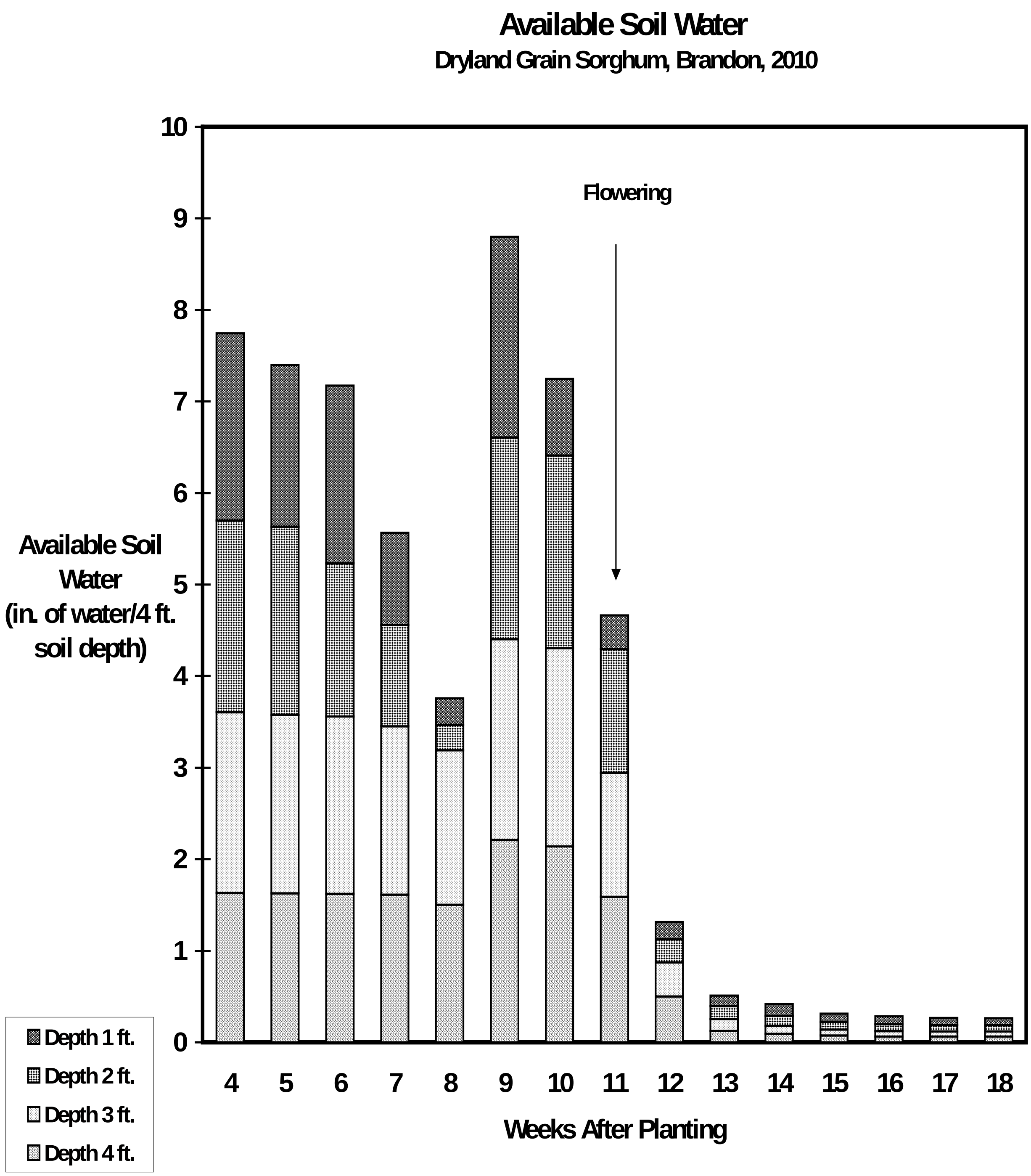

Fig. 1. Available soil water in dryland grain sorghum at Brandon. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Brandon from planting to first freeze was 8.98 in. Any increase in available soil water between weeks is from rain.

Table 4.--Dryland Grain Sorghum Hybrid Performance Trial at Brandon, 2010. \1

Brand	Hybrid	Days to Emerge	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group	Plant Ht.	Harvest Density	Plants Lodged	Test Wt.	Grain Yield	Yield % of Test Average
							in	plants/a (1000 X)	%	lb/bu	bu/a	%
MYCOGEN	1G557	13	67	1746	111	E	40	24.7	30	57	78	116
TRIUMPH	TR424	10	64	1659	108	E	39	24.1	44	58	76	114
DEKALB	DKS28-05	12	63	1632	107	E	48	25.1	44	55	70	105
DEKALB	DKS29-28	13	66	1720	110	E	39	28.9	38	58	69	103
SORGHUM PARTNERS	SP3303	13	66	1720	109	E	40	23.7	50	58	60	89
SORGHUM PARTNERS	251	10	59	1527	102	E	38	26.1	6	60	55	81
SORGHUM PARTNERS	KS310	13	70	1827	112	ME	45	29.3	31	55	79	118
SORGHUM PARTNERS	K35-Y5	13	71	1851	115	ME	42	22.3	43	55	72	108
ASGROW	Pulsar	11	69	1804	113	ME	46	20.2	25	55	70	104
TRIUMPH	TR452	10	73	1893	116	M	47	31.7	28	57	66	98
DEKALB	DKS37-07	13	72	1870	117	M	46	29.6	34	57	61	91
SORGHUM PARTNERS	NK5418	13	73	1893	116	M	42	31.4	61	55	60	90
MYCOGEN	M3838	10	74	1915	120	M	42	18.1	33	58	48	71
Average		12	68	1774	112	ME	43	25.8	36	57	66	
LSD 0.20									23.4		15.2	

\1 Planted: June 4; Harvested: October 28, 2010.

Yields are adjusted to 14.0% seed moisture content.

DAP: Days After Planting or maturation of seed at first freeze.

Seed Maturation: EM, early milk; MM, mid milk; LM, late milk; ED, early dough; SD, soft dough; HD, hard dough; mature (DAP).

GDD: Growing Degree Days for sorghum.

Maturity Group: E, early; ME, medium early; M, medium; ML, medium late; L, late.

Table 5.--Summary: Dryland Grain Sorghum Hybrid Performance Trials at Brandon, 2008-2010.

Brand	Hybrid	Grain Yield					Yield as % of Test Average				
		2008	2009	2010	2-Year Avg	3-Year Avg	2008	2009	2010	2-Year Avg	3-Year Avg
		------------------bu/a---------------------					----------------------%----------------------				
ASGROW	Pulsar	--	58	70	64	--	--	102	104	103	--
DEKALB	DKS37-07	--	66	61	64	--	--	117	91	104	--
DEKALB	DKS29-28	--	64	69	67	--	--	114	103	109	--
DEKALB	DKS28-05	--	61	80	71	--	--	115	89	102	--
MYCOGEN	1G557	--	67	78	73	--	--	118	116	117	--
MYCOGEN	M3838	--	49	48	49	--	--	87	71	79	--
SORGHUM PARTNERS	KS310	--	62	79	71	--	--	110	118	114	--
SORGHUM PARTNERS	251	--	60	55	58	--	--	106	81	94	--
SORGHUM PARTNERS	NK5418	--	55	60	58	--	--	97	90	94	--
SORGHUM PARTNERS	K35-Y5	--	53	72	63	--	--	94	108	101	--
SORGHUM PARTNERS	SP3303	--	47	60	54	--	--	84	89	87	--
TRUIMPH	TR452	--	54	66	60	--	--	96	98	97	--
Average		--	57	66	62	--					

Grain Yields were adjusted to 14.0% seed moisture content.

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2010

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 3700 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30” row spacing, 50’ long. SEEDING DENSITY: 43,600 seed/a. PLANTED: June 2. HARVESTED: November 1.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 72 F.

PEST CONTROL: Preemergence Herbicides: Glyphosate, 24 oz/a; 2,4-D, 0.5 lb/a, Banvel 3 oz/a, Sharpen 3.0 oz/a. Post Emergence Herbicides: Banvel 4.0 oz/a, Atrazine 1.0 lb/a, COC 32 oz/a. CULTIVATION: None. INSECTICIDES: None.

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
June	2.00	741	15	4	28
July	3.65	856	21	4	59
August	4.09	811	19	2	90
September	1.79	646	14	0	120
October	0.23	321	0	0	147
Total	11.76	3696	69	10	147

\1 Growing season from June 2 (planting) to October 27 (first freeze, 27 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture. Weed control was very good. Above normal precipitation for the growing season with wet July and August. No greenbug infestation. No lodging. Late freeze date. Yields and test weights were excellent.

SOIL: Silty Loam for 0-8” and Silty Loam 8”-24” depths from soil analysis.

Summary: Soil Analysis of Plant Available Nutrients.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8”	7.8	0.7	1.9	10	5.3	389	0.8	3.3
8”-24”				9				
Comment	Alka	Vlo	Hi	Mod	Lo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

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

Yield Goal: 50 bu/a.
Actual Yield: 89 bu/a.

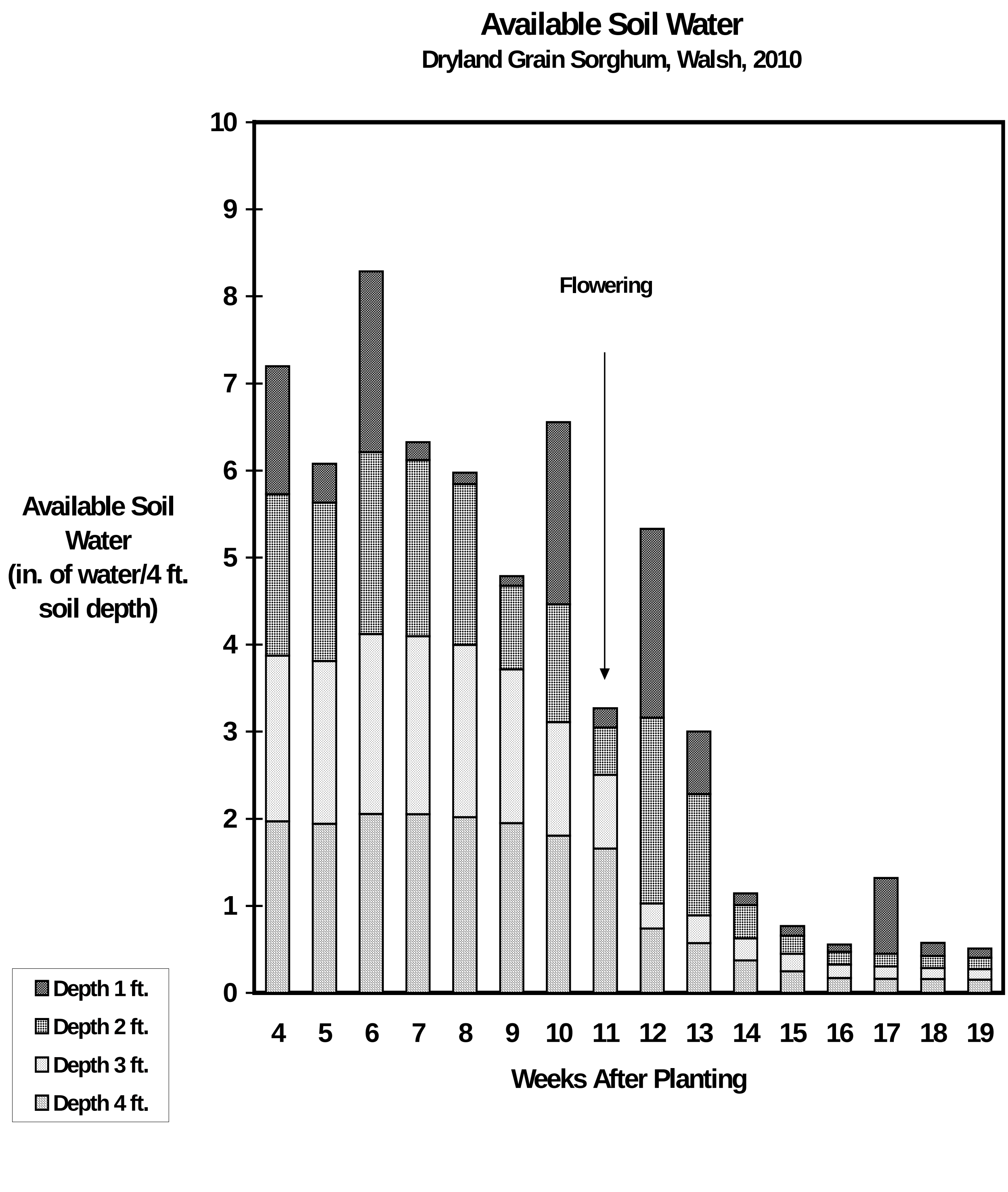

Fig. 2. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 11.76 in. Any increase in available soil water between weeks is from rain.

Table 6.--Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2010. \1

Brand	Hybrid	Days to Emerge	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group	Plant Ht.	Harvest Density	Test Wt.	Grain Yield	Yield % of Test Average
							in	plants/a (1000 X)	lb/bu	bu/a	%
DEKALB	DKS28-05	8	63	1719	109	E	41	27.9	59	87	97
TRIUMPH	TR424	7	62	1687	107	E	39	30.6	61	83	93
DEKALB	DKS29-28	8	62	1687	107	E	38	30.6	61	80	89
SORGHUM PARTNERS	SP3303	9	64	1744	113	E	40	27.5	60	64	72
SORGHUM PARTNERS	251	7	58	1565	102	E	36	27.9	60	57	63
TRIUMPH	TR438	7	65	1768	111	ME	44	31.0	60	100	112
MYCOGEN	627	9	71	1939	118	ME	44	28.7	60	97	109
SORGHUM PARTNERS	K35-Y5	7	66	1794	112	ME	40	22.9	62	95	107
DEKALB	DKS37-07	7	70	1909	118	ME	48	31.4	61	91	102
ASGROW	Pulsar	8	65	1768	117	ME	42	22.9	60	88	98
SORGHUM PARTNERS	KS310	6	66	1794	112	ME	42	29.4	61	79	89
SORGHUM PARTNERS	NK5418	6	72	1969	118	M	43	29.8	61	112	126
TRIUMPH	TR452	8	72	1969	119	M	46	24.4	61	108	121
MYCOGEN	1G600	7	73	1996	123	M	45	29.4	59	95	106
TRIUMPH	TR448	7	72	1969	122	M	43	29.4	61	93	104
TRIUMPH	TRX84732	8	72	1969	120	M	47	19.4	61	89	100
MYCOGEN	M3838	8	72	1969	122	M	43	24.8	60	88	99
(Check)	399 X 2737	7	83	2255	131	ML	42	21.3	59	101	113
Average		7	68	1859	116	ME	42	27.2	60	89	
LSD 0.20										6.5	

\1 Planted: June 2; Harvested: November 1, 2010.

Yields are adjusted to 14.0% seed moisture content.

DAP: Days After Planting or maturation of seed at first freeze.

Seed Maturation: EM, early milk; MM, mid milk; LM, late milk; ED, early dough; SD, soft dough; HD, hard dough; mature (DAP

GDD: Growing Degree Days for sorghum.

Maturity Group: E, early; ME, medium early; M, medium; ML, medium late; L, late.

Table 7.--Summary: Dryland Grain Sorghum Hybrid Performance Trials at Walsh, 2008-2010.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2008	2009	2010	2-Year Avg	3-Year Avg	2008	2009	2010	2-Year Avg	3-Year Avg
		------------------bu/a---------------------					---------------------%----------------------				
ASGROW	Pulsar	75	56	88	72	73	112	104	98	101	105
DEKALB	DKS37-07	75	65	91	78	77	112	121	102	112	112
DEKALB	DKS36-16	73	67	--	70	--	110	125	--	118	--
DEKALB	DKS29-28	65	60	80	70	68	98	130	89	110	106
DEKALB	DKS28-05	--	61	80	71	--	--	115	89	102	--
DEKALB	DK39Y	63	51	--	57	--	95	96	--	96	--
SORGHUM PARTNERS	KS310	63	72	79	76	71	95	135	89	112	106
SORGHUM PARTNERS	251	49	45	57	51	50	74	83	63	73	73
SORGHUM PARTNERS	NK5418	77	65	112	89	85	116	122	126	124	121
SORGHUM PARTNERS	K35-Y5	--	55	95	75	--	--	103	107	105	--
SORGHUM PARTNERS	SP3303	--	46	64	55	--	--	86	72	79	--
TRUIMPH	TR438	--	62	100	81	--	--	116	112	114	--
TRUIMPH	TR448	--	64	93	79	--	--	119	104	112	--
TRUIMPH	TR452	--	62	108	85	--	--	116	121	119	--
TRUIMPH	TRX84732	--	63	89	76	--	--	117	100	109	--
(Check)	399 X 2737	58	38	101	70	66	87	72	113	93	91
Average		66	53	89	71	69					

Grain Yields were adjusted to 14.0% seed moisture content.
The site was pre-irrigated with furrow irrigation in 2008.

Limited Sprinkler Irrigation Grain Sorghum Study at Walsh, 2010

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

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

RESULTS: The highest yielding hybrid, Channel X29210, produced 128 bu/a and had the second highest test weight of 61 lb/bu. The lowest yielding and earliest maturing hybrid, Sygenta 5875, produced 79 bu/a and had the lowest test weight of 57 lb/bu.

PLOT: Four rows with 30" row spacing, at least 600' long. SEEDING DENSITY: 80,000 seeds/a. PLANTED: May 27. HARVESTED: November 2.

IRRIGATION: Eight sprinkler rotations applied 10 acre-in/a of total water.

PEST CONTROL: Preemergence Herbicides: Glyphosate 28 oz/a, Sharpen 3.0 oz/a; Post Herbicides: Atrazine 1.0 lb/a, Banvel 4 oz/a, COC 1.0 qt/a. CULTIVATION: Once. INSECTICIDE: None.

FIELD HISTORY: Last Crop: Corn. FIELD PREPARATION: Sweep plow.

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------No. of Days--------		
May	0.00	104	2	0	5
June	2.00	761	15	4	35
July	3.65	856	21	4	66
August	4.09	811	19	2	97
September	1.79	646	14	0	127
October	0.23	321	0	0	154
Total	11.76	3499	71	10	154

\1 Growing season from May 27 (planting) to October 7 (first freeze, 27 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture. Weed control was good. Above normal precipitation for the growing season with wet July and August. All the hybrids fully matured because of the long and warm season. Grain yields were very good.

SOIL: Silty Clay Loam for 0-8" and Silty Clay Loam 8"-24" depths from soil analysis.

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8"	7.7	1.0	2.4	21	2.8	371	0.7	3.3
8"-24"				24				
Comment	Alka	Vlo	VHi	Hi	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	0	20	2	0
Applied	100	20	0.3	0

Yield Goal: 90 bu/a.
Actual Yield: 114 bu/a.

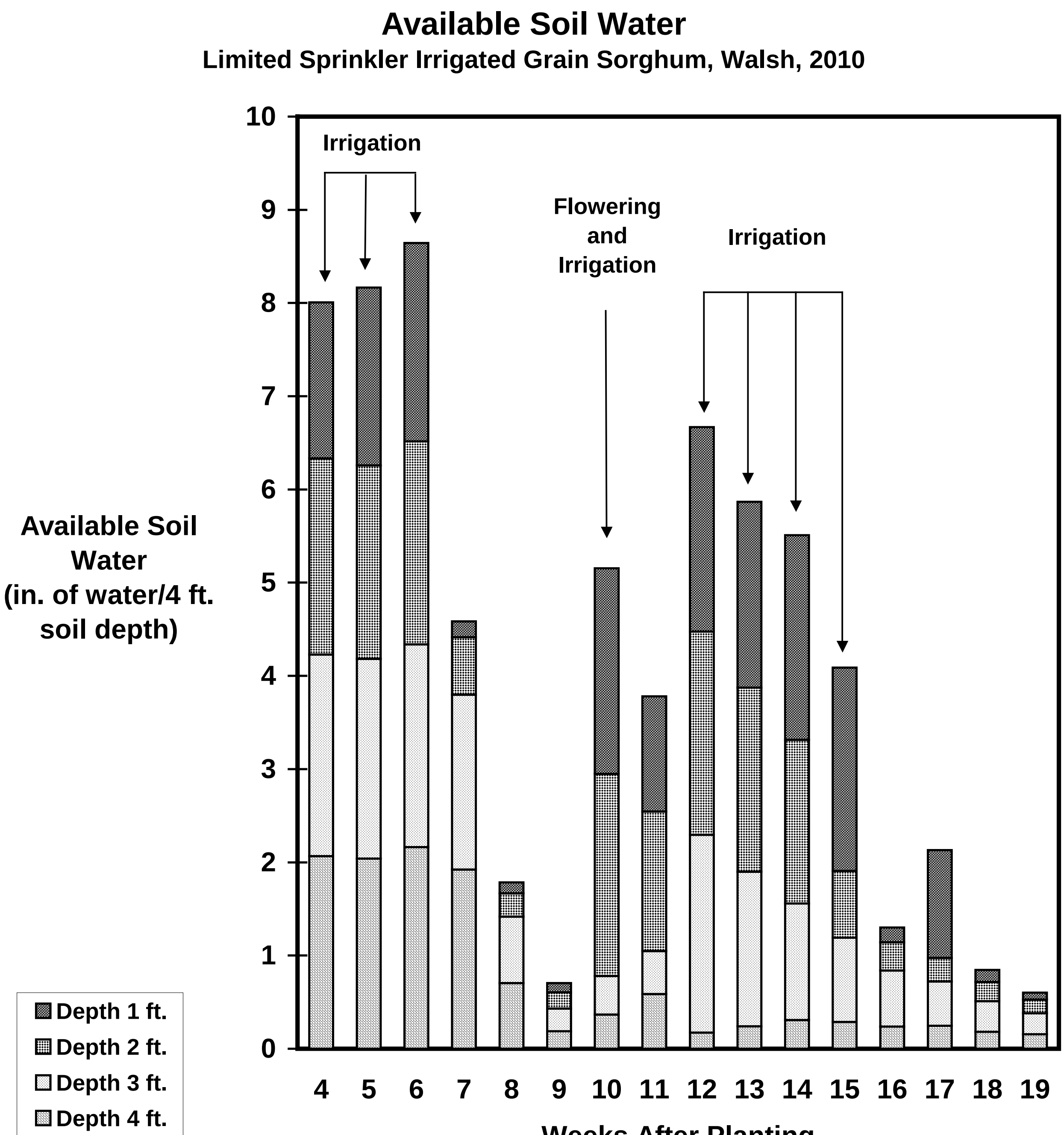

Fig. . Available soil water in limited sprinkler irrigation grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 11.76 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigation Grain Sorghum, Plainsman Research Center, Walsh, 2010.

Brand	Hybrid	Plant Density	50% Flowering Date	50% Maturity Date	Plant Height	Seed Moisture Content	Test Weight	Grain Yield
		plants/a (1000X)			%	%	lb/bu	bu/a
CHANNEL	X29210	53.7	8/2	9/16	47	13.4	61	128
PIONEER	86G08	57.3	8/1	9/14	44	13.1	61	126
MYCOGEN	627	39.3	8/6	9/21	46	13.1	59	123
TRIUMPH	TR452	55.7	8/5	9/19	46	12.0	60	121
CHANNEL	6B50	60.9	8/9	9/25	42	12.7	58	120
TRIUMPH	TR448	52.1	8/4	9/20	40	13.2	62	118
MYCOGEN	M3838	55.3	8/5	9/22	40	13.0	61	118
TRIUMPH	TRX84732	40.1	8/8	9/24	42	12.9	60	117
GOLDEN HARVEST	H-390W	41.3	8/7	9/23	44	13.1	59	117
CHANNEL	6B10	63.3	8/4	9/18	39	12.2	61	112
GOLDEN HARVEST	5745	50.1	8/6	9/20	46	13.0	60	107
TRIUMPH	TR438	60.1	8/3	9/15	43	13.0	60	107
PIONEER	87P06	58.1	7/30	9/10	38	12.2	59	102
SYNGENTA	5875	38.5	7/29	9/9	35	11.8	57	79
Average		51.8	8/4	9/18	42	12.8	60	114
LSD 0.20								7.1

Planted: May 27; Harvested: November 2, 2010.
50% Flowering Date: minimum date on which a hybrid flowers on half of its population.
50% Maturity Date or maturation of seed at first freeze.
Seed Maturation: LM, late milk; ED, early dough, SD, soft dough; HD, hard dough; mature (date).
The limited sprinkler irrigation grain sorghum received 10 acre-in of applied water.
Yields are adjusted to 14.0% seed moisture content.

