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Agricultural Experiment Station

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

Plainsman Research Center 2008 Research Reports

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2008 Climatological Summary
Plainsman Research Center

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.	70	-5	43.2	16.8	30.0	0.21	0.08	2.75	1.25	
Feb.	69	4	49.8	19.7	34.8	0.23	0.16	1.75	1.00	
Mar.	81	16	57.9	28.3	43.1	0.53	0.44	1.50	1.50	
Apr.	90	25	66.8	33.2	50.0	0.48	0.14			5.91
May	92	28	79.7	45.2	62.5	0.71	0.51			13.87
Jun.	105	43	91.2	55.6	73.4	1.02	0.54			14.32
Jul.	102	50	94.2	63.2	78.7	1.65	0.57			15.10
Aug.	105	56	86.2	61.2	73.7	7.03	1.51			5.58
Sept.	88	41	77.9	51.7	64.8	0.83	0.52			7.91
Oct.	86	22	70.3	39.1	54.6	2.75	0.95			1.70
Nov.	80	18	59.7	30.4	45.0	0.14	0.12			
Dec.	70	-1	46.5	18.3	32.4	0.13	0.12	1.00	1.00	
Total Annual			**68.62**	**38.56**	**53.58**	**15.71**		**7.00**		

*** 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.

	2008	2007
Highest Temperature:	105 degrees on Jun. 3, Aug. 2	103 degrees on Aug. 21
Lowest Temperature:	-5 degrees on Jan 1	-7 degrees on Jan 15, Feb. 15
Last freeze in spring:	28 degrees on May 11	32 degrees on Apr. 26
First freeze in fall:	22 degrees on Oct. 24	31 degrees on Oct. 19
2008 frost free season	166 frost free days	176 frost free days
Avg. for 25 years:	Avg for 24 years 19.65 inches	Avg for 24 years 19.82 inches

Maximum Wind:

Jan.	38 mph on 29tht	July.	40 mph on 29th
Feb.	45 mph on 26th	Aug.	42 mph on 13th
Mar.	41 mph on 3rd	Sept.	44 mph on 19th
Apr.	43 mph on 24th	Oct.	46 mph on 24th
May	50 mph on 3rd,23rd	Nov.	46 mph on 15th
Jun.	42 mph on 8th,12th	Dec.	62 mph on 23rd
			54 mph on 22nd
			50 mph on 1st

2008 Colorado Winter Wheat Variety Performance Trial Results

Jerry Johnson, CSU Crop Testing Program Leader
Scott Haley, Wheat Breeder, CSU

The following four tables were taken from the Colorado Variety Performance Database (CSU Wheat Breeding Program) at http://wheat.colostate.edu/vpt.html. Because of dry weather, the only dryland site in Southeastern Colorado with reportable results was the Arapahoe site in Cheyenne County.

Other websites of interest are the CSU Crops Testing website for all Colorado crop performance results at http://www.csucrops.com and the Colorado Wheat Administrative Committee, CAWG, and CWRF website at http://www.coloradowheat.org.

Table .-Irrigated Wheat Variety Trial, Rocky Ford, CO, 2008.

Variety	Grain Yield bu/a	Grain Yield Test Average %	Test Weight lb/bu	Test Weight Test Average %
CO03W239	99.5	117	58.0	98
CO04575	96.7	114	61.3	103
NuDakota	96.6	114	58.7	99
Prairie Red	93.8	110	60.2	101
TAM 111	91.9	108	60.5	102
Jagalene	90.3	106	60.4	102
CO04W210	89.7	105	58.9	99
CO03W054	89.4	105	59.0	99
CO04551	89.1	105	59.1	100
CO04499	89.1	105	60.6	102
CO04549	88.9	104	60.4	102
Keota	88.6	104	60.2	102
Bond CL	88.2	104	58.5	99
TAM 112	88.0	103	61.2	103
Hatcher	87.7	103	59.7	101
CO04448	85.4	100	59.3	100
Aspen	85.0	100	59.6	100
Bill Brown	84.3	99	58.1	98
CO04W320	83.6	98	58.5	99
Hawken	81.6	96	60.5	102
CO04393	81.0	95	59.7	101
CO04W323	80.0	94	58.8	99
Yuma	79.6	94	57.4	97
CO04025	79.5	93	59.4	100
CO04W369	79.4	93	58.5	99
CO03W139	79.3	93	58.1	98
CO03064	78.0	92	57.3	97
Camelot	77.6	91	59.8	101
OK05737W	76.8	90	59.1	100
Ok Rising	76.4	90	58.9	99
Anton	75.9	89	60.7	102
CO02W237	73.3	86	58.4	98
Average	**85.1**		**59.3**	

Table .-Ripper vs. Hatcher at Dryland Sites in Southeast, CO, 2003 to 2008.