Limited Sprinkler Irrigation Corn Study at Walsh, 2010

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

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

RESULTS: Of the 16 hybrids tested, Channel 214-14VT3P was the highest yielding hybrid with 189 bu/a. For this limited irrigation trial, we applied 15 in./a of water.

PLOT: Four rows with 30" row spacing, at least 600' long. SEEDING DENSITY: 28,000 seeds/a. PLANTED: May 7. HARVESTED: November 19.

IRRIGATION: Twelve sprinkler rotations applied 15.0 a-in/a of total water.

PEST CONTROL: Pre Herbicides: Balance 1.75 oz/a, Atrazine 1.0 lb/a, Sharpen 3.0 oz/a, Glystar Plus 28 oz/a; Post Herbicides: Roundup WeatherMax 24 oz/a, Banvel 6 oz/a. CULTIVATION: None. INSECTICIDE: Oberon and Brigade for mite control.

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	1.25	358	3	0	24
June	2.00	761	15	4	54
July	3.65	856	21	4	85
August	4.09	811	19	2	116
September	1.79	646	14	0	146
October	0.23	321	0	0	173
Total	13.01	3753	72	10	173

\1 Growing season from May 5 (planting) to October 27 (first freeze, 27 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture. Weed control was good. Above normal precipitation for the growing season with wet July and August. The nonresistant corn borer hybrid had no second-generation corn borer damage, due to a late application of Oberon and Brigade to control a severe infestation of mites. Grain yields were good.

SOIL: Silty Clay Loam for 0-8" and Silty Clay Loam 8"-24" depths from soil analysis.

Summary: Soil Analysis from Sprinkler Site.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8"	7.7	1.0	2.4	21	2.8	371	0.7	3.3
8"-24"				24				
Comment	Alka	Vlo	VHi	Hi	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization for Sprinkler Site.

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

Yield Goal: 150 bu/a.
Actual Yield: 163 bu/a.

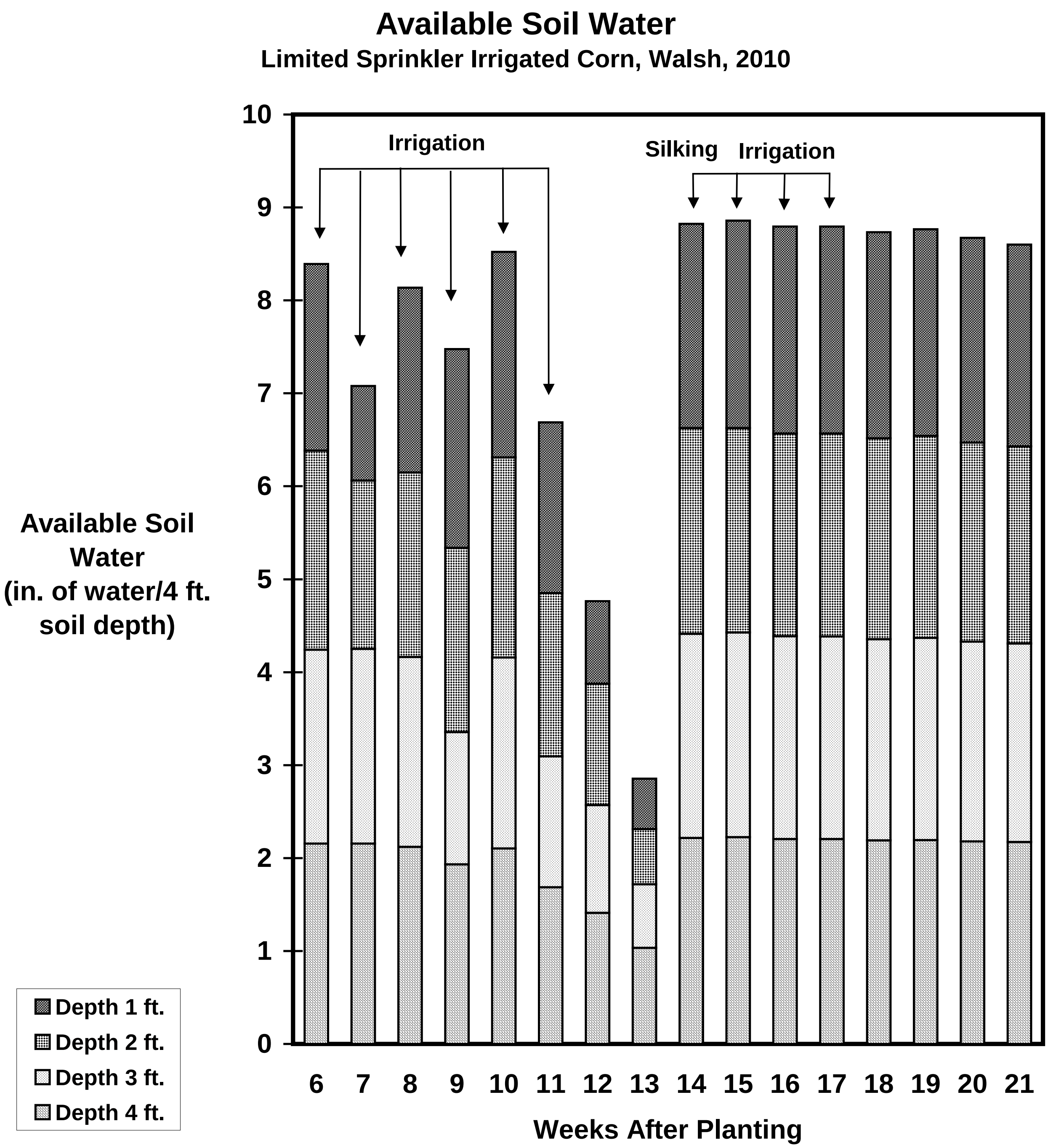

Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.01 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigation Corn, Plainsman Research Center, 2010.

Firm	Hybrid	50% Silking Date	Plant Density	Seed Moisture	Test Weight	Grain Yield
			plants/a (X 1000)	%	lb/bu	bu/a
CHANNEL	214-14VT3P	22-Jul	26.8	13.9	61	189
TRIUMPH	1204V	23-Jul	26.8	13.5	59	173
MYCOGEN	2T832	25-Jul	26.8	14.3	57	172
TRIUMPH	1420X	25-Jul	28.8	14.5	59	172
CHANNEL	214-77VT3P	23-Jul	27.6	14.0	59	171
GARST	83E90-3000GT	24-Jul	26.8	14.8	58	170
MYCOGEN	2T784	25-Jul	26.4	13.8	58	166
TRIUMPH	7514S	25-Jul	27.2	13.9	58	165
MYCOGEN	2T777 (non Bt)	22-Jul	27.2	13.3	59	162
MYCOGEN	2T806	24-Jul	24.8	14.1	59	160
CHANNEL	209-85VT3P	21-Jul	26.0	10.9	58	159
TRIUMPH	1326X	19-Jul	27.2	11.9	59	159
PIONEER	P1162HR	19-Jul	26.0	12.7	60	157
GARST	84N18-3000GT	22-Jul	28.0	12.5	58	155
GARST	85Z64 GT/CB/LL	20-Jul	28.0	11.4	57	137
PIONEER	P1508HR	22-Jul	27.2	13.0	62	135
Average		22-Jul	27.0	13.3	59	163
LSD 0.20						9.7

Planted: May 7; Harvested: October 19, 2010.
Grain Yield adjusted to 15.5% moisture content.
Twelve sprinkler rotations applied a total of 15.0 acre-in./acre of water.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2010

K. Larson, D. Thompson, D. Harn, C. Thompson

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

RESULTS: Only the nonresistant corn borer hybrid displayed any first generation corn borer damage and this shot hole damage was very minor. There was no second-generation corn borer damage this year because we had to spray to control a severe outbreak of mites. Some hybrids lodged, but their lodging was due to stalk rot and not to second-generation corn borer damage. Grain yields were good.

DISCUSSION: There was no damage from second-generation corn borer due to an aerial application of Oberon and Barrage that controlled a severe infestation of mites, as well as, corn borer. The very low level of first-generation corn borer damage may be the result of the widespread use of Bt hybrids that reduced native population levels. 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 to help delay corn borer resistance to the Bt events.

We define limited sprinkler corn as receiving 10 inches or less of irrigation above normal precipitation. This year we applied 15 inches of irrigation. Even though the growing season was wet, there was insufficient precipitation during the winter and spring to fill the soil water profile. The extra 5 inches of irrigation was used to fill the soil water profile.

Table .Limited Sprinkler Irrigated Corn, Corn Borer Ratings, Plainsman Research Center, 2010.

Firm	Hybrid	50% Silking Date	Plant Density	1st Gen Shot Holes	2nd Gen Stock Holes	Non 2nd Gen Plant Lodging	Test Weight	Grain Yield
			plants/a (X 1000)	%	%	%	lb/bu	bu/a
CHANNEL	214-14VT3P	22-Jul	26.8	0	0	0	61	189
TRIUMPH	1204V	23-Jul	26.8	0	0	3	59	173
MYCOGEN	2T832	25-Jul	26.8	0	0	8	57	172
TRIUMPH	1420X	25-Jul	28.8	0	0	0	59	172
CHANNEL	214-77VT3P	23-Jul	27.6	0	0	5	59	171
GARST	83E90-3000GT	24-Jul	26.8	0	0	0	58	170
MYCOGEN	2T784	25-Jul	26.4	0	0	3	58	166
TRIUMPH	7514S	25-Jul	27.2	0	0	8	58	165
MYCOGEN	2T777 (non Bt)	22-Jul	27.2	3	0	23	59	162
MYCOGEN	2T806	24-Jul	24.8	0	0	5	59	160
CHANNEL	209-85VT3P	21-Jul	26.0	0	0	0	58	159
TRIUMPH	1326X	19-Jul	27.2	0	0	5	59	159
PIONEER	P1162HR	19-Jul	26.0	0	0	0	60	157
GARST	84N18-3000GT	22-Jul	28.0	0	0	0	58	155
GARST	85Z64 GT/CB/LL	20-Jul	28.0	0	0	3	57	137
PIONEER	P1508HR	22-Jul	27.2	0	0	0	62	135
Average		22-Jul	27.0	0	0	4	59	163
LSD 0.05				1.8	0.0	5.8		9.7

Planted: May 7; Harvested: October 19, 2010.
Grain Yield adjusted to 15.5% moisture content.
Twelve sprinkler rotations applied a total of 15.0 acre-in./acre of water.
No second generation corn borer damage due to pesticide application for mite control.

Skip-Row Planting and Seeding Rate Comparison for Dryland Corn and Grain Sorghum Production

Kevin Larson and Dennis Thompson

Skip-row planting is an old idea that is being revitalized for dryland row crop production in the drier areas of the High Plains. The two main advantages of skip-row planting compared to solid planting are reported to be late-season water availability from water stored in the skip-row (Klein et al., 2005) and less input costs (Jost and Brown, 2001). Another approach for increasing late-season water availability is planting density manipulation. Adjusting the seeding rate to the moisture conditions may be as effective as skip-row planting for increasing late-season water availability. In this study, we compared skip-row planting to seeding rate to see which approach is most effective for increasing grain yield under dry conditions.

Materials and Methods

The site was planted no-till into wheat stubble. Our two skip-row treatment patterns were: 1) all rows planted at two planting densities: 13,200 seeds/a (12,900 plants/a) and 16,500 seeds/a (15,300 plants/a) and 2) skip row/plant two rows at two planting densities: 13,200 seeds/a (11,600 plants/a) and 14,400 seeds/a (14,000 plants/a). We planted Garst 85Z64 on May 20 with an eight-row John Deere vacuum planter. We applied N at 50 lb/a and we seedrow applied 20 lb P2O5/a and 0.38lb/a of Zn chelate. For preplant weed control, we sprayed Glystar Plus at 24 oz/a, Banvel 4.0 oz/a, and 2,4-D at 0.5 lb/a, and Balance Pro 2.0 oz/a, Sharpen 3.0 oz/a, Atrazine 0.75 lb/a and COC 16 oz/a. For postemergence weed control we applied Glystar Plus at 30 oz/a. We harvested the corn on October 18 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 15.5% seed moisture content.

Results and Discussion

The corn yields were excellent; the corn averaged 95 bu/a. This year, there was no benefit from skip row planting for dryland corn: the all rows planted treatments produced significantly more than the skip row/plant two treatments at similar planting densities. The solid planted treatment at the higher planting rate (16,500 seeds/a) produced the highest yield of 100 bu/a, although it was not significantly higher than the solid planted treatment at the lower planting rate (13,200 seeds/a). This trend toward higher yield with higher planting density and the overall high yield of the study indicates that the corn was not critically moisture stressed. Rainfall during the growing season was 36% above average (11.76 in.), and moreover, the rains were well timed. The critical water use and developmental periods for corn in our area occur in July and August. Rainfall in July was 3.65 in., 50% higher than average, and rainfall in August was 4.09 in., 106% above average. With this season’s higher than average and well-timed rainfall, it is not surprising that the moisture-conserving, skip row treatments did not yield as well as the solid planting treatments.

In previous years where we had tested grain sorghum in skip rows, we found that the skip row patterns allowed weeds to flourish in the skipped areas of the grain sorghum, negating the water stored in these fallow areas. We stated that until there are herbicides available to control weeds in the skip row areas, planting grain sorghum in skip row patterns is not recommended. With the new herbicide (ALS and ACCase) tolerant grain sorghum hybrids, controlling weeds in the skip row fallow areas may now be practical. We tested two of these new herbicide tolerant grain sorghum hybrids, one ALS tolerant hybrid and one ACCase tolerant hybrid, in a skip row study. The study site was heavily infested with sandbur. To control the sandbur, we applied Assure II 8.0 oz/a, COC 16 oz/a, and AMS 2.0 lb/a to the ACCase tolerant hybrid, and Accent 0.67 oz/a, COC 16 oz/a, and AMS 2.0 lb/a to the ALS tolerant hybrid. Control of sandbur was excellent with the Assure II treatment. The Accent treatment turned the leaves of the sandbur yellow, but soon the leaves re-greened and the sandbur flourished. We had to destroy the grain sorghum crop before grain harvest because these hybrids are not yet registered. Nonetheless, we believe that the superior sandbur control achieved with the Assure II on the ACCase tolerant grain sorghum hybrid would have produced much higher yields than the ALS tolerant hybrid with Accent applied.

Skip-row planting is not a new idea. For many years, cotton growers in Texas have used skip-row to take advantage of government programs. The skip-row area was considered set-aside acres and only the cotton in the planted rows was counted as production acres. This has caused a potential insurance problem with skip-row plantings for other row crops because only 20 inches on each side of the planted row is considered planted area (Little, 2002). Only the crop area that is considered planted is insurable; therefore, insurance coverage is dependent on growers' skip-row planting patterns. With an alternate skip row pattern on 40 in. rows, only 50% of the field is considered planted and insurable. Recent rulings may change the insurability of skip-row plantings; therefore, before planting row crops in a skip-row pattern, we recommend that growers consult with their FSA office for further details on this issue.

Literature Cited

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Little, J. (Signed). December, 2002. Skip row and strip crops. EPA Federal Register, December, 2002. www.epa.gov/fedrgstr/EPA-IMPACT/2002/December/Day-03/i30702.htm.

Table .Dryland Corn, Skip Row and Plant Density Study, Plainsman Research Center, Walsh, 2010.

Skip Row Pattern	Plant Density	Test Weight	Grain Yield
↑ - plant X - skip	plants/a X 1000	lb/bu	bu/a
↑↑↑↑↑↑↑↑	15.3	58	100.1
↑↑↑↑↑↑↑↑	12.9	58	97.1
↑↑X↑↑X↑↑	14.0	58	92.6
↑↑X↑↑X↑↑	11.6	58	91.2
Average	13.5	58	95.3
LSD 0.20			5.08

Planted: May 20, Garst 85Z64 GT/CB/LL in 30 in. rows.
Harvested: October 18, 2010.
Grain Yield adjusted to 15.5% moisture content.

Drought Stressed Corn, Foliar Treatments

VBC 2010 Corn Foliar Kevin Larson (VBC Experiment/EXSUM # 2010JMULL076_KLCOWACOLW)

Kevin Larson
Box 477, Walsh, CO 81073

Planted: May 11, 2010; Harvested: November 5 and 6, 2010
Final Report Submitted: December 15, 2010

Executive Summary:

Crop growth and grain yields of this drought-stress induced subsurface drip irrigated corn study were excellent. Yields for the drought stressed treatments averaged 217 bu/acre, and the fully irrigated treatment produced 243 bu/acre. Little or no water stress was noted during the four weeks of induced drought. The lack of visual response to the four weeks without irrigation are attributable to the growing season precipitation being 26% higher than average. Nonetheless, three foliar treatments (2, 8, and 18) produced significantly higher grain yield than the unsprayed control. We believe that this study should be repeated, because under more severe drought stress these foliar treatments may result in greater yield differentiation compared to the untreated control.

Introduction:

Drought is a frequent concern for the growers in Southeastern Colorado. All too often, drought and heat stress limit corn yields. Hot, dry conditions, particularly at silking, reduce yields and test weights of corn, even with irrigation. With our typically dry conditions, growers in Southeastern Colorado need management tools that alleviate the affects of drought and heat stress and increase yields.

Materials and Methods:

This corn study was conducted at the Plainsman Research Center farm near Walsh, Colorado. The site was irrigated by a subsurface drip irrigation system with drip tape spaced 60 inches apart and 9 inches deep in a Richfield Silt Loam soil. We banded N 200 lb/acre as 32-0-0 prior to planting. We no-till planted DeKalb 61-69 VT at 34,000 seeds/acre on May 11, 2010 into sunflower stubble. At planting, we seedrow-applied 20 lb/acre P_2O_5 as 10-34-0 and Zn 0.38 lb/acre as Zn chelate. The soil analysis for residual nutrients was: N = 26 ppm (in 2 ft profile), P = 9.3 ppm, K = 528 ppm, Zn = 0.5 ppm, pH = 7.8. For pre-emergence weed control, we applied Atrazine 1.0 lb/a, Balance Pro 2.0 oz/a, Sharpen 3.0 oz/a, COC 16 oz/a, and glyphosate 30 oz/a on May 13, 2010. We applied gylphosate 30 oz/a for post emergence weed control on June 26. To control mites, the site was aerially sprayed with Capture and Oberon. The plots consisted of four rows 30 inches wide and 30 feet long with 5 feet alleys between each range. Treatment applications and harvests were from the two center rows of each plot (5 ft x 30 ft). The experimental design was a randomized complete block design with 8 replications. Nineteen foliar treatments and one unsprayed control were tested for this induced drought study, in which irrigation was shut off for four weeks surrounding silking (R1). There were 19 foliar spray treatments and one unsprayed control in the drought section of this study. One additional treatment was a fully irrigated reference check grown in an adjacent drip irrigated zone. The fully irrigated check was irrigated throughout the season, including the four weeks of induced drought.

Initial irrigation for the study site was delayed until June 23 because part of the main irrigation line needed replacement. The study was irrigated until July 6, two weeks prior to V15 treatments. Irrigation water remained off for four weeks to simulate drought conditions. On July 20, the V15 treatments (2, 3, 4, 5, 6, and 7) were applied. The corn in the study site reached 50% silking (R1) on July 24. Five days after silking (July 29), the R1+5 treatments (8, 9, 10, 11, 12, 13, and 14) were applied. On August 3, 10 days after silking, the R1+10 treatments (15, 16, 17, 18, 19, and 20) were applied. Irrigation was restarted on August 6 and was irrigated to the end of the season. To make treatments, specified amounts of concentrated test products were diluted with water and sprayed. Treatments were applied to the two center rows of each plot (5 ft x 30 ft) using a CO_2 propellant hand boom consisting of 2 nozzles spaced 20 inches apart. Standard flat fan nozzles were used to spray 20 gallons/acre. Grain was harvested from the center two rows of the plots on November 5 and 6, and yield, moisture, and test weight were recorded for each plot. Grain yields were adjusted to 15.5% seed moisture content.

Statistical analysis of the data was performed with CoStat statistical software. Outliers were identified using the three-fold interquartile method. Analysis of variance was applied to the results and the least significant difference (LSD) was computed at alpha = 0.10 for mean separation.

Results and Discussion:

During the four weeks of the induced drought, the corn in the study displayed little if any water stress symptoms. The lack of water stress was due to above normal precipitation during the growing season, 26% more rain than average (Fig. 1).

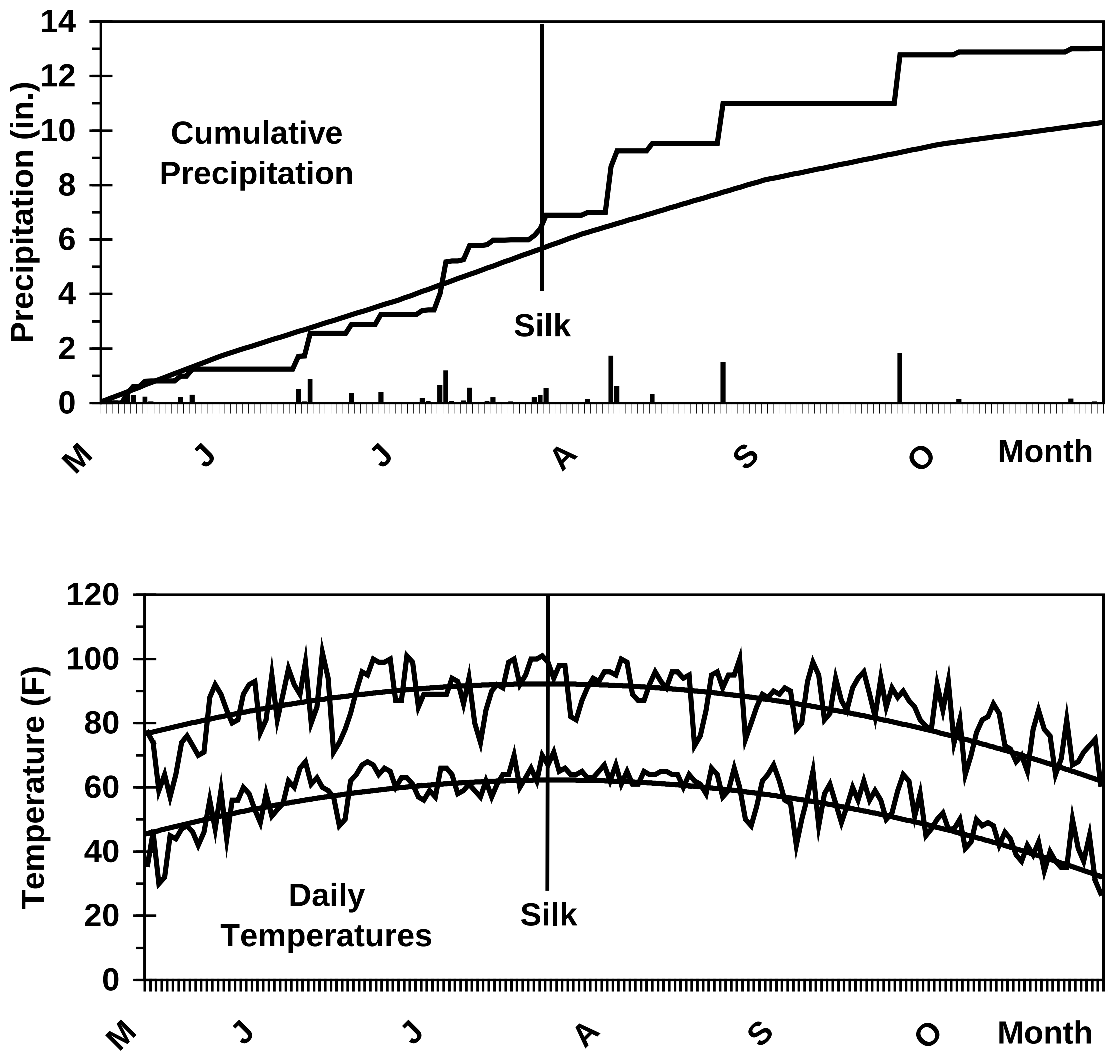

Fig.1—Cumulative precipitation and daily temperature for Walsh, Colorado from May 11, 2010 (planting) to October 27, 2010 (first freeze, 27F).

Average yield for the unsprayed control treatment in the drought study was 211 bu/acre, and the fully irrigated check produced 243 bu/acre. This 13% yield reduction between the fully irrigated check and the unsprayed control in the drought study was less than the 20 to 30% targeted yield reduction. Unexpectedly, even without visual water stress symptoms, three foliar treatments (2, 8, and 18) produced significantly higher grain yield than the unsprayed control (Table 1). These three treatments had different application timings. Two of these treatments (2 and 8) had the same applied product and rate. The unsprayed control had the highest adjusted test weight. It was significantly higher than treatments 3, 6, 7, 8, 16, and 20, although the test weight range was only 0.8 lb/bu (Table 1). The grain moisture range was 0.5 percent and only treatment 3 had grain moisture significantly lower than the control (Table 1). The unsprayed control had the lowest stay green score. Nearly half of the treatments (2, 4, 10, 12, 14, 15, 16, 18, and 20) had significantly higher stay green ratings than the control (Table 1). The higher stay green ratings did not result in higher grain moisture at harvest or a reduction in lodging (the study had no lodging). However, treatments 2 and 18, two of the three treatments that had significantly higher grain yield than the control, also had significantly higher stay green scores. The higher stay green ratings may reflect prolonged grain filling periods. Leaf disease ratings were performed on September 27 at R2 (milk stage) on treatments 1, 13, and 14. Treatment 13 had significantly less leaf disease than the control (Table 1). The reduction in leaf diseases did not translate into higher yield for treatment 13 compared to the control.

Table 1.--2010 VBC Foliar Corn Drought Study

Trt	Product	Rate	Timing	Mean Yield	Mean Adjusted Test Wt.	Mean Moist.	Mean Stay Green	Mean Leaf Disease
				bu/a	lb/bu	%	%	%
1	UTC	No spray		210.8	57.1	11.6	46.9	5.9
2	VBC_1	1x	V15	232.8	56.7	11.6	51.9	
3	VBC_1	10x	V15	223.8	56.3	11.2	48.8	
4	VBC_2	1x	V15	214.0	56.9	11.6	51.3	
5	VBC_3	1x	V15	208.8	56.8	11.7	49.4	
6	VBC_4	1x	V15	214.3	56.6	11.4	50.0	
7	VBC_5	1x	R1D5	212.9	56.6	11.4	49.4	
8	VBC_1	1x	R1D5	228.3	56.6	11.5	47.5	
9	VBC_1	10x	R1D5	226.7	57.0	11.6	48.1	
10	VBC_2	1x	R1D5	211.7	56.8	11.6	51.9	
11	VBC_3	1x	R1D5	208.0	56.7	11.4	48.8	
12	VBC_5	1x	R1D5	211.4	56.8	11.7	51.3	
13	VBC_6	1x	R1D5	219.9	57.1	11.6	48.8	3.0
14	VBC_7	1x	R1D5	213.8	56.9	11.5	51.9	5.1
15	VBC_1	1x	R1D10	212.0	56.8	11.5	51.3	
16	VBC_1	10x	R1D10	222.2	56.4	11.6	50.6	
17	VBC_2	1x	R1D10	215.7	56.9	11.5	50.0	
18	VBC_3	1x	R1D10	234.2	56.8	11.5	50.6	
19	VBC_5	1x	R1D10	214.1	56.9	11.7	50.0	
20	VBC_4	1x	R1D10	212.4	56.6	11.6	51.9	
Average (Drought)				217.4	56.8	11.5	50.0	4.7
LSD 0.10 (Drought)				16.71	0.42	0.33	3.35	1.37
21	Fully Irr.	No spray		243.3	56.4	11.4		

Treatment means were generated from data after outliers were removed
Mean Yield and Adjusted Mean Test Weight are adjusted at 15.5 % moisture.

Conclusions:

For the induced month long drought, irrigation was withheld during the most critical water use period, two weeks before and two weeks after silking. Typically a month of water stress encompassing silking would dramatically lower corn yields in the hot, dry environment of Southeastern Colorado (average annual long-term precipitation is 15.81 in.). However, the effects of this imposed drought were reduced because of abundant rainfall during the growing season (long-term May to October precipitation is 10.29 in., and 2010 May to October precipitation was 13.01 in.). There was only a 13% yield reduction between the fully irrigated check and the unsprayed control of the drought study, much less than the targeted 20 to 30% yield reduction. Despite the above average precipitation masking the visual drought symptoms and lowering the targeted induced drought yield reduction, treatments 2, 8, and 18 produced significantly higher grain yield than the unsprayed control. If the yield differences for these treatments can be transfer to corn grown commercially, this would be quite beneficial to growers in the arid West. Since the effectiveness of these three treatments varied with application timing, they may provide a large application window for the alleviation of drought effects. If dry conditions occur around V10, then the same product and rate for treatments 2 and 8 is applicable at V15 through five days after silking. If the drought continues beyond silking, then treatment 18 product and rate may be used at 10 days after silking to reduce drought affects and increase yields.

The yield differences between treatments 2, 8, and 18 and the unsprayed control would probably have been greater given our more typical stressful conditions. Therefore, we recommend that the study be repeated. We suggest that the RCBD with 8 replications for the irrigated studies be retained.

Dryland Corn, Valent Seed Treatments, Walsh 2010

Kevin Larson

Drought is an all too frequent occurrence in the Southern High Plains. Higher yields and better quality grain could be two of the possible effects of lessening drought stress. If these seed treatments are effective in ameliorating drought stress, we believe that growers in arid regions would readily utilize these new seed treatments.

Materials and Methods

We planted four corn hybrids that were treated with four seed treatments on May 18, 2010 at 14,000 seeds/a. The four seed treatments were designated as 1) treatment A at rate 1x, 2) treatment A at rate 2x, 3) treatment B, and 4) no seed treatment. The four hybrids were designated as 176, 182, 185, and 186. The design of the study was a Latin Square with 8 replications. We fertilized the study with 75 lb N/a and we seedrow applied 20 lb P_2O_5/a and 0.38 lb/a of chelated Zn. For preplant weed control we applied Glystar Plus 30 oz/a, Atrazine 1.0 lb/a, Sharpen 3.0 oz/a, Balance Pro 2.0 oz/a, and COC 16 oz/a. For in-crop weed control, we applied two applications of Glystar Plus 30 oz/a. The site was aerially sprayed with Oberon and Barrage to control mites. We harvested the 10 ft. x 44 ft. plots on October 15 and 16 with a self propelled combine equipped with a digital scale. We took grain samples for test weight and seed moisture. Grain yields were adjusted to 15.5% seed moisture.

Results

In this 26% above average rainfall season, Treatment A at the 2x rate had the highest grain yield, 62 bu/a, of the four seed treatments tested. The grain yield of Treatment A 2x was significantly higher (at the 10% alpha level) than the Treatment A at the 1x rate and Treatment B 1x, but it was not significantly higher than the untreated control. There was no significant difference in grain yield between the four hybrids tested.

Seed treatments did not improve test weights compared to the control. There was only 0.2 lb/bu difference in test weights for the seed treatments. Test weights were significantly different between the hybrids. The test weight ranking of the hybrids was 185>186>176>182.

The range in days to 50% silking was 66.2 to 66.9 for the seed treatments. This 0.7 days to 50% silking range was minor compared to the range of 5.4 days to 50% silking between the hybrids. Seed treatments had little influence on the time to silking.

Discussion

Since there were no grain yield or test weight differences between the seed treatments and the untreated control, these seed treatments did not appear to improve plant growth in this above average rainfall season. Rainfall from planting to harvest (May to October) was 13.01 inches, 2.72 inches above our seasonal average. We believe that Treatment A at the 2x rate warrants further investigation, because the yield difference between Treatment A 2x and the untreated control may be increased under drier, more typical, drought stressed conditions.

Table .--Dryland Corn, Valent Seed Treatment Summary at Walsh, 2010

	Grain Yield		Test Weight		Seed Moisture		50% Silking
	bu/a		lb/bu		%		DAP
Seed Treatment and Rate							
Treatment A 2x	62.0	a	59.0	a	11.5	a	66.2
Control None	58.8	ab	59.2	a	11.4	a	66.6
Treatment A 1x	57.5	b	59.1	a	11.5	a	66.9
Treatment B 1x	57.0	b	59.2	a	11.3	a	66.6
Seed Trt. LSD 0.10	3.60		0.28		0.28		
Hybrid							
186	61.8	a	59.6	b	11.4	bc	63.9
176	60.2	a	58.6	c	11.8	a	69.3
185	58.2	a	60.2	a	11.5	ab	66.6
182	55.1	a	58.0	d	11.1	c	66.4
Hybrid LSD 0.10	7.15		0.30		0.39		
Average	58.8		59.1		11.4		66.6

Planted: May 18, 2010 at 14,000 seeds/a.
DAP is Days After Planting.
Grain Yield is adjusted to 15.5% seed moisture content.

Long-Term N Effects on Irrigated Sunflower-Corn Rotation, Walsh, 2010

K. Larson, D. Thompson, D. Harn, and C. Thompson

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

Materials and Methods: All crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted each year. We planted corn, Mycogen 2T784, on May 11 at 27,500 seeds/a, and sunflower, Pioneer 63N82, on June 21 at 26,000 seeds/a. For our N treatments, we streamed liquid N (32-0-0) at 100, 150, or 200 lb/a with two replications. We seedrow applied 20 lb P_2O_5/a to the corn, but not the sunflowers. In addition to the seedrow applied P, the corn received 0.38 lb/a of Zn chelate. For weed control, we applied pre-emergence Glystar Plus 24 oz/a, 0.5 lb/a of 2,4-D, and Banvel 4 oz/a to both the corn and sunflower plots. The corn also received pre-emergence Balance Pro 2.0 oz/a, Sharpen 3.0 oz/a, Atrazine 1.0 lb/a, and COC 16 oz/a. For postemergence weed control in the corn, we applied two applications of Glystar Plus at 30 oz/a. For weed control in the sunflower, we applied pre-emergence Spartan 2 oz/a and Prowl H2O 40 oz/a. For postemergence weed control in the sunflower, we applied Express 0.5 oz/a and Select 10 oz/a. The corn received approximately 18 in./a of drip irrigation and the sunflower received approximately 13 in./a of drip irrigation (we used approximations because we had well problems). The site had aerial applications of Oberon and Barrage to control mites in the corn, and Warrior to control head moth in the sunflower. We harvested two replications of the 20 ft. by 650 ft. plots on October 20 for corn and November 9 for sunflower with a self-propelled combine and weighed them in a digital weigh cart. Yields were adjusted to 15.5% for corn and 10% for sunflower.

Results and Discussion: The corn in Sunflower-Corn and continuous corn rotations responded differently to increasing N rates: the Sunflower-Corn rotation had an optimum N rate around 125 lb/a, and the continuous corn rotation increased linearly with increasing N rates. If the corn in the Sunflower-Corn rotation continues to have low or no response to increasing N, this would indicate that relatively low amounts of applied N are needed for high corn yields following sunflowers. Continuous corn required high rates of N for high grain yields. High rates of N for high yields would be the acceptable practice for corn production. Therefore, the increased yield with increased N for continuous corn is not surprising, but the low or lack of N response of corn following sunflower is surprising.

The response of the sunflower declined linearly with increasing N rates. After reviewing the soil test recommendation, it is not surprising that the 100 lb N/a rates produced similarly high corn and sunflower yields in the Sunflower-Corn rotation. The recommended N fertilizer rates for our yield goals were 70 lb/a for sunflower and 50 lb/a for corn. Our yield goal for the corn was 175 bu/a, our actual average grain yield was 165 bu/a, and the yield goal for the sunflowers was 2500 lb/a, our actual average seed yield was 2105 lb/a or 847 lb/a oil yield. We observe the typical percent oil decrease with increasing N. The oil percentages were: 40.8, 40.5, and 39.3, respectively for 100, 150, and 200 lb N/a.

Table .-Soil Analysis.

Depth	pH	Salts mmhos/cm	OM %	N	P	K	Zn	Fe	Mn	Cu
				----------------------			ppm			----------------------
0-8”	7.9	0.7	2.4	16	3.7	632	0.4	3.3	23.4	3.1
8-24”				17						

This is the fifth year of this long-term N on Sunflower-Corn rotation study. We started this study because of 1) the lack of N response for dryland sunflower in our long-term N on Wheat-Sunflower-Fallow study, 2) the role of N in reducing oil yield, and 3) reports from growers that their irrigated corn following sunflower often produced their highest yields. This year, the difference in average corn yield between the Sunflower-Corn and continuous corn rotations was 14 bu/a with the continuous corn producing higher yields than the corn following sunflower, which is contrary to our results last year. Under dryland conditions, crop yields are often reduced following sunflower in the rotation. The yield reduction in the crop following sunflower is due to the deep and thorough extraction of the available water in the soil profile, leaving the subsequent crop with little soil water profile base. With irrigation, the dry soil profile left by sunflower is not a detriment since the soil profile can be refilled by irrigation. In the past, we speculated that the reason irrigated corn yielded well following sunflower was that the deep water extraction of sunflower loosened the soil and provided better root penetration by the corn. In the following study titled, “Soil Compaction Measurements in Irrigated Sunflower-Corn Rotations,” we tested our sunflower soil-loosening theory by taking penetrameter measurements in the corn and sunflower residues prior to planting.

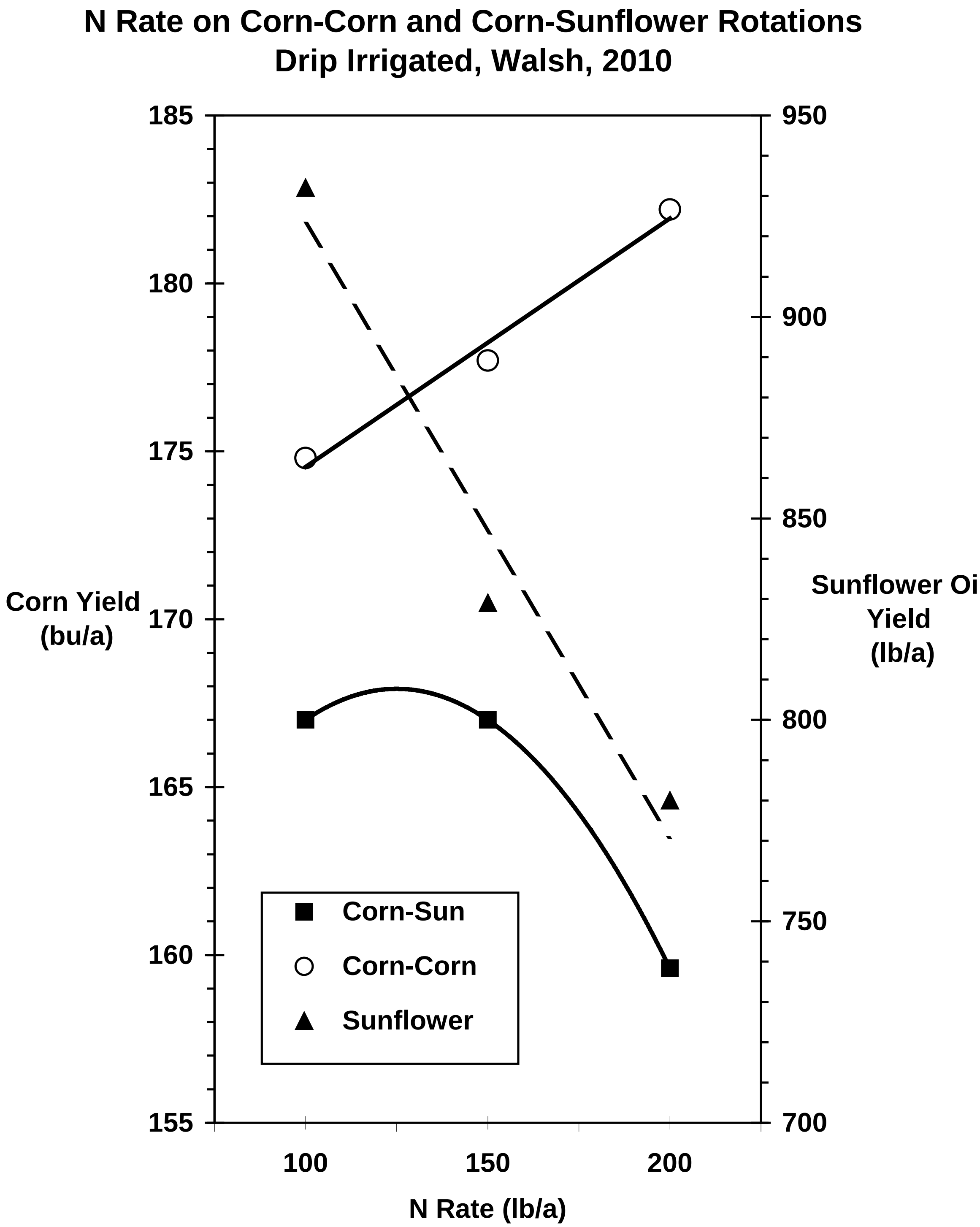

Fig. . N rate on drip irrigated sunflower and corn in Sunflower-Corn rotations at Walsh. The N rates were 100, 150, and 200 lb N/a as 32-0-0. The sunflower hybrid was PIONEER 63N82 planted at 26,000 seeds/a. The corn hybrid was MYCOGEN 2T784 planted at 27,500 seeds/a.

Soil Compaction Measurements in Irrigated Sunflower-Corn Rotations, Walsh, 2010

Kevin Larson and Dennis Thompson

Purpose

To determine if sunflower in a Sunflower-Corn rotation lessens soil compaction compared to corn in a Corn-Corn (continuous corn) rotation.

Materials and Methods

All crop phases (corn and sunflower) of Sunflower-Corn and Corn-Corn rotations were planted each year. We planted corn, Mycogen 2T832, on May 6 at 27,000 seeds/a, and sunflower, Pioneer 63N82 on June 24 at 26,000 seeds/a. For our N treatments, we streamed liquid N (32-0-0) at 0, 50, or 100 lb N/a with two replications. We seedrow applied 20 lb P_2O_5/A to the corn and sunflowers. In addition to the seedrow applied P, the corn received 0.38 lb Zn/a. For weed control, we applied pre-emergence Glystar Plus 24 oz/a and 0.5 lb/a of 2,4-D to both the corn and sunflower plots. The corn also received pre-emergence Balance 1.75 oz/a and Atrazine 1.0 lb/a. For Postemergence weed control in the corn, we applied two applications of Roundup Weather Max at 24 oz/a. For weed control in the sunflower, we applied pre-emergence Spartan 2 oz/a and Prowl H2O 40 oz/a. The corn received approximately 14 in./a of drip irrigation and the sunflower received approximately 10 in./a of drip irrigation (we used approximations because we had well problems). Other than herbicides, no other pesticides were applied to the corn, but we did apply Warrior on the sunflowers to control head moth. We harvested two replications of the 20 ft. by 650 ft. plots on December 1 for corn and November 11 for sunflower with a self-propelled combine and weighed them in a digital weigh cart. We measured soil compaction in the sunflower and corn rotations on April 1, 2010 with a Dickey John penetrameter. The soil was not tilled before penetrameter measurements.

Results and Discussion

In 2009, the corn following sunflower produced 18 bu/a more than the corn in the continuous corn rotation. We speculated that the reason irrigated corn produced more following sunflower than corn following corn was that the deep water extraction of sunflower loosened the soil and provided better root penetration by the corn.

All three rotational phases, corn in the Corn-Corn rotation, corn in the Sunflower-Corn rotation, and sunflower in the Sunflower-Corn rotation, had similar soil compaction levels to 15 in. soil depths. Soil compaction in the corn stubble of the Corn-Corn and Sunflower-Corn rotations peaked at about 210 psi (slightly compacted) between 18 in. to 21 in depths and drop to around 160 to 170 psi at 27 in. depth. Soil compaction in the sunflower stubble of the Sunflower-Corn rotation peaked at about 240 psi (moderately compacted) at 21 in. depth and remained around 230 psi to 27 in. depth. The greater soil compaction in sunflower stubble compared to corn stubble at soil depths beyond 18 in. indicates that sunflower in a Sunflower-Corn rotation does not lower soil compaction. In fact, there was less soil compaction following corn than following sunflower in the Sunflower-Corn rotation.

The higher soil penetrameter measurements in the sunflower stubble than in the corn stubble does not necessarily negate our sunflower soil compaction abatement theory. Sunflower is known to dry the soil to a greater depth and to a greater degree than corn. The higher penetrameter readings in the sunflower stubble may be attributed to greater probe pressure required to penetrate the drier soil following sunflower than following corn and not due to greater soil compaction.

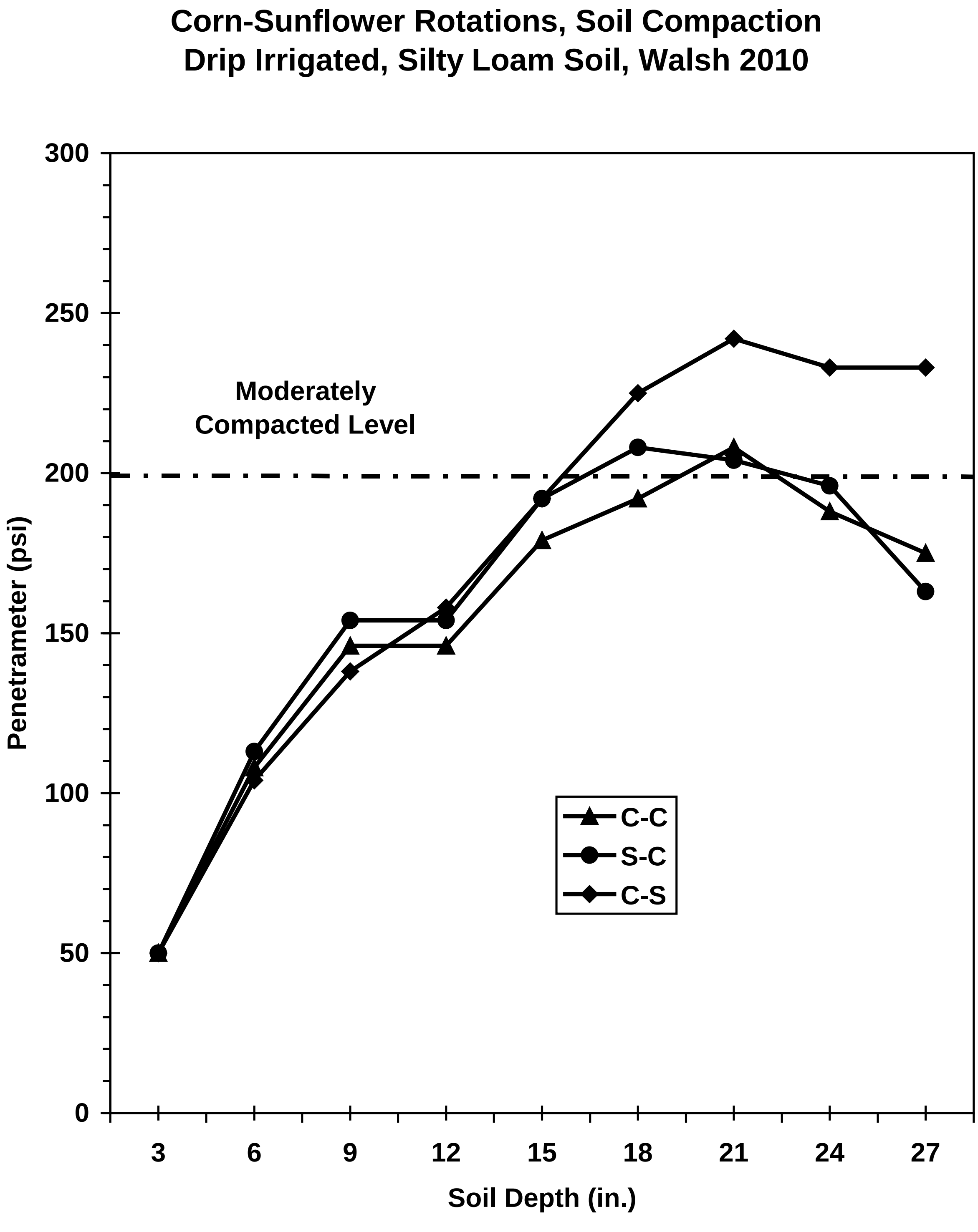

Fig. .Soil compaction measurements taken with Dickey John penetrameter in Silty Loam soil prior to planting (April 1, 2010) in corn-sunflower rotations. The rotations were Corn-Corn (C-C), Corn-Sunflower (C-S), and Sunflower-Corn (S-C).

Long-Term N Effects on Wheat-Sunflower-Fallow Rotation, Walsh, 2010

K. Larson, D. Thompson, D. Harn, and C. Thompson

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

Materials and Methods: We planted wheat, Hatcher, at 50 lb seed/a on October 5, 2009, and sunflower on June 23, 2010 at 20,000 seeds/a using MYCOGEN 8N358CL. We banded liquid N (32-0-0) at 0, 30, 60, and 90 lb N/a to the treatment plots with two replications to both N and N residual sides on April 14, 2010 for wheat, and no N was applied to the sunflower this season (the sunflower N response was to residual N applied to the wheat the previous season). We seedrow applied 5 gal/a of 10-34-0 (20 lb P_2O_5/a) at planting to the wheat, but not the sunflowers. For weed control in the wheat, we applied pre-emergence Glystar Plus 24 oz/a, Banvel 4.0 oz/a, and 2,4-D 0.5 lb/a and post emergence Express, 0.33 oz/a and 2,4-D, 0.38 lb/a. For weed control in the sunflower, we applied pre-emergence Glystar Plus 30 oz/a, Spartan 2 oz/a, and Prowl H2O 40 oz/a. We harvested two replications of the 20 ft. by 1100 ft. plots on July 1 for wheat and November 9 for sunflower with a self-propelled combine and weighed them in a digital weigh cart. Yields were adjusted to 12.0% for wheat and 10% for sunflower.

Results: Wheat yields had a negative response to increasing N rates. Yield declined at a rate of 1.2 bu per 30 lb N applied (R^2 = 0.885). The 0 N rate had the highest grain yield of 35 bu/a. Wheat yields were good, averaging 33 bu/a. Sunflower yields increased with higher residual N rates, although the linear increase was not significant (R^2 = 0.215) and the yield response was insufficient to offset the cost of applied N. Sunflower yields were good, ranging from 1228 lb/a to 1327 lb/a. The percent oil in the sunflower seeds generally decreased with increasing N rates, although this, too, was not significant. Both wheat and sunflower responded to increasing N rates; however the wheat had a negative response and the sunflower had a slightly positive response, although it was not an economical response.

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

This year, the wheat had a negative response to applied N. Only one time in nine years had the wheat positively responded to applied N. Since the wheat this year had a negative response to applied N, applying N could not be justified. The non-response of wheat yields to increasing N rates for eight out of nine years can be explained by sufficient residual N for the first year and low to average yields for the subsequent years. In 2007, there was sufficient winter moisture to produce very good wheat yields (over 50 bu/a), and in 2009 the wheat responded to N rates. However in 2009, this positive response to applied N was not economical. Generally, however, moisture has been the primary yield-limiting factor for this study, not N.

This year the sunflower yields were good and there was a slightly positive increase in yield in response to increasing residual N rates; however, the yield response was not profitable. Each 30 lb/a of applied N lost $11.54/a. Yield increased 18.2 lb/a per 30 lb N/a increment, which was worth $3.46/a (at a sunflower seed price of $0.19), and the cost of 30 lb N (as 32-0-0) was $15.00 ($3.46/a income yield - $15/a N cost = -11.54/a loss).

With the exception of 2007, we have reported no wheat yield response to N rates since establishing this wheat-sunflower-fallow rotation study. For eight out of nine years, wheat yields in this rotation were very low to average, 6 to 33 bu/a. The low to average wheat yields can be attributed to the lack of moisture remaining after sunflower extracted all available soil water and little soil water replenishment due to dry conditions during fallow. For wheat production in this wheat-sunflower-fallow rotation, moisture was probably the limiting factor, not N. In 2009, when the wheat did respond to applied N, the yield response was insufficient to justify the N cost.

This year like most years, sunflower yields increased with increasing N rates; however the yield response failed to offset the cost of the N fertilizer. The no N fertilizer treatment produced the highest income every year of sunflower production (there was no sunflower crop in 2002 and 2008 because of drought). This lack of N response suggests that N fertilizer is not needed for dryland sunflower production if the expected yield is 1200 lb/a or less.

Seed oil content tends to decrease with increasing N rates. This year there was a non-significant decrease in oil content with increasing N rates: 40.2%, 40.8%, 39.6%, and 39.8% for 0, 30, 60, and 90 lb N/a, respectively. Generally in previous years, we observed no response or a decline in oil content with increasing N rates. This negative correlation of oil content with N rate has been previously reported (Vigil and Bowman, 1998).

<u>Literature Cited</u>

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

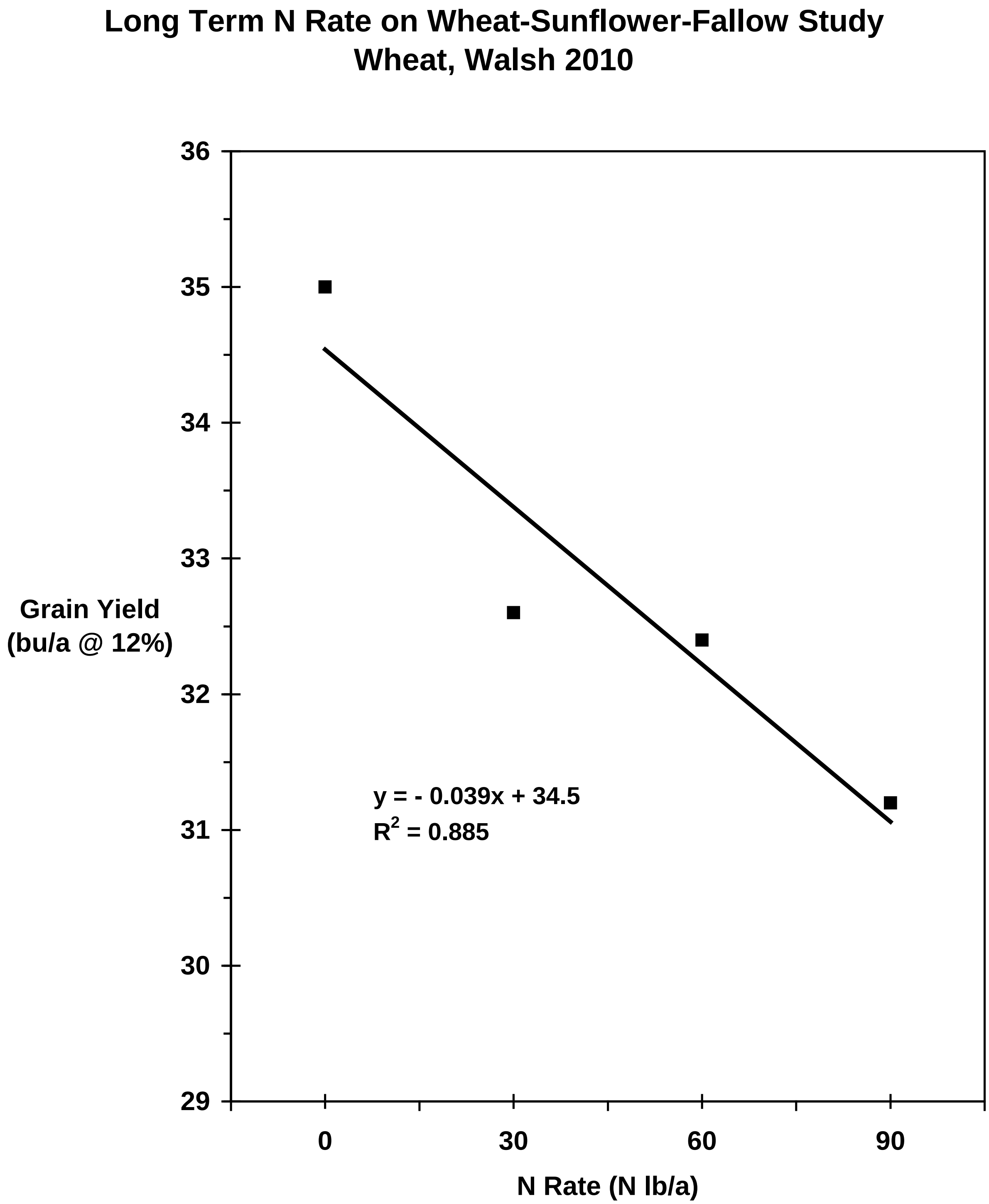

Fig. . N rate on dryland wheat in Wheat-Sunflower-Fallow rotation at Walsh. The N rates were 0, 30, 60, and 90 lb N/a as 32-0-0. The wheat variety was Hatcher sown at 50 lb/a.

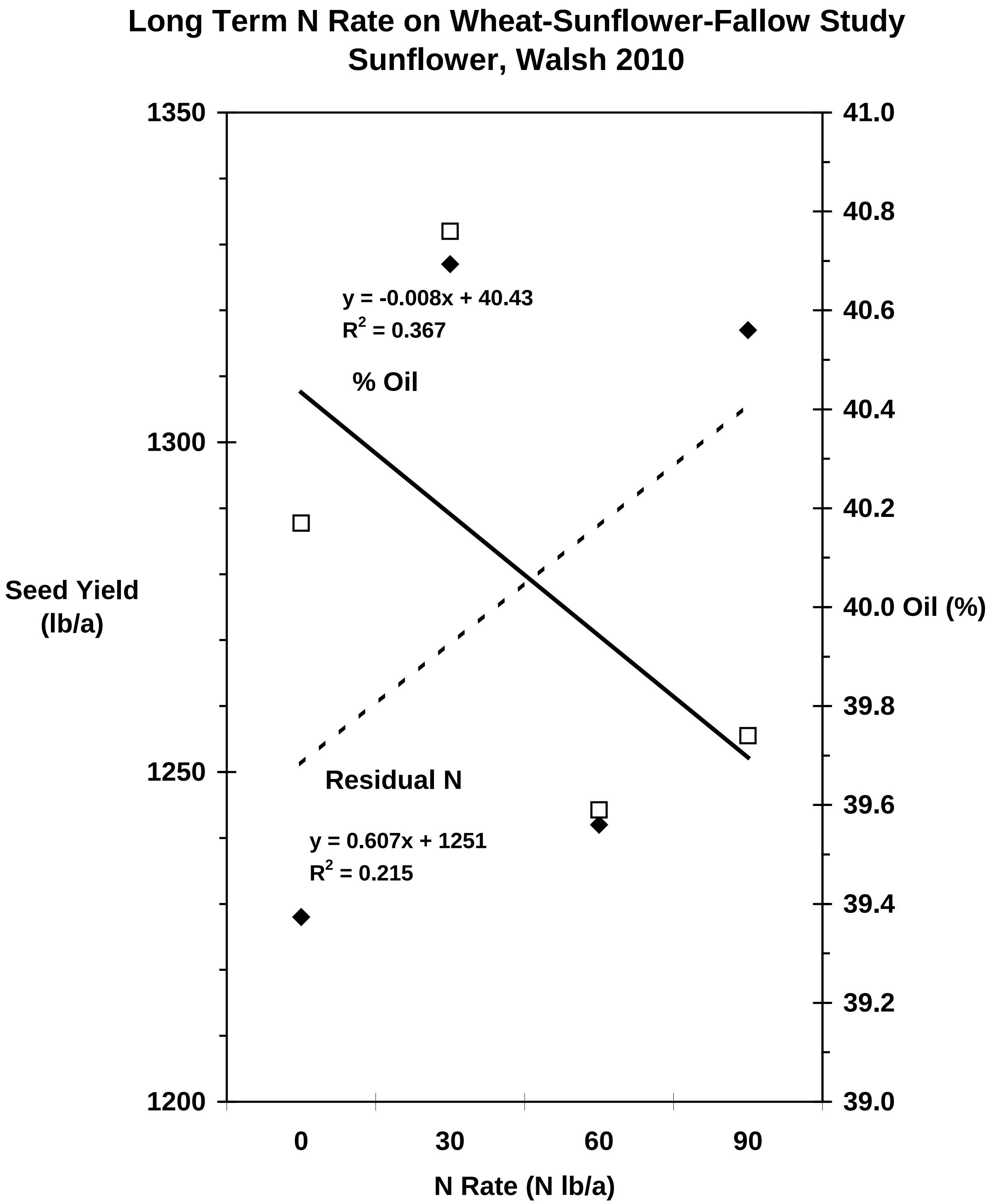

Fig. . N rate on dryland sunflower in Wheat-Sunflower-Fallow rotation at Walsh. The Residual N rates were 0, 30, 60, and 90 lb N/a as 32-0-0 applied to the wheat the previous season. The sunflower hybrid was MYCOGEN 8N358CL at 20,000 seeds/a.

Crop Rotation Sequencing

Kevin Larson and Dennis Thompson

Crops differ in their utilization of water and nutrients. Some crops, such as sunflower, are believed to mine nearly all available soil water and nutrients and leave little for subsequent crops. Whereas, other crops, such as millet, use only a portion of the available water and nutrients, leaving residual water and nutrients for subsequent crops. There are other advantages from crop rotation, including abatement of weeds, insects and diseases. The purpose of this study is to determine the crop rotation sequences that produce highest yields and incomes.

Materials and Methods

We tested fallow and five spring crops: sunflower, grain sorghum, corn, millet, and mung bean. Annually, each crop follows itself and every other crop. We planted corn (Pioneer P1162 Bt/RR) on May 14 at 13,200 seed/a, sunflower (Mycogen 8N358CL) on June 23 at 20,000 seed/a, grain sorghum (Mycogen 627) on May 27 at 32,500 seed/a, mung bean (Berken) on May 26 at 17 lb/a, and proso millet (Huntsman) on June 19 at 18 lb/a. Before planting we sprayed two applications of Glystar Plus at 24 oz/a, LoVol at 0.5 lb/a, and Banvel 4 oz/a. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: millet and grain sorghum, Banvel 4 oz/a and 2,4-D amine 10 oz/a; corn, Balance Pro 2.0 oz/a, Sharpen 3.0 oz/a, COC 16 oz/a, Atrazine 24 oz/a, and two applications of Glystar Plus 30 oz/a; mung bean, Raptor 5 oz/a, COC 16 oz/a; sunflower, Prowl H2O 40 oz/a and Spartan 2 oz/a; and fallow, Glystar Plus 30 oz/a, Banvel 4 oz/a and LoVol 0.5 lb/a (two applications). We harvested the crops with a self-propelled combine equipped with a digital scale: millet, September 20; grain sorghum, November 4; corn, October 10; mung bean, October 12; and sunflowers, November 10.

This is the seventh cropping year of this dryland crop rotation sequencing study. In 2003, the first year the rotations were started, all crops were planted in fallow. The second year, 2004, the crops were planted into the five crop stubbles and fallow. In 2005, we decided to change the rotations, based on the 2004 results, to obtain the highest potential yield and income, and still have all five crops and fallow represented. We planted the 2005 crops in the different locations where the 2003 crops were originally planted: 2005 grain sorghum in 2003 millet, 2005 millet in 2003 mung bean, 2005 corn in 2003 fallow, 2005 mung bean in 2003 corn, 2005 sunflower in 2003 grain sorghum, and 2005 fallow in 2003 sunflower. In 2006, 2007, 2009, and 2010 we went back to the original rotations where all crops followed themselves and every other crop. No crops were harvested in 2008 because of drought.

Results and Discussion

The two-year rotation sequence with the highest variable net income was Sorghum-Sorghum with $659.50/a. The rotation that had the second highest variable net income for the previous two cropping years was Sorghum-Millet and its reciprocal Millet-Sorghum together produced an average variable net income of $463.82/a. This year the grain sorghum following grain sorghum had the highest variable net income of $474.24/a, and grain sorghum following fallow had the second highest variable net income of $449.28/a. Only sunflower and fallow produced negative net income averages for 2010 because fallow has no crop and the sunflower had poor stands. The four-year rotation that produced the highest variable net income was continuous grain sorghum with $765.30/a. The four-year rotation and reciprocal rotation combination that had the second highest variable net income was Sorghum-Millet with $577.29/a. Surprisingly, the worst four-year rotation was continuous sunflower and not continuous fallow. Continuous sunflower produced the lowest four-year rotations with -$146.64/a, because two out of four sunflower crops failed (chemical damage) and this year it had a poor stand. Undoubtedly, sunflower in the rotations is at a disadvantage because of operator error negating crop yield. 2010 was a banner year for grain sorghum, producing high yields with high market prices. Currently, grain sorghum and millet have the highest overall variable net incomes and sunflower the lowest variable net income of the five crops and fallow tested in our dryland rotation sequencing study.

Table .-Crop Rotation Sequence Study, Yield Summary 2010.

	2010 Crop						2010 Average Total
Previous Crop	Grain Sorghum	Millet	Corn	Mung Bean	Sunflower	Fallow	Production
	--------------------			lb/a	--------------------		
Grain Sorghum	5533	1861	3030	850	69	0	2269
Millet	5415	1600	2761	930	431	0	2227
Fallow	5242	1603	2402	684	75	0	2001
Sunflower	4172	1787	2050	622	0	0	1726
Corn	4183	1341	1260	595	35	0	1483
Mung Bean	3002	1491	2223	228	282	0	1445
Average	4591	1614	2288	652	149	0	1859
LSD 0.20	1652.0	178.5	801.9	435.5	272.9		

Table .-Two-Year Crop Rotation Sequence, Variable Net Income Summary for 2009 and 2010.

	Total Variable Net Income for 2009 and 2010 Crops						Average 2-Year Variable Net Income
	2010 Crop						
2009 Crop	Grain Sorghum	Millet	Corn	Mung Bean	Fallow	Sunflower	
	$/a						
Grain Sorghum	659.50	292.50	289.07	191.23	178.78	41.93	275.50
Millet	635.13	258.11	211.94	201.54	127.67	170.38	267.46
Corn	475.88	118.06	1.93	107.67	86.62	-25.45	127.45
Fallow	410.29	98.72	108.72	41.65	-51.32	-68.41	89.94
Mung Bean	237.20	121.78	121.18	-11.77	-19.21	-8.97	73.37
Sunflower	294.40	90.19	51.43	7.83	-75.53	-106.87	43.58
Average	452.07	163.23	130.71	89.69	41.17	0.44	146.22

Variable Net Income: Gross Income - Seed Cost - Weed Control Cost.
The highest two-year variable net income of $659.50 was the Sorghum-Sorghum rotation.

Table .-Four-Year Crop Rotation Sequence, Variable Net Income Summary for 2006, 2007, 2009, and 2010.

	Total Variable Net Income for 2006, 2007, 2009 and 2010 Crops						Average 4-Year Variable Net Income
	2007 and 2010 Crops						
2006 and 2009 Crops	Grain Sorghum	Millet	Corn	Mung Bean	Fallow	Sunflower	
	$/a						
Grain Sorghum	765.30	395.12	374.96	243.08	232.26	61.96	345.45
Millet	759.45	357.77	298.73	276.96	150.96	189.40	338.88
Fallow	548.14	209.99	177.89	67.20	-89.76	-91.05	137.07
Corn	514.78	191.81	22.07	110.14	37.00	-54.72	136.85
Mung Bean	273.85	190.11	144.60	-13.97	-58.20	-47.10	81.55
Sunflower	375.01	164.73	73.92	21.80	-125.45	-146.64	60.56
Average	539.42	251.59	182.03	117.54	24.47	-14.69	183.39

Variable Net Income: Gross Income - Seed Cost - Weed Control Cost.
No crops were harvested in 2008 because of drought.
The highest four-year variable net income of $765.30 was the GS-GS-GS-GS rotation.

Table .-Grain Sorghum: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	2010 Grain Sorghum Seed Yield	2010 Grain Sorghum Gross Income	2010 Grain Sorghum Variable Net Income	2009 Grain Sorghum Variable Net Income	2007 Grain Sorghum Variable Net Income	2006 Grain Sorghum Variable Net Income	4-Year Average Variable Net Income
	bu/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	94	449.28	437.05	203.34	156.09	73.68	217.54
Grain Sorghum	99	474.24	462.01	197.49	102.52	3.28	191.33
Corn	75	358.56	346.33	94.79	80.57	0.08	130.44
Millet	97	464.16	451.93	145.17	112.19	0.08	177.34
Sunflower	75	357.60	345.37	84.72	110.33	0.08	135.12
Mung Bean	54	257.28	245.05	97.07	53.79	6.48	100.60
Average	82	393.52	381.29	137.09	102.58	13.95	158.73
LSD 0.20	29.5	141.57	137.17	113.84	54.45	7.97	

Planted: Grain Sorghum (Mycogen 627) on May 27, 2010 at 32,500 seed/a.
Grain Sorghum Seed Cost: $3.95/a ($1.70/lb).
Harvested: Grain Sorghum November 4, 2010.
Grain Sorghum Market Price $4.80/bu.
Weed Control: Banvel, 4 oz; 2,4-D amine, 10 oz.
Chemical Cost: $2.78/a; Application Cost $5.50/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Table .-Millet: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	2010 Millet Grain Yield	2010 Millet Gross Income	2010 Millet Variable Net Income	2009 Millet Variable Net Income	2007 Millet Variable Net Income	2006 Millet Variable Net Income	4-Year Average Variable Net Income
	bu/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	29	135.85	125.48	152.23	129.51	43.49	112.68
Grain Sorghum	33	157.70	147.33	183.20	102.54	12.13	111.30
Corn	24	114.00	103.63	42.86	113.67	9.78	67.49
Millet	29	135.85	125.48	132.63	96.55	3.11	89.44
Sunflower	32	151.53	141.16	144.39	104.26	5.47	98.82
Mung Bean	27	126.35	115.98	95.00	81.57	27.03	79.89
Average	29	136.88	126.51	125.05	104.68	16.83	93.27
LSD 0.20	3.2	15.10	13.96	61.45	19.53	7.21	

Planted: Millet (Huntsman) on June 19, 2010 at 18 lb/a.
Millet Seed Cost: $2.09/a ($6.50/bu).
Harvested: Millet on September 20, 2010.
Millet Market Price $4.75/bu.
Weed Control: Banvel, 4 oz; 2,4-D amine, 10 oz.
Chemical Cost: $2.78/a; Application Cost $5.50/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Table .-Corn: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	2010 Corn Seed Yield	2010 Corn Gross Income	2010 Corn Variable Net Income	2009 Corn Variable Net Income	2007 Corn Variable Net Income	2006 Corn Variable Net Income	4-Year Average Variable Net Income
	bu/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	43	225.23	135.48	111.18	118.44	-29.42	83.92
Grain Sorghum	54	284.03	194.28	129.55	136.81	-41.67	104.74
Corn	23	118.13	28.38	-26.45	-19.19	-44.47	-15.43
Millet	49	258.83	169.08	14.43	21.69	-39.92	41.32
Sunflower	37	192.15	102.40	23.80	31.06	-35.02	30.56
Mung Bean	40	208.43	118.68	53.05	60.31	-42.02	47.50
Average	41	214.46	124.71	50.93	58.19	-38.75	48.77
LSD 0.20	14.3	74.80	43.50	49.88	14.37	-34.44	

Planted: Corn (Pioneer P1162 Bt/RR) on May 14, 2010 at 13,200 seed/a.
Corn Seed Cost: $46.20/a ($3.5/1000 seeds).
Harvested: Corn on October 10, 2010.
Corn Market Price $5.25/bu.
Weed Control: Balance Pro 2.0 oz, Sharpen 3.0 oz, COC 16 oz, Atrazine 24 oz, Glystar Plus 30 oz (two applications).
Chemical Cost: $32.55/a; Application Cost $11/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Table .-Mung Bean: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	2010 Mung Bean Seed Yield	2010 Mung Bean Gross Income	2010 Mung Bean Variable Net Income	2009 Mung Bean Variable Net Income	2007 Mung Bean Variable Net Income	2006 Mung Bean Variable Net Income	4-Year Average Variable Net Income
	lb/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	684	106.02	68.41	5.35	-10.81	-18.79	11.04
Grain Sorghum	850	131.75	94.14	-7.85	-19.61	-17.14	12.39
Corn	595	92.23	54.62	2.50	-12.71	-24.79	4.90
Millet	930	144.15	106.54	5.80	-10.51	-13.24	22.15
Sunflower	622	96.41	58.80	-6.65	-18.81	-23.59	2.44
Mung Bean	228	35.34	-2.27	-9.50	-20.71	-26.29	-14.69
Average	652	100.98	63.37	-1.73	-15.53	-20.64	6.37
LSD 0.20	435.5	67.45	42.33	0.57	13.86	-14.54	

Planted: Mung Bean (Berken) on May 26, 2010 at 17 lb/a.
Mung Bean Seed Cost: $6.80/a ($40/cwt).
Harvested: Mung Bean on October 12, 2010.
Millet Market Price $0.155/lb.
Weed Control: Raptor 5oz, COC 16oz.
Chemical Cost: $23.51/a; Application Cost $5.50/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Table .-Sunflower: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	2010 Sunflower Seed Yield	2010 Sunflower Gross Income	2010 Sunflower Variable Net Income	2009 Sunflower Variable Net Income	2007 Sunflower Variable Net Income	2006 Sunflower Variable Net Income	4-Year Average Variable Net Income
	lb/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	75	14.25	-41.65	-50.97	-4.40	-29.72	-31.68
Grain Sorghum	69	13.11	-42.79	-50.97	13.55	-29.72	-27.48
Corn	35	6.65	-49.25	-50.97	5.75	-29.72	-31.05
Millet	431	81.89	25.99	-50.97	13.55	-29.72	-10.29
Sunflower	0	0.00	-55.90	-50.97	-10.05	-29.72	-36.66
Mung Bean	282	53.58	-2.32	-50.97	-14.54	-29.72	-24.39
Average	149	28.25	-27.65	-50.97	0.64	-29.72	-26.93
LSD 0.20	272.9	51.74	50.64		10.39		

Planted: Sunflower (Mycogen 8N358CL) on June 23, 2010 at 20,000 seed/a.
Sunflower Seed Cost: $30/a ($1.50/1000 seeds).
Harvested: Sunflower November 10, 2010.
Sunflower Market Price $0.19/lb.
Weed Control: Prowl H2O, 40 oz; Spartan, 2 oz.
Chemical Cost: $20.40/a; Application Cost $5.50/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Table .-Fallow: Crop Rotation Sequencing Study, Walsh, 2010.

Previous Crop	Seed Yield	Gross Income	2010 Fallow Variable Net Income	2009 Fallow Variable Net Income	2007 Fallow Variable Net Income	2006 Fallow Variable Net Income	4-Year Average Variable Net Income
	bu/a	$/a	$/a	$/a	$/a	$/a	$/a
Fallow	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Grain Sorghum	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Millet	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Mung Bean	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Corn	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Sunflower	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
Average	0	0.00	-24.56	-26.76	-20.20	-18.24	-22.44
LSD 0.20							

Weed Control: Glystar 30 oz; 2,4-D ester 0.5 lb, Banvel 4 oz/a (two applications).
Chemical Cost: $13.56/a; Application Cost $11/a.
Variable Net Income: Gross Income - Seed Cost - Weed Control.

Dryland Crop Rotation Study
Kevin Larson and Dennis Thompson

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

Materials and Methods

This is our fifth year in testing the following rotations: Wheat-Grain Sorghum-Fallow (W-S-F), Wheat-Sunflower-Fallow (W-Sun-F), and Sorghum-Millet (S-M). We added a fourth rotation of Millet/Wheat-Fallow (M/W-F) in 2006. In 2008, no crops were harvested because of drought. We planted wheat, Hatcher, at 50 lb/a on October 1, 2009; Proso millet, Huntsman, at 18 lb/a on June 17, 2010; grain sorghum, Mycogen 627, at 32,500 seeds/a on May 27, 2010; and sunflower, Mycogen 8N358CL, at 20,000 seeds/a on June 23, 2010. We applied 50 lb/a of N to the study site. Before planting we sprayed two applications of Glystar Plus at 24 oz/a, LoVol at 0.5 lb/a, and Banvel 4 oz/a. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Penetrant II 8 oz/a; millet, Banvel 4 oz/a and amine 10 oz/a; grain sorghum, Atrazine 1.0 lb/a, Banvel 4 oz/a, and COC 32 oz/a; sunflower, Prowl H2O 40 oz/a and Spartan 2 oz/a; and fallow, Glystar Plus 24 oz/a, Banvel 4 oz/a and LoVol 0.5 lb/a two times. We harvested the crops with a self-propelled combine equipped with a digital scale: wheat, July 2; millet, September 20; grain sorghum, November 4; and sunflower, November 8. We recorded cost of production and yields in order to determine rotation revenues.

Results and Discussion

The S-M rotation produced the highest annual rotation production of 3234 lb/a, and the highest annual rotation variable net income, $262.97/a, for 2010. Because we have all phases of each crop rotation present each year, we can compare annual rotation production and income even without a full crop rotational cycle. For example, the 2010 total production for the S-M rotation was 6468 lb/a. The crop rotational phases were: grain sorghum, 5174 lb/a; millet 1294 lb/a. The annual rotation production would be 3234 lb/a, which is half the total production because the S-M rotation takes two years to complete.

The W-S-F had the second highest annual rotation income of $198.75/a because it included grain sorghum in its rotation. The majority of the 2010 income for the S-M and W-S-F rotations was from grain sorghum. The 2010 season was favorable for grain sorghum production and the grain sorghum market price was excellent. The reason S-M has higher average annual rotation income than W-S-F is because S-M has a crop each year, whereas W-S-F has two crops in three years. Less fallow, more crops, more income. In 2007, 2009, and 2010 the W-Sun-F rotation produced the least variable net income because the sunflower crop either outright failed or had poor stands.

In past years, winter wheat has performed better than the spring crops in both yield and income. This was primarily due to more favorable moisture during the wheat growing seasons. This year the timing of the rains favored grain sorghum production and grain sorghum prices were excellent. This suggests that rotations that include both wheat and grain sorghum crops may continue to be the most profitable. Furthermore, having a winter grain in the rotation spreads the cropping risk and may increase crop rotation revenue.

Table .-Dryland Crop Rotation Study, Crop Production, 2010.

	Crop Production						
	---2010 Crop---					2010 Total	Annual
Rotation	Wheat	Grain Sorghum	Millet	Sunflower	Fallow	Rotation Production	Rotation Production
	---lb/a---						
S-M		5174	1294			6468	3234
W-S-F	2502	4486			0	6988	2329
M/W-F	1770		1557			3327	1664
W-Sun-F	2586			565	0	3151	1050
Average	2286	4830	1426	565	0	4984	2069
LSD 0.20	178.4	353.4	113.5				

Table .-Dryland Crop Rotation Study, Variable Net Income, 2010.

	---2010 Crop---					2010 Total	Annual Rotation
Rotation	Wheat	Grain Sorghum	Millet	Sunflower	Fallow	Crop Net Income	Variable Net Income
	---$/a---						
S-M		426.57	99.36			525.93	262.97
W-S-F	252.01	367.53			-23.30	596.24	198.75
M/W-F	172.71		121.68		-23.30	271.09	135.55
W-Sun-F	261.11			62.05	-23.30	299.86	99.95
Average	228.61	397.05	110.52	62.05	-23.30	423.28	174.30

Variable Net Income is gross income minus seed cost and weed control cost.

Table .-Dryland Crop Rotation Study, Walsh, 2010.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
		--------------------	----------	$/a	----------	----------	--------------------
Wheat	50 lb	6.67	12.37	38.1 bu	6.50/bu	247.65	228.61
M/W-F				29.5	6.50	191.75	172.71
W-Sun-F				43.1	6.50	280.15	261.11
W-S-F				41.7	6.50	271.05	252.01
Millet	18 lb	2.09	8.28	25.5 bu	4.75/bu	120.89	110.52
S-M				23.1	4.75	109.73	99.36
M/W-F				27.8	4.75	132.05	121.68
Grain Sorghum	32,500 seeds	3.83	13.12	86.3 bu	4.80/bu	414.00	397.05
S-M				92.4	4.80	443.52	426.57
W-S-F				80.1	4.80	384.48	367.53
Sunflower	20,000 seeds	24.20	21.10	565 lb	0.19/lb	107.35	62.05
W-Sun-F				565	0.19	107.35	62.05
Fallow	---	---	23.30	---	---	-23.30	-23.30
Average			15.63			173.32	154.99

Planted: Grain Sorghum Mycogen 627 at 32,500 on May 27; Millet, Huntsman at 18 lb/a on June 17; and Sunflower Mycogen 8N358CL at 20,000 seeds/a on June 23; Wheat, Hatcher at 50 lb/a on October 1, 2009.
Harvested: Millet, September 20; Sunflower, November 8; and Grain Sorghum, November 4; Wheat, July 2, 2010.
Weed control cost is herbicide cost and $5.50/a application cost for each application.

Table .-Dryland Crop Rotation Study, Annual Rotation Income, 2006 to 2010.

Rotation	Annual Rotation Variable Net Income 2006	2007	2009	2010	2006-2010 Total Crop Net Income	Average Annual Rotation Variable Net Income
	--------------------$/a--------------------					
S-M	12.70	118.18	141.76	262.97	535.61	133.90
W-S-F	36.67	120.47	105.16	198.75	461.05	115.26
M/W-F	30.79	121.22	143.26	135.55	430.82	107.71
W-Sun-F	8.01	103.07	27.69	99.95	238.72	59.68
Average	22.04	115.74	104.47	174.31	416.55	104.14

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

Dryland Millet and Wheat Rotation Study

Kevin Larson and Dennis Thompson

This is the third year of harvest for our dryland millet and wheat rotation study. We established these rotations to identify which millet and wheat and fallow rotation sequence produces the highest net income. 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 is our third harvest-year in testing 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 wheat, Hatcher, at 50 lb/a on October 5, 2009 and Proso millet, Huntsman, at 18 lb/a on June 17, 2010. We applied 50 lb N/a to the study site. Before planting we sprayed two applications of Glystar Plus at 24 oz/a, Banvel 4.0 oz/a, and LoVol 0.5 lb/a. For in-season weed control, we chose short-residual herbicides that should not interfere with crop rotations: wheat, Express 0.33 oz/a, LoVol 0.38 lb/a, and Penetrant II 8 oz/a; millet (except W/M-F) Banvel 4 oz/a and 2,4-D amine 10 oz/a; and fallow, Glystar Plus 24 oz/a, Banvel 4 oz/a and LoVol 0.5 lb/a two times. For the millet in the W/M-Fallow rotation, we applied Glystar 24 oz/a and Atrazine 0.75 lb/a. The M/W-Fallow rotation received an additional 24 oz/a of Glystar after millet harvest. We harvested the crops with a self-propelled combine equipped with a digital scale: wheat, July 1 and millet, September 22. Grain yields for the wheat and millet were adjusted to 12% moisture content. We recorded cost of production and yields in order to determine rotation revenues. There were no crops harvested in 2008 because of drought.

Results and Discussion

The W-W rotation produced the highest annual rotation variable net income of $170.76/a, and the highest annualized yield of 1752 lb/a for 2010. The M-M rotation had the lowest annualized variable net income, $93.66/a, and the lowest annualized crop production, 1226 lb/a. Because all phases of each crop rotation are present each year, we can compare annual rotation production and income even without a full crop rotational cycles. However, complete crop rotation cycles are needed to compare full rotational affects.

We are still in the establishment phase with these rotations and we already have had crop failures and missed plantings, therefore rotational affects are, at best, difficult to generalize and quantify. This year, we had good yields and we were able to plant and harvest all crops for in all phases of all rotations. 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.

Table .-Dryland Millet and Wheat Rotation Study, Walsh, 2010.

Crop Rotation	Seeding Density	Seed Cost	Weed Control Cost	Yield	Crop Price	Gross Income	Variable Net Income
	lb/a	$/a	$/a	bu/a	$/a	$/a	$/a
Wheat							
W-F	50	6.67	12.37	37.2	6.50	241.67	222.63
W-W	50	6.67	12.37	41.0	6.50	266.50	247.46
W-M-F	50	6.67	12.37	29.2	6.50	189.80	170.76
M/W-F	50	6.67	12.37	41.6	6.50	270.40	251.36
W/M-F	50	6.67	20.54	33.1	6.50	215.15	187.94
	50	6.67	12.37	41.0	6.50	266.50	247.46
Millet							
M-M	18	2.09	8.28	19.2	4.75	91.08	80.71
W-M-F	18	2.09	8.28	21.9	4.75	104.03	93.66
M/W-F	18	2.09	8.28	27.7	4.75	131.58	121.21
W/M-F	18	2.09	8.28	19.5	4.75	92.63	82.26
	18	2.09	20.64	7.6	4.75	36.10	13.37
Fallow	---	---	23.30	---	---	0.00	-23.30
Average			13.29			158.79	141.29

Planted: Millet, Huntsman at 18 lb/a on June 17; Wheat, Hatcher at 50 lb/a on October 5, 2009.
Harvested: Millet on September 22, 2010; Wheat on July 1, 2010.
Wheat herbicides: Express 0.33 oz/a, 2,4-D, 0.38 lb/a; Wheat hericide cost: $6.87/a.
Millet herbicides: Banvel 4 oz/a, 2,4-D amine 10 oz/a: Millet herbicide cost: $2.78/a
Fallow herbicides: Gylstar Plus 24 oz/a, 2,4-D 0.5 lb/a, Banvel 4 oz/a;
Fallow herbicide cost: $12.30/a (two application, $6.15/a per application)
Wheat in M/W-F additional herbicide: Glystar 24 oz/a cost $2.67/a.
Millet in W/M-F herbicides: Glystar 24 oz/a, Atrazine 0.75 lb/a; W/M-F herbicide cost: $6.86/a.
Weed control cost is herbicide cost and $5.50/a application cost for each application.

Dryland Millet-Wheat Rotation, Variable Net Income, 2010.

Rotation	-----------2010 Crop----------			2010 Total Crop Net Income	Annual Rotation Variable Net Income
	Wheat	Millet	Fallow		
	-------------------------$/a----------------------------				
W-F	247.46		-23.30	224.16	112.08
W-W	170.76			170.76	170.76
W-M-F	251.36	121.21	-23.30	349.27	116.42
M/W-F	187.94	82.26	-23.30	246.90	123.45
W/M-F	247.46	13.37	-23.30	237.53	118.77
M-M		93.66		93.66	93.66
Average	221.00	77.63	-23.30	220.38	122.52

Variable Net Income is gross income minus seed cost and weed control cost.

Millet-Wheat Rotation, Annual Rotation Income, 2007 to 2010.

Rotation	Annual Rotation Variable Net Income 2007	2009	2010	2007-2010 Total Crop Net Income	Average Annual Rotation Variable Net Income
	---$/a---				
W-F	108.22	52.13	112.08	272.43	90.81
W-W	193.14	105.30	170.76	469.20	156.40
W-M-F	95.53	72.66	116.42	284.60	94.87
M/W-F	141.03	32.87	123.45	297.35	99.12
W/M-F	95.36	38.57	118.77	252.70	84.23
M-M	102.97	73.83	93.66	270.46	90.15
Average	89.65	43.82	87.12	220.60	73.53

No crops were harvested in 2008 because of drought.
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.

Table .-Dryland Millet and Wheat Rotations, Third Year, Walsh, 2010.

Rotation	Millet Test Weight	Millet Yield	Wheat Test Weight	Wheat Yield	2010 Total Prod.	2009 Total Prod.	2007 Total Prod.	3-Year Total Prod.	Projected 6-Year Rotation Production
	lb/bu	lb/a	lb/bu	lb/a	lb/a	lb/a	lb/a	lb/a	lb/a
W-F			57	2460	2460	1980	2640	7080	3540
W-W			56	1752	1752	1608	2190	5550	5550
M-M	56	1226			1226	1212	1478	3916	3916
W-M-F	55	1551	57	2496	4047	3785	3813	11645	7802
M/W-F	55	1092	58	1986	3078	1920	3850	8848	8848
W/M-F	57	426	58	2460	2886	1842	2532	7260	7260
Average	56	1074	57	2231	2575	2058	2751	7383	6153
LSD 0.20		261.5		105.6					

Rotations: W, wheat; M, millet; F, fallow. M/W-F, wheat planted same year as millet was harvested; W/M-F, millet planted same year as wheat was harvested.
Planted: Wheat, Hatcher at 50 lb/a on October 5, 2009.
Harvested: Wheat on July 1, 2010.
Planted: Millet, Huntsman at 18 lb/a on June 17, 2010.
Harvested: Millet on September 22, 2010.
There were no crops harvested in 2008 because of drought.
Yields were adjusted to 12.0% seed moisture for both wheat and millet.

Seedrow P Rates on Dryland Proso Millet at Walsh, 2010

Kevin Larson

Grain sorghum and proso millet are the two crops that consistently produce high yields and incomes in our dryland crop rotation studies. Of these two crops, proso millet is not as intensively researched and grown in our area. Proso millet is reported to be a low input crop. So when Linly and Lane Stum told me that they noticed a large yield increase with applied P, I decided to conduct a seedrow P rate study to investigate their report.

Materials and Methods

Into no-till wheat stubble, we seedrow applied 0, 10, 20, 30, and 40 lb/a of P_2O_5 as 10-34-0 with a squeeze pump equipped drill set on 12 in. row spacing. We planted the proso millet cultivar Huntsman at 15 lb seed/a on June 14, 2010. Our treatment plots consisted of two 5 ft. beds, 400 ft. long with two replications. The entire site received 50 lb/a of N as 32-0-0 before planting. For preplant weed control, we applied Glystar Plus 24 oz/a, Banvel 4.0 oz/a, and 2,4-D ester 0.5 lb/a. For post emergence weed control, we applied Banvel 4.0 oz/a and 2,4-D amine 10 oz/a. On September 20, 2010, we harvested the proso millet with a self-propelled combine, weighed the grain with a digital scale, and took samples for test weight and moisture. Seed yields were adjusted to 13% seed moisture content.

Results and Discussion

Proso millet yield did not respond to higher seedrow P rates. In fact, there was a slight, nonsignificant trend of decreasing yield with increasing seedrow P rates. The 0 P seedrow rate produced the highest yield of 2478 lb/a. However, test weights improved by 0.5 lb/bu for the 10 lb P_2O_5/a rate and 1.0 lb/bu for the 20, 30, and 40 lb P_2O_5/a rates compared to the 0 P seedrow rate. The results of this study suggest that proso millet yields do not increase with applied P. Nonetheless, there may be a seed quality improvement (higher test weights) with seedrow applied P on proso millet.

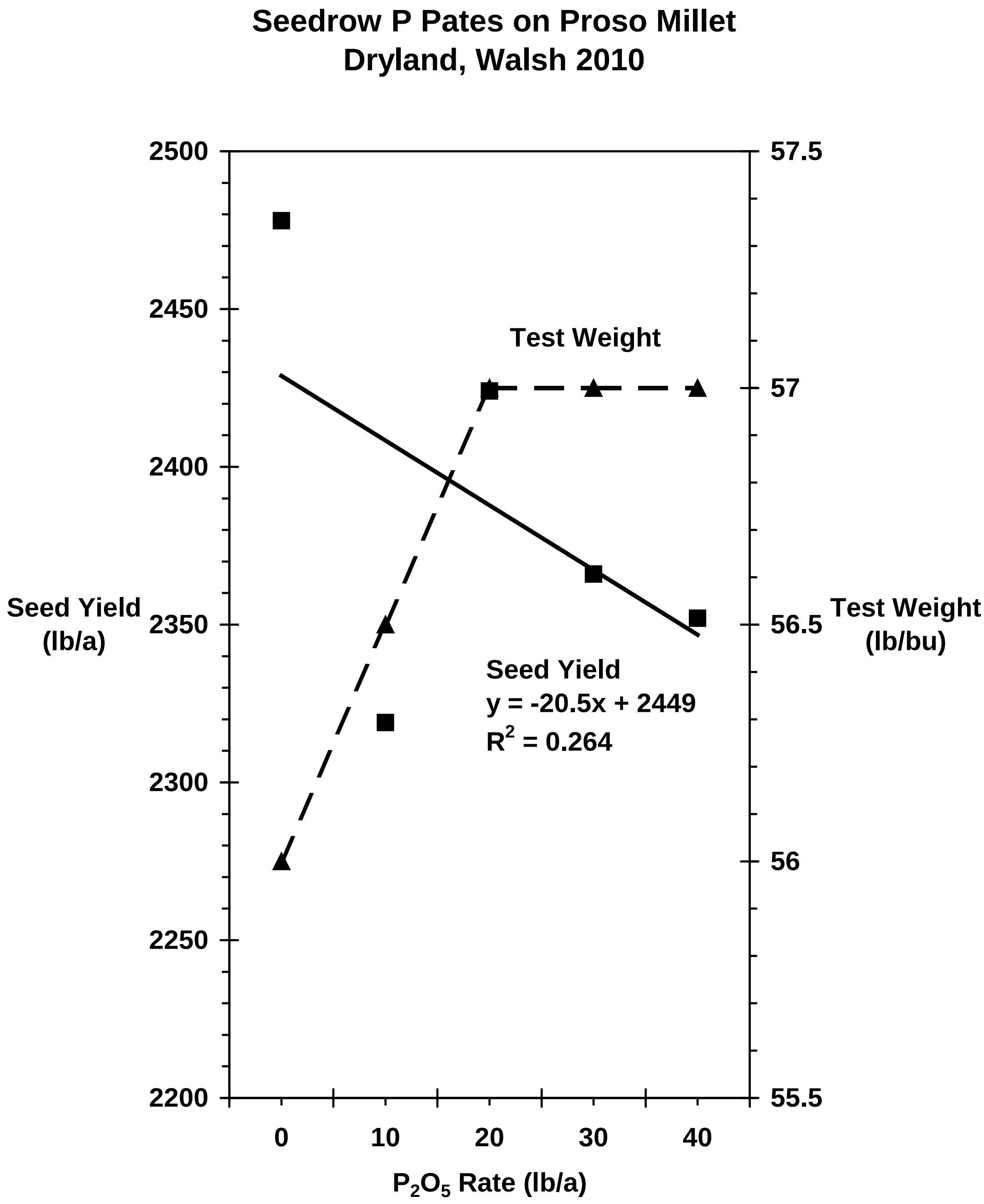

Fig. .Seedrow P rates on dryland proso millet at Walsh. Seedrow P_2O_5 rates were 0, 10, 20, 30, and 40 lb/a, applied as 10-34-0. The variety was Huntsman planted at 15 lb/a on June 14, 2010.

Second Annual Report (2010) for Sun Grant Initiative South Central Region

Expanding Production Area and Alternative Energy Crop Market of Proso Millet for Water Deficient Lands

Kevin Larson, Rick Kochenower, and Jeffrey Tranel

Proso millet is a low water-use, low input crop. It is an ideal crop for water deficient lands, such as contract-expired CRP lands. Expanding the production area of proso millet will require development of a new end-use market. Currently, proso millet is used almost exclusively for birdseed. The birdseed market is limited and expansion is improbable. The feed grain market with recent exponential growth is ethanol. Most ethanol production in the United States is from corn. If proso millet replaces some of the corn as an ethanol feedstock, expansion of proso millet production would occur. The purpose of this study is two-fold: 1) to determine if proso millet is viable crop outside of its traditional production area and 2) to determine if proso millet is a viable ethanol crop. If our objectives for proso millet are successful, production area expansion (into new dryland areas) and market expansion (as a new ethanol feedstock) will be realized.

Material and Methods for 2009

We planted proso millet at two sites, the Plainsman Research Center at Walsh, Colorado and the Oklahoma Panhandle Research and Extension Center at Goodwell, Oklahoma. We planted four proso millet cultivars at four incremental planting dates throughout July 2009. Three of the cultivars were standard starch cultivars: Huntsman, Sunrise, and Horizon. The fourth cultivar was a waxy starch cultivar, Plateau. The four planting dates at Walsh were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31, 2009. The four planting dates at Goodwell were: PD1, July 7; PD2, July 14; PD3, July 21; and PD4, July 28, 2009. The experimental designs were split-plots with planting dates as the main plot and cultivars as the subplots with four replications. The plot size at Walsh was 10 ft. by 50 ft. (harvested 10 ft. by 44 ft.). The plot size at Goodwell was 5 ft. by 35 ft. (harvested 5 ft. by 30 ft.). Both sites were irrigated to assure seed germination. All cultivars and planting dates were seeded at 15 lb/a. Nitrogen was the only fertilizer applied, 50 lb/a at Walsh and 100 lb/a at Goodwell. For weed control at Walsh, the entire site had a preplant application of glyphosate 24 oz/a and 2,4-D ester 0.5 lb/a, and a post emergence application of dicamba 4 oz/a and 2,4-D amine 0.38 lb/a. For weed control at Goodwell, the entire site had a preplant application of atrazine 1.0 lb/a, and no post emergence herbicides were applied. Both sites were harvested with a self-propelled combines equipped with conventional grain heads. For both sites at harvest, we recorded grain yield, test weight, and seed moisture. The harvest dates at Walsh were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17. The harvest dates at Goodwell were: PD1, September 14 and PD3 October 19. At Goodwell, the July 14 planting date (PD2) did not establish an adequate stand and was eliminated from the study, and the July 28 planting date (PD4) was not harvested because of excessive rainfall.

To determine ethanol production, grain samples (7 lb of cleaned seed) were milled three times with a grain mill set at 0.008 in. The milled grain was diluted with water (20 gal/bu). The mash was boiled and alpha amylase was added to liquefy it. The mash was cooled and alpha amylase was again added to breakdown the starches into dextrins. The mash was further cooled and gluco amylase was added to convert the dextrins into sugars. The temperature of the mash was further lowered, yeast was added, and the mash was allowed to ferment for five days in an airlocked container. After fermentation was completed, the beer in the mash was pressed out with a fruit press. To extract the remaining beer, water was added and the dilute beer was pressed (this step was repeated twice). The remaining wet distillers grain was oven dried. The alcohol in the beer was distilled with a stainless steel still with a refractation column.

Material and Methods for 2010

All cultural practices in 2010 were similar to the cultural practices we used in 2009, except we planted the proso millet cultivars at four monthly planting dates from May to August. The four planting dates at Walsh were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2, 2010. The four planting dates at Goodwell were in early May, June, July, and the August planting date was not planted due to bird damage in the previous planting dates. The Goodwell site was not harvested because of severe bird damage. Grain yield, test weight, seed moisture, plant height, and seed shattering measurements were recorded at harvest for Walsh. The harvest dates at Walsh were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.

Results for 2009

The first planting dates at both sites produced the highest average grain yield, 1645 lb/a at Walsh and 1450 lb/a at Goodwell (Tables 1 and 2). The planting date ranking for grain yield at Walsh was: PD1>>PD2>PD3=PD4 (Table 3). The planting date ranking at Goodwell was PD1>PD3 (Table 4). Huntsman produced the highest yield at all harvested planting dates at both sites, although Huntsman was not significantly different than Sunrise at Walsh, and Huntsman only significantly out yielded Plateau at Goodwell. Grain yield ranking of the four cultivars was consistent for all four planting dates at Walsh: Huntsman=Sunrise>Horizon>Plateau (Table 3 and Figure 1). The relative ranking of the four cultivars for the two harvested planting dates at Goodwell was: Huntsman>Sunrise=Horizon>Plateau, although the only significant difference was between Huntsman and Plateau (Table 4 and Figure 3).

At both sites, the first planting date produced the highest ethanol production, 59.5 gal/a for Walsh and 50.0 gal/a for Goodwell (Tables 3 and 4). The ethanol production rankings for the planting dates were: PD1>>PD2>PD3=PD4 at Walsh, and PD1>PD3 at Goodwell. These planting date ethanol production rankings have the same order and magnitude as the grain yield rankings. At both sites, Huntsman had the highest ethanol production at each planting date (Tables 1 and 2) and highest overall production, 36.6 gal/a for Walsh and 56.8 gal/a for Goodwell. Plateau produced the highest per bushel ethanol yield for each planting date at Walsh. Horizon had the highest overall ethanol yield at Goodwell with 1.98 gal/bu, and Plateau had the highest overall ethanol yield at Walsh with 2.11 gal/bu.

Test weights significantly decreased with later planting dates at Walsh (Table 3 and Figure 2), but increased, although not significantly, between the two harvested planting dates (PD1 and PD3) at Goodwell (Table 4 and Figure 3). Huntsman had the highest overall test weight at both sites, 56.9 lb/bu at Goodwell and 54.6 lb/bu at Walsh.

Plant height consistently decreased with later planting dates at Walsh (Table 1). The plant height ranking from tallest to shortest was: Huntsman, Sunrise, Horizon, and Plateau.

At Walsh, date to 50% heading averaged 33 days after planting (DAP) for all planting dates and cultivars (Table 1). With later planting dates, date of 50% heading became increasingly earlier for all cultivars, except Plateau. Plateau was the earliest maturing cultivar tested and its date to 50% heading remained at 30 to 31 DAP for the first three planting dates then dropped to 29 DAP at the last planting date. Date to 80% maturity, when the crop was ready for swathing, averaged 61 DAP for all planting dates and cultivars. Like heading, date to 80% maturity was earlier with later planting dates for all cultivars, except Plateau. Date of maturity of Plateau remained 58 to 59 DAP for all four planting dates.

Results for 2010

All the yield results for 2010 are from the Walsh site only, because the Goodwell site was lost to bird damage. At Walsh, the June planting date had the highest grain yield of 1891 lb/a, but it was not significantly higher than the July planting date with 1783 lb/a (Table 6 and Fig. 4). The May and June plantings dates were significantly higher than the July planting date, and the July planting date was significantly higher than the August planting date. The grain yield ranking for the planting dates was PD2=PD1>>PD3>>PD4. Huntsman had the single highest yield of 2170 lb/a with the June planting date, although it was not significantly different from Sunrise, which had the second highest yield of 2045 lb/a with the May planting date (Table 5). Huntsman and Sunrise produced significantly higher yield than Plateau and Horizon. The yield ranking for the cultivars was Huntsman=Sunrise>Plateau=Horizon.

The average test weight for the July planting was significantly higher than May and August planting dates, but it was not significantly higher than the June planting date (Table 6 and Fig. 5). The test weight ranking for the planting dates was PD3=PD2>PD4>PD1. Test weight for PD4 was based solely on Huntsman because there was insufficient plot yield from the other three cultivars for test weight measurements. The highest test weight of 56.4 lb/bu occurred with Huntsman at the July planting date, and the lowest test weight was 50.9 lb/bu with Plateau at the May planting date (Table 5). Huntsman had the highest test weight, 55.7 lb/bu. The test weight of Huntsman was significantly higher than Sunrise and Horizon, which were significantly higher than Plateau. The test weight ranking for the cultivars was Huntsman>Sunrise=Horizon>Plateau.

Plant height remained relatively constant at about 25 in. for the first three planting date, but it was only half as high for the last planting date (Table 5). Huntsman was the tallest cultivar; it was an inch taller than the second tallest cultivar, Sunrise, in three of the four planting dates.

It took an average of 5 to 8 days longer for the cultivars planted in May to reach 50% heading and 80% maturity than the other three planting dates (Table 5). The cultivars in the July planting date had the fewest days to heading and maturity. Huntsman required an average of an extra day more than Sunrise to reach 50% heading and 80% maturity.

We have not yet performed the fermentations and distillations on the 2010 crop needed for ethanol analyses. Ethanol analysis for the 2010 crop will be conducted later this winter. For later reports, we will include ethanol yield and ethanol production after we perform the necessary fermentations and distillations.

Discussion

In 2009, we evaluated only July planting dates for proso millet production. The first planting dates (July 1 for Walsh and July 7 for Goodwell) produced the highest grain yield and ethanol production (Tables 3 and 4). There was a significant yield decrease between the July 1 and July 10 planting dates at Walsh (990 lb/a yield drop), and the yield difference between the two harvested planting dates (July 7 and July 21) at Goodwell of 267 lb/a was also significant. This suggests that, when planting in July, early July planting is critical for high yields at Walsh and Goodwell, but with the small yield decrease, the planting window maybe longer at Goodwell. Highest ethanol production corresponded with highest grain yield. Huntsman planted in early July had the highest grain yield and ethanol production at both Walsh and Goodland (Tables 1 and 2). Test weights decreased significantly with later planting dates at Walsh, but they actually increased at Goodwell, although the test weight increase was not significant. Moreover, at Walsh, Plateau consistently had the lowest test weight for all four planting dates; however, Plateau had the highest per bushel ethanol yield. Delayed planting, past early July, did not appear to have the severe yield and test weight penalty at Goodwell as it did at Walsh. Nonetheless, the highest grain yield and ethanol production averages were from the first planting dates at both sites.

The 2010 yield results were only from the Walsh site. Huntsman at the June 3 planting date had the single highest yield of 2170 lb/a (Table 5). The optimum planting date for Huntsman was late May (Fig. 4). We have yet to perform ethanol analysis on grain samples harvested in 2010, but ethanol analysis from 2009 indicates that high ethanol production corresponded with high grain yield. Therefore, Huntsman planted in late May/early June may produce the highest ethanol production. After we identify the optimum ethanol production window for the highest ethanol producing cultivar, we will develop crop enterprise budgets for proso millet as an ethanol crop and compare it to proso millet as a birdseed crop.

Table 1.--Proso Millet: Planting Dates and Cultivars, Walsh, CO, 2009.

Cultivar	Seed Yield	Test Weight	Ethanol Yield	Total Ethanol Production	Plant Height	50% Heading	80% Maturity
	lb/a	lb/bu	gal/bu	gal/a	in	DAP	DAP
PD1 - July 1							
Huntsman	2137	56.5	2.04	77.8	27	39	66
Sunrise	1956	56.3	1.96	68.5	26	38	65
Horizon	1411	56.0	2.03	51.1	24	36	64
Plateau	1076	53.5	2.10	40.4	21	30	58
PD1 Average	**1645**	**55.6**	**2.03**	**59.5**	**25**	**36**	**63**
PD2 - July 10							
Huntsman	981	55.8	2.04	35.7	21	36	63
Sunrise	940	54.5	2.04	34.2	20	35	62
Horizon	490	54.4	2.07	18.1	19	34	61
Plateau	208	54.1	2.10	7.8	16	30	58
PD2 Average	**655**	**54.7**	**2.06**	**24.0**	**19**	**34**	**61**
PD3 - July 20							
Huntsman	429	54.1	2.08	15.9	18	34	62
Sunrise	399	53.9	2.01	14.3	16	34	62
Horizon	139	55.0	2.08	5.2	16	33	61
Plateau	151	53.5	2.18	5.9	13	31	59
PD3 Average	**280**	**54.1**	**2.09**	**10.3**	**16**	**33**	**61**
PD4 - July 31							
Huntsman	365	51.9	2.00	13.0	16	32	59
Sunrise	316	51.5	1.94	10.9	14	32	59
Horizon	229	51.3	2.06	8.4	15	30	58
Plateau	201	50.7	2.07	7.4	12	29	58
PD4 Average	**278**	**51.4**	**2.02**	**10.0**	**14**	**31**	**59**
Average	714	53.9			18	33	61
LSD 0.05	272.1	0.94					

Harvested: PD1, Sept. 29; PD2, Oct. 16; PD3, Oct. 17; PD3, Oct. 17, 2009.
DAP is days after planting.
Seed yields adjusted to 13% seed moisture content.
Ethanol Production is 100% ethanol.

Table 2.-Proso Millet Planting Dates and Cultivars, Seed Yield and Ethanol Yield at Goodwell, OK, 2009.

	-----------PD1 - July 7-----------				-----------PD3 - July 21----------			
Cultivar	Seed Yield	Test Weight	Ethanol Yield	Total Ethanol Prod.	Seed Yield	Test Weight	Ethanol Yield	Total Ethanol Prod.
	lb/a	lb/bu	gal/bu	gal/a	lb/a	lb/bu	gal/bu	gal/a
Huntsman	1686	56.4	1.95	58.7	1558	57.3	1.97	54.8
Sunrise	1498	54.8	1.88	50.3	1065	57.6	2.03	38.6
Horizon	1450	55.4	1.97	51.0	1234	55.5	1.98	43.6
Plateau	1168	52.4	1.91	39.8	873	54.7	1.98	30.9
Mean	1450	54.8	1.93	50.0	1183	56.3	1.99	42.0
LSD 0.05	NS	NS			NS	NS		
CV %	23	3			27	3		

Seed Yield is adjusted to 13.0% seed moisture content.
Ethanol Production is 100% ethanol.

Table 3.--Proso Millet Planting Dates and Cultivar Summary at Walsh, 2009.

	Total Ethanol Production	Seed Yield		Ethanol Yield	Test Weight		Seed Moisture	
	gal/a	lb/a		gal/bu	lb/bu		%	
Planting Date								
PD1 - July 1	59.5	1645	a	2.03	55.6	a	13.0	a
PD2 - July 10	24.0	655	b	2.06	54.7	b	14.4	b
PD3 - July 20	10.3	280	c	2.09	53.9	c	14.7	b
PD4 - July 31	10.0	278	c	2.02	51.3	d	17.0	c
PD LSD 0.05		160.8			0.44		0.35	
Cultivar								
Huntsman	35.6	978	a	2.04	54.6	a	14.8	a
Sunrise	32.0	903	a	1.99	54.0	b	14.8	a
Horizon	20.7	567	b	2.06	53.9	b	14.7	a
Plateau	15.4	409	c	2.11	53.0	c	14.8	a
Cultivar LSD 0.05		135.2			0.49		0.37	
Average	26.0	715		2.05	53.9		14.8	

Seed Yield is adjusted to 13% seed moisture content.
Ethanol is adjusted to 100% alcohol.

Table 4.--Proso Millet Planting Dates and Cultivar Summary at Goodwell, 2009

	Total Ethanol Production	Seed Yield		Ethanol Yield	Test Weight		Seed Moisture	
	gal/a	lb/a		gal/bu	lb/bu		%	
Planting Date								
PD1 - July 7	50.0	1450	a	1.93	54.7	b	13.8	a
PD3 - July 21	42.0	1183	b	1.99	56.3	a	12.9	a
PD LSD 0.05		91.2			2.31		2.33	
Cultivar								
Huntsman	56.8	1622	a	1.96	56.9	a	13.8	a
Sunrise	44.5	1282	ab	1.96	56.3	a	13.5	a
Horizon	47.3	1342	ab	1.98	55.4	ab	13.3	a
Plateau	35.4	1021	b	1.95	53.5	b	12.8	a
Cultivar LSD 0.05		354.0			1.97		1.88	
Average	46.0	1317		1.96	55.5		13.4	

Seed Yield is adjusted to 13% seed moisture content.

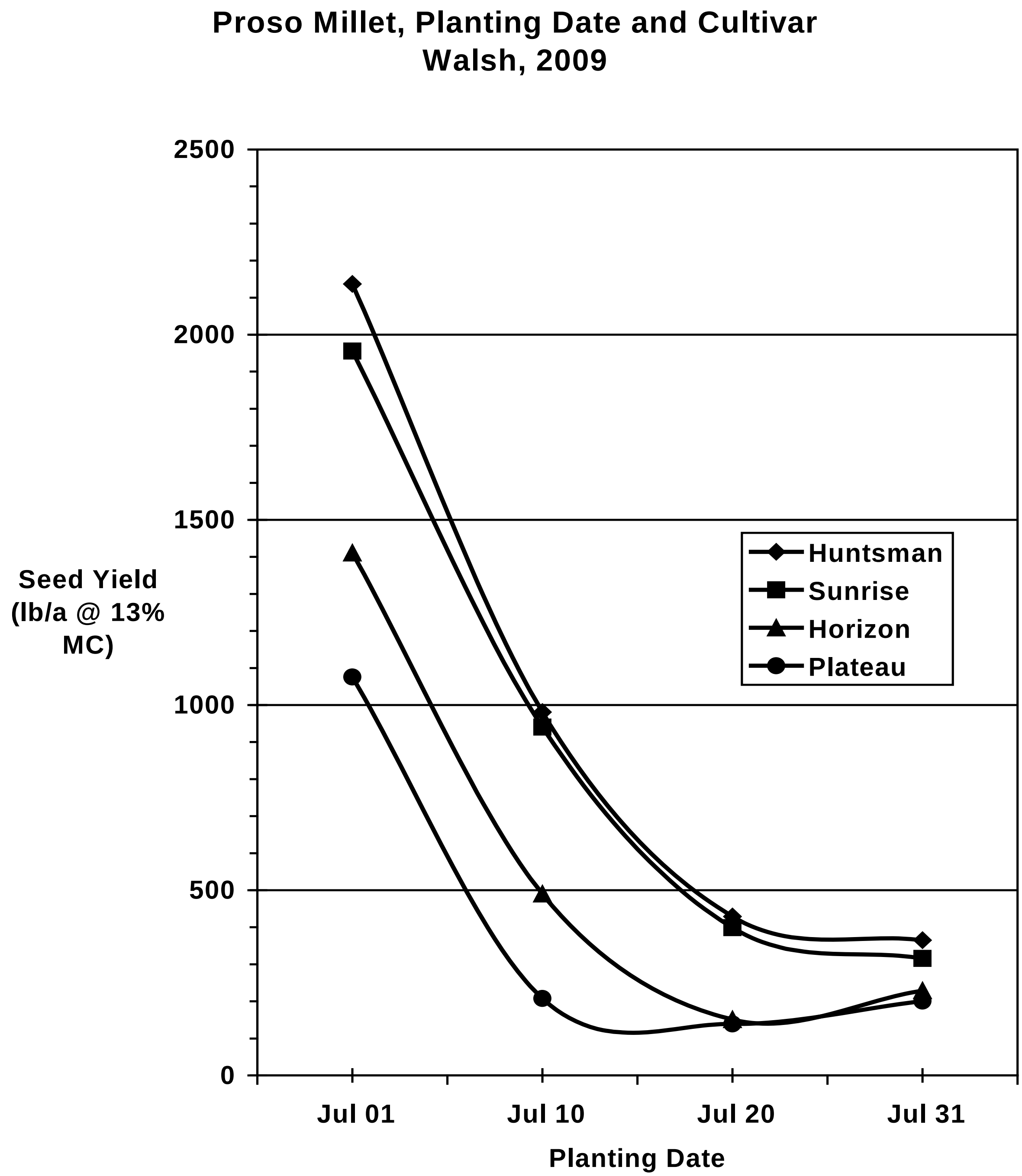

Fig. 1. Seed yield of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2009. The planting dates were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17.

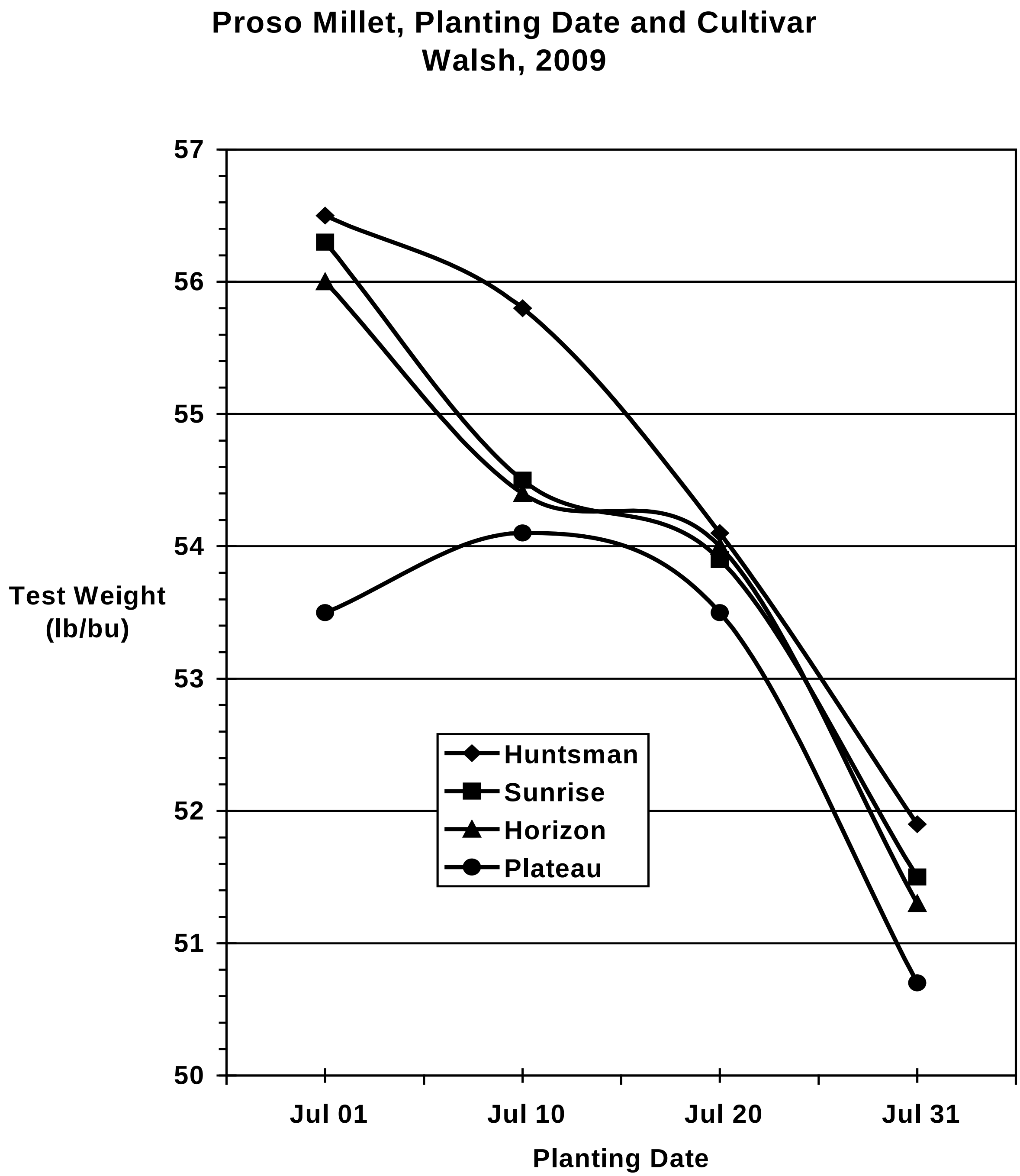

Fig. 2. Test weight of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2009. The planting dates were: PD1, July 1; PD2, July 10; PD3, July 20; and PD4, July 31. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 29; PD2, October 16; PD3 and PD4, October 17.

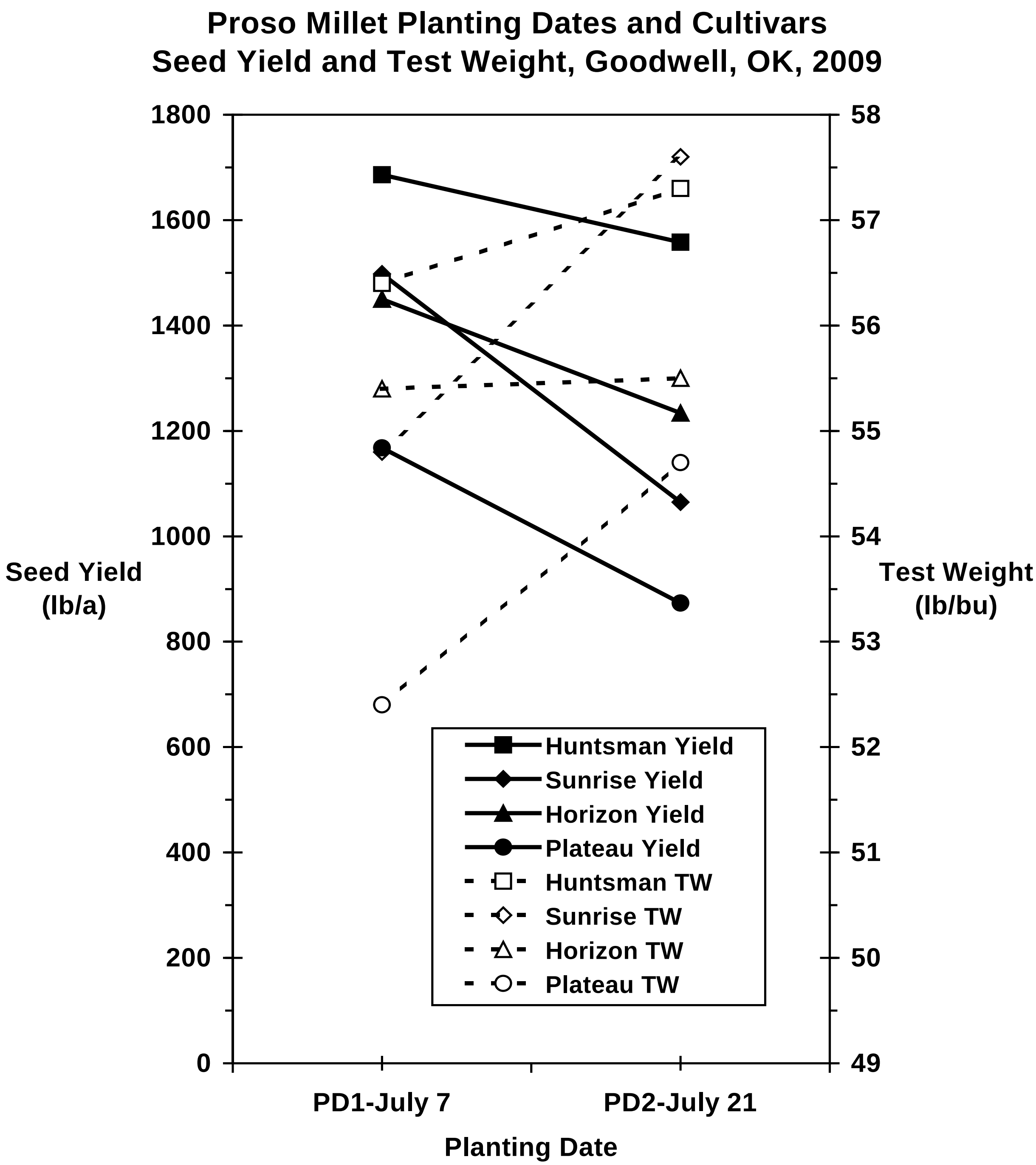

Fig. 3. Seed yield and test weight of proso millet planting dates and cultivars for ethanol production study at Goodwell, OK, 2009. The harvested planting dates were: PD1, July 7; and PD3, July 21, 2009. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, September 14; and PD3, October 19. Seed yield is adjusted to 13.0% seed moisture content.

Table 5.--Proso Millet: Planting Dates and Cultivars, Walsh, CO, 2010.

Cultivar	Seed Yield	Test Weight	Moisture	Shattering	Plant Height	50% Heading	80% Maturity
	lb/a	lb/bu	%	%	in	DAP	DAP
PD1 - May 12							
Huntsman	2101	54.9	14.0	15.0	26	54	87
Sunrise	2045	54.4	13.7	12.5	25	53	86
Horizon	1466	53.7	14.3	12.5	22	51	84
Plateau	1519	50.9	14.4	9.0	22	47	80
PD1 Average	**1783**	**53.5**	**14.1**	**12.3**	**24**	**51**	**84**
PD2 - June 3							
Huntsman	2170	56.0	16.6	5.0	29	47	78
Sunrise	1985	55.1	16.4	3.5	28	46	77
Horizon	1717	55.5	14.9	5.5	25	44	75
Plateau	1692	51.9	14.6	4.0	23	40	73
PD2 Average	**1891**	**54.6**	**15.6**	**4.5**	**26**	**44**	**76**
PD3 - July 2							
Huntsman	1126	56.4	13.6	4.0	26	38	66
Sunrise	1143	55.4	14.0	3.0	25	38	65
Horizon	766	55.1	14.2	1.5	22	36	62
Plateau	926	53.5	13.9	3.0	21	32	62
PD3 Average	**990**	**55.1**	**13.9**	**2.9**	**24**	**36**	**64**
PD4 - Aug. 2							
Huntsman	79	54.3	13.7	0.0	12	49	77
Sunrise	40	--	--	0.0	13	48	76
Horizon	17	--	--	0.0	11	45	76
Plateau	30	--	--	0.0	11	43	75
PD4 Average	**42**	**54.3**	**13.7**	**0.0**	**12**	**46**	**76**
Average	1177	54.4	14.3	4.9	22	44	75
LSD 0.05	221.1	0.86	0.44	2.12			

Harvested: PD1, Aug. 30; PD2, Aug. 30; PD3, Sep. 21; PD4, Nov. 5, 2010.
DAP is days after planting.
Seed yields adjusted to 13% seed moisture content.

Table 6.--Proso Millet Planting Dates and Cultivar Summary at Walsh, 2010.

	Seed Yield		Test Weight		Seed Moisture	
	lb/a		lb/bu		%	
Planting Date						
PD1 - May 12	1783	a	53.5	c	14.1	b
PD2 - June 3	1891	a	54.6	ab	15.6	a
PD3 - July 2	990	b	55.1	a	13.9	bc
PD4 - August 2	42	c	54.3	b	13.7	c
PD LSD 0.05	134.6		0.71		0.37	
Cultivar						
Huntsman	1369	a	55.7	a	14.7	a
Sunrise	1303	a	55.0	b	14.7	a
Horizon	991	b	54.8	b	14.5	ab
Plateau	1042	b	52.1	c	14.3	b
Cultivar LSD 0.05	113.5		0.45		0.23	
Average	1177		54.4		14.3	

Seed Yield is adjusted to 13% seed moisture content.
PD4 test weight and seed moisture of Huntsman only.

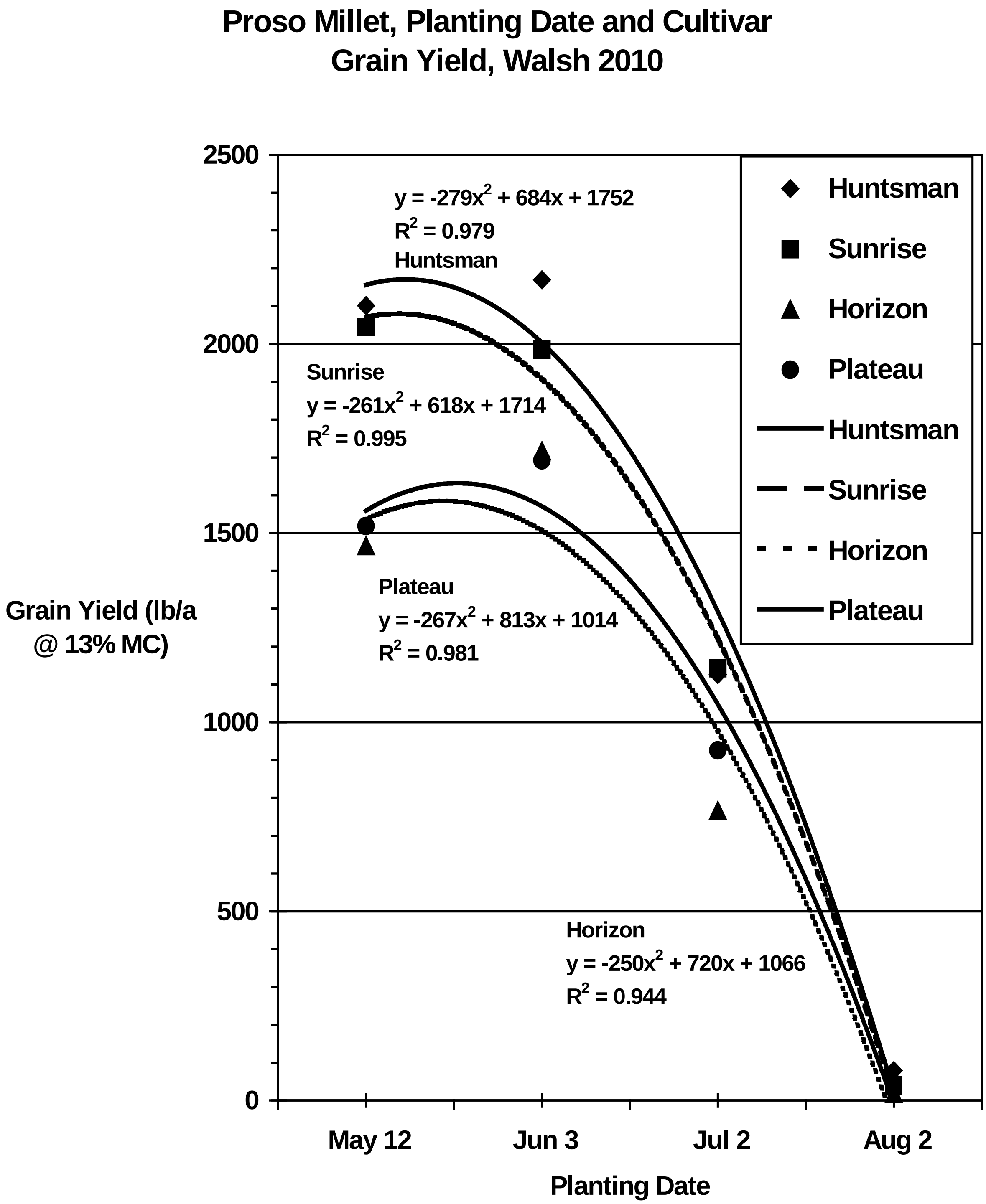

Fig. 4. Seed yield of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2010. The planting dates were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.

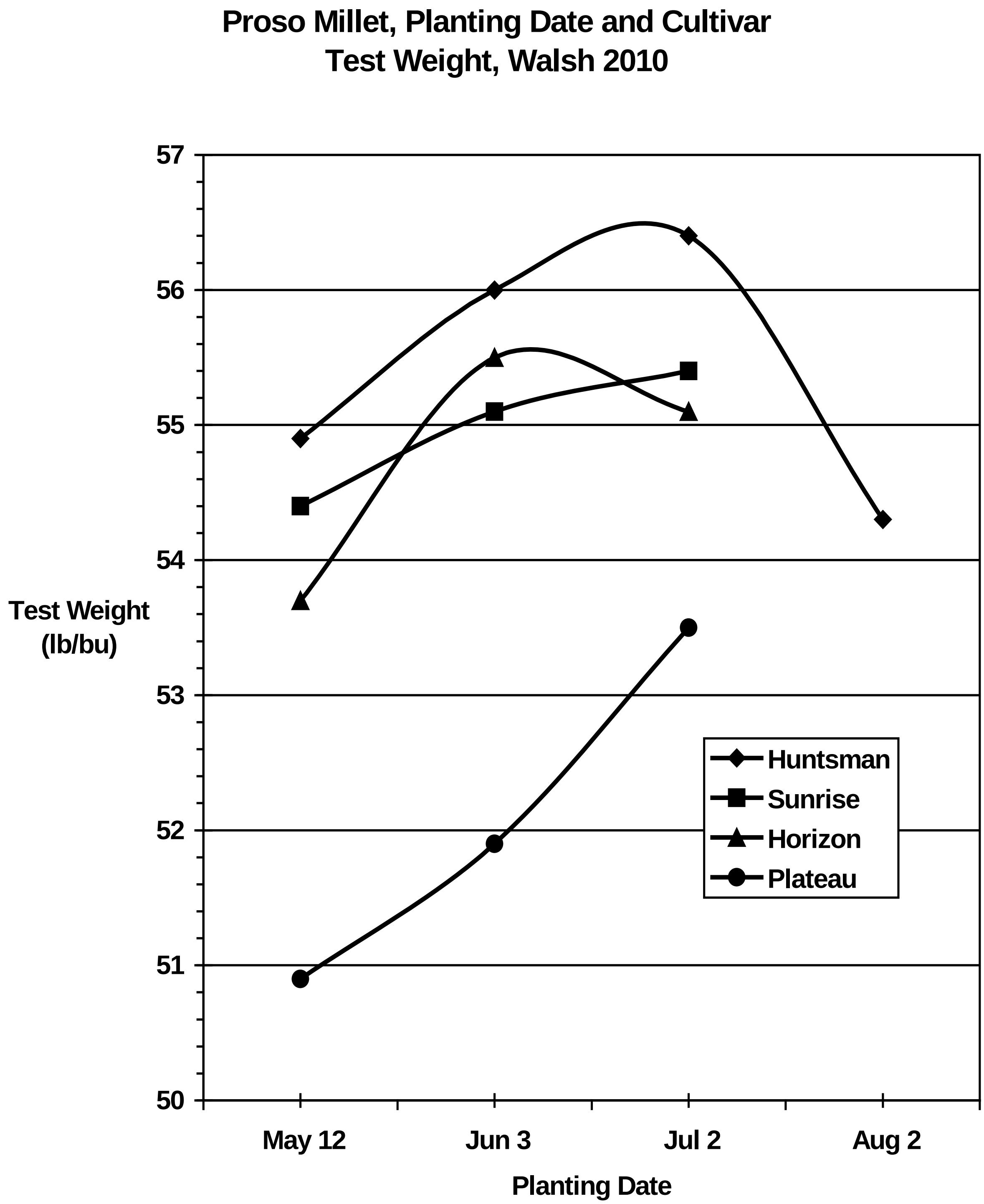

Fig. 5. Test weight of proso millet planting dates and cultivars for ethanol production study at Walsh, CO, 2010. The planting dates were: PD1, May 12; PD2, June 3; PD3, July 2; and PD4, August 2. The cultivars were: Huntsman, Sunrise, Horizon, and Plateau. All planting dates and cultivars were seeded at 15 lb/a. Harvest dates were: PD1, August 30; PD2, August 30; PD3, September 21; and PD4, November 5.

Irrigated Mid and High Oleic Sunflower Hybrid Performance Trial at Walsh, 2010

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

PURPOSE: To identify high yielding hybrids under irrigated conditions with 2900 heat units in a Silty Loam soil.

RESULTS: Of the 8 hybrids tested, Triumph s671 had the highest oil yield of 908 lb/a. For this limited irrigation trial, we applied 13 in./a of water.

PLOT: Four rows with 30" row spacing, at least 600' long. SEEDING DENSITY: 26,000 seeds/a. PLANTED: June 21. HARVESTED: November 9.

IRRIGATION: Subsurface Drip Irrigated: total water applied approximately 13 a-in./a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 24 oz/a, 2,4-D 0.5 lb/a, Spartan 2.0 oz/a, Prowl H2O 40 oz/a. Post Emergence Herbicides: Select 10 oz/a, COC 16 oz/a. CULTIVATION: Once. INSECTICIDES: Warrior (Sunflower Head Moth control).

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------No. of Days--------		
June	0.69	275	5	2	7
July	3.65	856	21	4	38
August	4.09	811	19	2	69
September	1.79	646	14	0	99
October	0.23	321	0	0	126
Total	10.45	2909	59	8	126

\1 Growing season from June 21 (planting) to October 27 (first freeze, 27 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

FIELD HISTORY: Last Crop: Grain Sorghum. FIELD PREPARATION: No-till.

COMMENTS: Planted in good soil moisture. Weed control was good. Above normal precipitation for the growing season with wet July and August. Warrior was applied to control head moth. Seed yields were good and oil content was very good.

SOIL: Silty Clay Loam for 0-8" and Silty Clay Loam 8"-24" depths from soil analysis.

Summary: Soil Analysis from Drip Site.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------------ppm----------------				
0-8"	7.9	0.7	2.4	16	3.7	632	0.4	3.3
8"-24"				17				
Comment	Alka	Vlo	VHi	Hi	Lo	VHi	VLo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization for Drip Site.

Fertilizer	N	P_2O_5	Zn	Fe
	--------------------lb/a------------------			
Recommended	70	0	0	0
Applied	150	20	0	0

Yield Goal: 2500 lb/a.
Actual Yield: 1940 lb/a.

Drip Irrigated Sunflower, Mid and High Oleic Variety Trial, PRC, Walsh, 2010.

Firm	Hybrid	Mid or High Oleic	50% Flower	Plant Density	Plant Ht.	Test Wt.	Oil	Seed Yield	Oil Yield
			date	plants/a (X1000)	in	lb/bu	%	lb/a	lb/a
TRIUMPH	s671	mid	8/18	22.0	39	33	43.5	2088	908
TRIUMPH	s678	mid	8/21	20.0	45	32	42.9	2075	890
MYCOGEN	8N358CL	mid	8/15	16.0	54	33	45.1	1960	884
TRIUMPH	s673	mid	8/20	21.2	37	32	41.8	2094	875
TRIUMPH	s878HO	high	8/20	17.6	43	32	40.6	2081	845
TRIUMPH	s870HCL	high	8/18	18.8	36	31	42.4	1820	772
PIONEER	63N82	mid	8/18	18.4	59	32	39.8	1824	726
MYCOGEN	8H449DM	high	8/15	24.8	56	30	40.5	1574	637
Average			8/18	19.9	46	32	42.1	1940	817
LSD 0.20								222.0	

Planted: June 21; Harvested: November 9, 2010.
Seed Yield adjusted to 10% seed moisture content.
Total water applied was 13 in./a of drip irrigation.

Dry Bean Trial, Row Crop Head and Hand Harvest Comparison, Walsh, 2010

Kevin Larson and Mark Brick

PURPOSE: To test the suitability of dry bean varieties (12 pinto beans) for direct row crop head harvesting.

MATERIALS and METHODS: We planted 12 pinto bean varieties into a site of failed winter canola. For our plot design, we used a RCBD with four replications. We fertilized the site with 50 lb/a of N as 32-0-0. We planted the beans on May 25 at 22,000 seeds/a. To control weeds, we applied Prowl H2O at 40 oz/a, and hand cultivated. We hand harvested 2.5 ft. by 5 ft. areas from two replications on November 16. We machine harvested the remaining 10 ft. by 44 ft. plots using a row crop head on November 19.

RESULTS: The hand harvested averaged 390 lb/a and the machine harvested averaged 28 lb/a. The 362 lb/a difference between machine harvested and hand harvested represents the seed yield left behind by machine harvesting. When machine harvested, there was no significant difference between the highest yielding variety, La Paz, and the next three top yielding varieties, (LSD 0.05). When hand harvested, there were significant yield differences between Montrose, the highest yielding variety, and Stampede, Fisher and the three numbered lines (LSD 0.05). Herbicide drift from 2,4-D caused pod drop and lower pod placement, which reduced the yield potential of the dry beans in this study.

DISCUSSION: This is the fourth edible dry bean trial that we have had at Plainsman since 1993. The renewed interest in dry beans occurred because of high dry bean prices. The reason we tested direct head harvest was to minimize soil loss. Dry beans leave little residue to protect against wind erosion, even before undercutting which leaves soils especially vulnerable. Direct harvesting with a row-crop head leaves a large amount of unharvested seedpods in the field. The large yield difference between the higher-yielding, hand harvested varieties and direct machine harvesting is due the inability of our row crop head to get low enough to harvest short plants and low pod sets caused by 2,4-D damage. We are, however, encouraged by the 736 lb/a hand harvested yield of Montrose under these conditions.

Table .Dryland Dry Bean Trial, Walsh, 2010.

Variety	Bean Type	Hand Harvested Yield	Row Head Harvested Yield
		lb/a	lb/a
Montrose	Pinto	736	25
Bill Z	Pinto	615	25
Grand Mesa	Pinto	542	41
Cahone	Pinto	502	38
CO 46348	Pinto	448	20
Croissant	Pinto	426	35
La Paz	Pinto	378	61
34142	Pinto	333	15
Stampede	Pinto	282	28
CO 24972	Pinto	265	23
Fisher	Pinto	88	10
54150	Pinto	59	10
Average		390	28
LSD 0.05		371.8	32.1

Planted: May 25, 2010 at 22,000 seeds/a
Weed Control: Prowl H2O 40 oz/a and
hand cultivated.
Hand Harvested: November 16, 2.5 ft X 2.5 ft.
Row Head Harvested: November 19, 10 ft X 44 ft

National Winter Canola Variety Performance and Great Plains Trials, Walsh 2010

Kevin Larson, Mike Stamm, and Dennis Thompson

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

Results and Discussion

There was marginal soil moisture at planting, but it rained two days after planting, therefore we did not have to irrigate for seed germination. For our area, it is atypical to have adequate soil moisture for planting winter canola. This is because its small seed requires shallow planting depths and its narrow planting window (late August to mid-September) is frequently too short for sufficient rain to occur. This year we had good germinating moisture from the rain after planting, but we had poor stands because the rain caused the soil to crust. This past winter was dry and cold and all of the varieties and lines had severe winterkill. This scenario of a dry and cold winter resulting in severe canola winterkill has happened a few times in the last decade. To see if we could improve the winter survival of canola, we conducted an irrigation timing study. We believed that adequate soil moisture prior to spring re-growth was one of the keys to winter survival. In this study, we applied either no irrigation, irrigation in the fall, winter, or spring on four winter canola varieties that have a range of tolerance to winterkilling conditions. Our theory was not correct. Winter survival from spring irrigation was no better than the no irrigation treatment. The fall irrigation had significantly better winter survival than all the other treatments; however, it was still too low to justify harvest. Since irrigation timing did not ameliorate winterkilling conditions in canola, we began a new study comparing furrow seeding to flat seeding to see if furrows protect the young plants from winterkill. Hopefully our idea is correct and furrows help canola survive the winter.

Since all of the canola varieties and lines in the National and Great Plains trials had poor stands and severe winterkill damage, there was no harvest and only stand and winter survival notes are recorded in the following tables.

Materials and Methods

We planted 42 winter canola varieties and lines for the National Winter Canola Trial and 36 winter canola varieties and lines for the Great Plains Winter Canola Trial on September 8, 2009. The trial was planted at 5 lb seed/a with a 12 in. row-spaced drill to a depth of 1.5 inches in marginal soil moisture. We stream-applied 50 lb N/a as 32-0-0 on 18 in. spacing. No other fertilizers were applied. For weed control, we applied Treflan 24 oz/a and incorporated the herbicide with a rotary hoe. It rained 1.30 in. two days after planting, which further incorporated the herbicide, but caused the soil to crust. To break the crust and enhance plant stands, we rotary hoed the site. Rotary hoeing helped seedlings emerge, but plant stands were still poor. The canola was not harvested because of poor plant stands and winterkill damage.

Table .--National Winter Canola Variety Trial, Walsh 2010.

Variety (Line)	Stand %	Winter Survival %	Variety (Line)	Stand %	Winter Survival %
ARC2189-2	39	28	BSX-7019	16	25
ARC00005-2	16	13	BSX-7127	32	5
ARC00024-2	25	25	BSX-7228	13	5
ARC99009-1	18	30	BSX-7341	40	18
Baldur	18	7			
Dimension	30	8	Average	24	14
Dynastie	37	30	LSD 0.05	25.9	30.5
Flash	36	17			
HyClass 154W	16	7			
Safran	11	0			
Sitro	30	32			
Visby	30	27			
KS3254	27	7			
KS4158	14	7			
KS4426	19	8			
KS4475	10	2			
Kiowa	5	0			
Sumner	11	7			
Wichita	23	28			
Hybristar	19	7			
Hybrisurf	35	3			
Kadore	24	28			
MH06E4	29	28			
MH06E11	22	0			
MH06E10	32	20			
CHHE96	29	13			
MH905492	32	2			
AAMU-18-07	35	10			
AAMU-33-07	20	17			
Virginia	36	25			
DKW41-10	17	17			
KS4022	15	15			
DKW46-15	30	27			
DKW47-15	11	0			
HyClass110W	35	7			
HyClass115W	36	17			
BSX-501	22	7			
BSX-6271	18	2			

Great Plains Canola Variety Trial, 2010.

Variety (Line)	Stand %	Winter Survival %
KS4033	34	40
KS4401	40	33
KS4475	26	33
KS4493	18	30
Baldor	48	30
KS4429	24	28
KS4442	24	28
KS4482	32	28
KS4489	24	25
KS4313	24	23
KS4486	23	22
KS4404	10	20
KS4443	23	20
KS4478	30	20
KS4391	21	18
KS4417	32	18
KS4499	20	18
KS4083	23	17
KS4423	26	17
KS4490	24	17
KS4031	30	15
KS4497	17	15
KS4280	19	13
Wichita	28	13
KS4488	27	12
KS4138	15	8
KS4424	31	8
KS4496	31	8
Virginia	24	8
KS4191	30	5
KS4425	23	5
KS4428	28	5
KS4480	15	5
KS4323	15	3
KS3R13BC	25	3
KSR09BC	11	0
Average	25	17
LSD 0.20	20.8	27.5

Soil Moisture and Winter Survival of Winter Canola

Kevin Larson and Dennis Thompson

In the 2008-2009 season, the winter canola regional nursery and national variety performance trials at Walsh, Colorado completely winterkilled. This was the second time in the last four years that none of the 57 varieties/lines in the national variety performance trial survived the winter. Both of these winterkill years occurred despite receiving pre-irrigation for stand establishment; however, the fall and winter seasons were very dry. We believe that there may be a correlation between soil moisture and winter survival of winter canola. To research this winter survival issue, we conducted a study that compared winter survival of winter canola varieties 1) without irrigation, 2) irrigated in the fall, 3) irrigated in the winter, and 4) irrigated in the spring. We tested four canola varieties with a range of winter survival levels to strengthen the results of this study.

Materials and Methods

We planted four winter canola varieties, Flash, Sitro, Virginia, and Kiowa, which represented a range of winter survival, on September 9, 2009 in 10 ft. by 50 ft plots with four replications. The trial was planted at 5 lb seed/a with a 12 in. row-spaced drill to a depth of 1.5 inches in marginal soil moisture. We fertilized the site with 60 lb N/a by surface banding 32-0-0. No other fertilizers were applied. The soil test results were: N, 25 ppm (two feet depth composite); P, 1.2 ppm; and K, 523 ppm. For weed control, we applied Treflan 24 oz/a and incorporated the herbicide with a rotary hoe. We furrow irrigated the site on 5 ft. beds until the moisture soaked across the beds. We applied 6 to 8 in/a of water for each of the irrigation treatments: fall irrigation on November 17,2009, winter irrigation on January 11, 2010, and spring irrigation on March 10, 2010. We also included a no irrigation check. We recorded plant stand, winter survival, and soil moisture. Soil moisture measurements were performed with gypsum blocks at 6 in, 18 in., 30 in., and 42 in. soil depths. The study was not harvested because poor plant stands and winterkill problems left too few plants to harvest.

Results and Discussion

All four winter canola varieties had low plant stands, ranging from 14.4% to 35.9% of solid stands. The plant stands of Sitro and Flash were significantly higher than Virginia and Kiowa. One of the reasons that the plant stands were so low was due to soil crusting from rainfall two days after planting. We rotary hoed the site to alleviate crusting, but seeding emergence was still low. The plant stand for the no irrigation treatment was significantly lower than the plant stands for the winter irrigation and spring irrigation treatments. This is surprising since plant stands were recorded before irrigation treatments were applied.

There was no difference in winter survival between the four winter canola varieties. The range in winter survival for the varieties was very low, only 9.7% to 20.0% of the plants survived. We expected a wide range in winter survival for the varieties, since we planted varieties that in the past had shown varying degrees of winter survival; however, under the conditions of our study, winter survival was uniformly low. There was a significant difference in winter survival between the fall irrigation treatment and all the other irrigation-timing treatments. Nonetheless, the fall irrigation treatment, which had the highest winter survival, still had only 29.7% of its plants survive the winter. Moisture measurements showed that fall irrigation timing kept the soil profile full from mid-November (irrigation) to the end of April (study termination). Fall irrigation timing improved soil moisture and winter survival of winter canola compared to no irrigation. However, the winter survival improvement with fall irrigation timing was still too low to justify crop harvest.

Table .--Irrigation Timing to Improve Canola Winter Survival, Stand and Winter Survival, Walsh 2010.

Treatment	Stand		Winter Survival	
	%		%	
Variety				
Flash	35.9	a	17.5	a
Sitro	36.5	a	20.0	a
Virginia	22.7	b	16.6	a
Kiowa	14.4	b	9.7	a
Varietal Average	27.4		16.0	
Varietal Stand LSD 0.05	12.80			
Varietal Winter Survival LSD 0.05			12.70	
Irrigation Timing				
No Irrigation	19.1	b	7.2	b
Fall Irrigation	24.8	ab	29.7	a
Winter Irrigation	33.4	a	15.0	b
Spring Irrigation	32.1	a	11.9	b
Irrigation Average	27.4		16.0	
Irrigation Stand LSD 0.05	10.73			
Irrigation Winter Survival LSD 0.05			12.39	

Means followed by the same letter are not significantly different at the 5% alpha level.
Irrigation Timing: Fall, November 17, 2009; Winter, January 11, 2010; Spring, March 10, 2010.

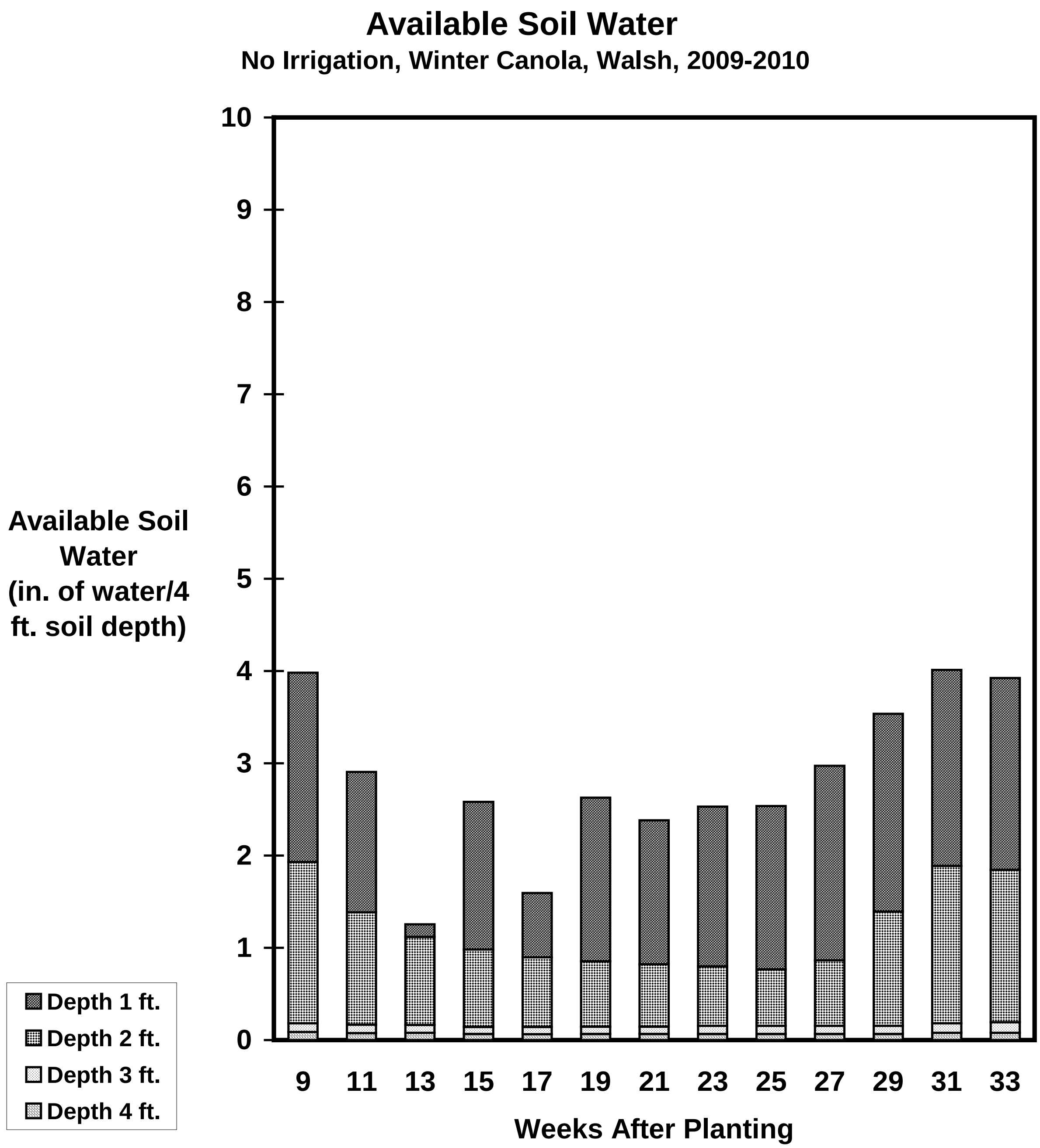

Fig.   . Available soil water in the no irrigation treatment at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total moisture at Walsh from September 9, 2009 (planting) to April 30, 2010 (study termination) was 12.20 in. Any increase in available soil water between weeks not attributed to applied irrigation is from snow and rain.

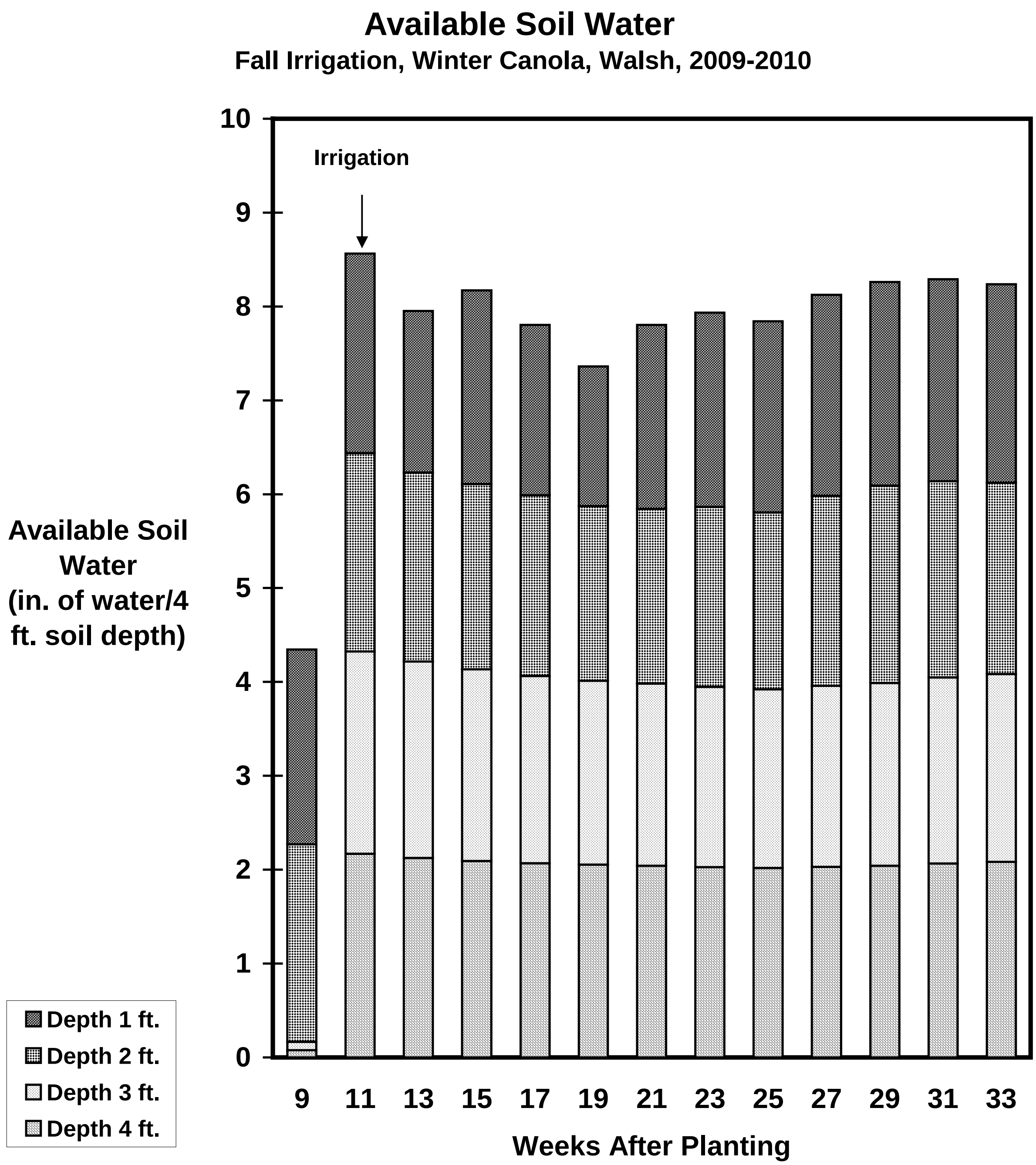

Fig. . Available soil water in the fall irrigation treatment at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total moisture at Walsh from September 9, 2009 (planting) to April 30, 2010 (study termination) was 12.20 in. Any increase in available soil water between weeks not attributed to applied irrigation is from snow and rain.

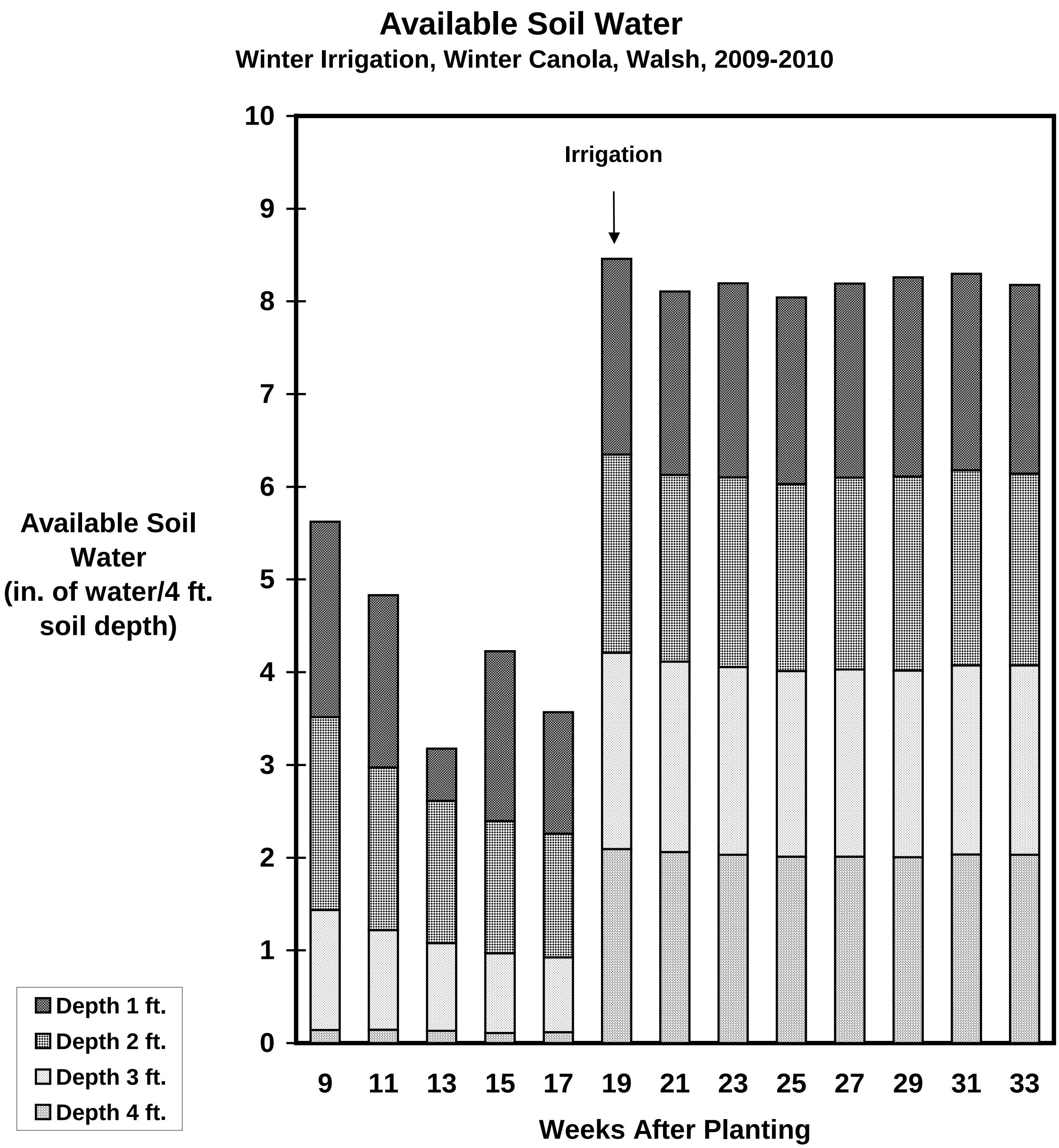

Fig. . Available soil water in the winter irrigation treatment at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total moisture at Walsh from September 9, 2009 (planting) to April 30, 2010 (study termination) was 12.20 in. Any increase in available soil water between weeks not attributed to applied irrigation is from snow and rain.

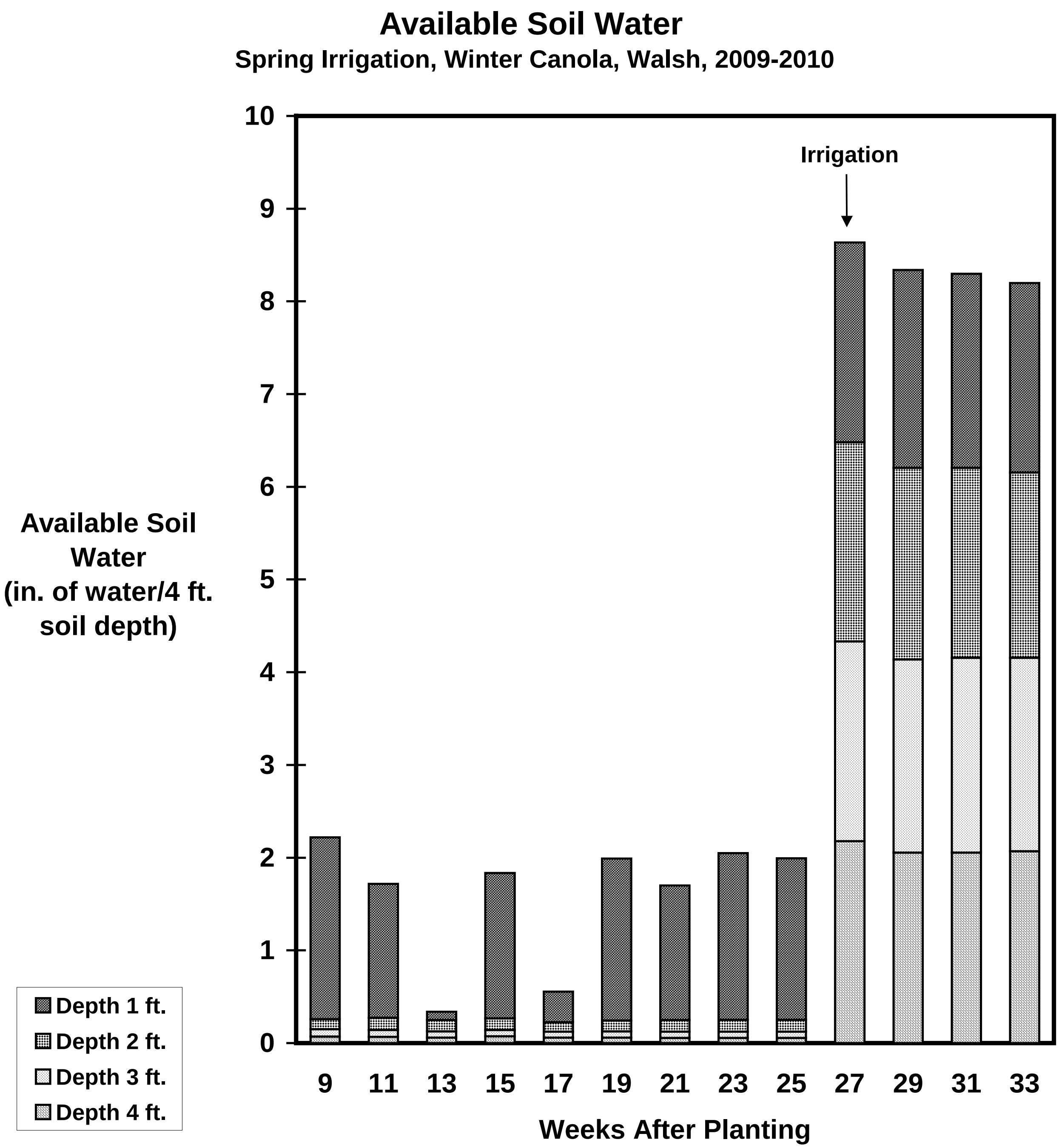

Fig. . Available soil water in the spring irrigation treatment at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total moisture at Walsh from September 9, 2009 (planting) to April 30, 2010 (study termination) was 12.20 in. Any increase in available soil water between weeks not attributed to applied irrigation is from snow and rain.