Location	Year	Ripper Grain Yield bu/a		Hatcher Grain Yield bu/a		Ripper Test Weight lb/bu		Hatcher Test Weight lb/bu	
Arapahoe	2008	49.9	+	40.4		60.5		61.6	+
Arapahoe	2007	46.4		60.7	+	59.7		62.4	+
Arapahoe	2006	15.0	+	13.4					
Arapahoe	2005	34.6	+	24.3		59.6		59.7	+
Cheyenne Wells	2003	43.9		47.1	+	58.5		59.2	+
Lamar	2007	48.2		76.7	+	51.5		57.3	+
Lamar	2006	28.8	+	23.0					
Lamar	2005	44.9	+	43.5		56.7	+	55.9	
Sheridan Lake	2007	75.6	+	74.7		59.5		60.5	+
Sheridan Lake	2006	36.5		38.7	+	56.5		57.8	+
Sheridan Lake	2005	38.4	+	30.4		54.5		55.7	+
Sheridan Lake	2004	45.1	+	41.7		55.8		57.6	+
Walsh	2007	55.2		61.5	+	54.6		57.5	+
Walsh	2006	24.7	+	21.2		53.6		55.4	+
Walsh	2005	57.4		65.0	+	58.0		59.0	+
Walsh	2003	25.1	+	24.0		59.1		60.2	+
Average		**41.9**		**42.9**		**57.0**		**58.5**	
		Yield is not significant (5% level).							
						Test Weight is significant.			

Dataset is from 16 replicated trials (2003-2008).
Yield - Ripper superior 10 of 16 times (63%).
Test Weight - Hatcher superior 13 of 14 times (93%)

Table .-Thunder CL vs. Danby at Dryland Sites in Southeast, CO, 2006 to 2008.

Location	Year	Thunder CL Grain Yield bu/a		Danby Grain Yield bu/a		Thunder CL Test Weight lb/bu	Danby Test Weight lb/bu	
Arapahoe	2008	30.1		36.9	+	60.7	62.3	+
Arapahoe	2007	50.8	+	46.0		61.3	62.9	+
Arapahoe	2006	15.9	+	13.1				
Lamar	2007	70.3	+	68.3		55.9	58.4	+
Lamar	2006	28.4	+	21.0				
Sheridan Lake	2007	64.1		65.2	+	61.2	63.8	+
Sheridan Lake	2006	37.2	+	36.0		57.0	57.7	+
Walsh	2007	61.7	+	55.5		57.2	58.1	+
Walsh	2006	19.4		28.5	+	53.3	57.8	+
Average		42		41.2		58.1	60.1	
		Yield is not significant (5% level).						
						Test Weight is significant.		

Dataset is from 9 replicated trials (2006-2008).
Yield - Thunder CL superior 6 of 9 times (67%).
Test Weight - Danby superior 7of 7 times (100%)

Dryland Wheat Strips for Forage and Grain Yield at Walsh, 2008

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 October 5, 2007 at 45 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 0.1 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 21) and at boot (May 13). We measure the forage for fresh weight, oven-dried the samples, and recorded dry weight at 15% moisture content. Except for herbicides, no other pesticides were applied because conditions were too dry for other pest problems. Grain yields were adjusted to 12% seed moisture content.

RESULTS: Grain yields were very poor, averaging 4.5 bu/a. Throughout the growing season, conditions were extremely dry. TAM 111 produced the highest dry forage yield at jointing, and Bond CL produced the highest dry forage yield at boot. These two varieties produced the highest grain yields; however, grain yields were very low: the highest grain yield this year was Bond CL with 8.3 bu/a. TAM 111 and Bond CL have the highest (and identical) two and three year averages of all the varieties tested (28 bu/a two year average and 24 bu/a three year average).

DISCUSSION: My choices for the best overall dual-purpose wheat varieties are TAM 111 and Bond CL. Bond CL is new variety to be elevated to the best dual-purpose wheat; however, TAM 111 was also my choice for the best overall dual-purpose wheat last year, too.

TAM 111 had the highest dry forage yield at jointing, the second highest dry forage yield at boot, and the second highest grain yield. Bond CL was fourth for dry forage yield at jointing, first for dry forage yield at boot, and first in grain yield. The dry season this year greatly reduced forage and grain yields compared to last year. This year's forage yields at jointing and at boot were three to four times less than the forage yields last year. Because of the dry conditions, grain yields were reduced to a greater extent than forage yields when comparing this year to last year. In fact, grain yield averages were ten times lower this year than last year (4.5 bu/a in 2008 and 46 bu/a in 2007).

Table .Dryland Wheat Strips, Forage and Grain Yield at Walsh, 2008.

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
Bond CL	1411	390	7088	2257	18	1077	58	8.3
TAM 111	1502	446	6634	2099	19	946	59	6.2
Ankor	1052	271	4984	1530	17	745	57	5.8
Ripper	854	197	5521	1581	16	836	56	5.2
Prairie Red	922	251	5793	1742	18	724	57	5.1
Bill Brown	862	224	4636	1494	18	757	59	4.8
NuDakota	1443	420	5506	1688	16	697	57	4.7
Keota	1107	293	3723	1114	16	601	59	4.5
TAM 112	1124	309	4376	1381	19	877	58	4.4
Above	1219	304	6447	1867	18	675	56	4.0
Protection	1106	283	3857	1121	18	677	58	3.5
Danby	1244	347	4650	1366	17	931	58	3.2
TAM 110	1185	314	6541	2014	19	709	57	3.1
Jagalene	1417	424	5711	1818	17	682	59	2.7
Hatcher	1175	313	3885	1122	15	577	57	2.7
Average	1175	319	5290	1613	17	767	58	4.5
LSD 0.05	432.6	148.3	1668.3	531.9		232.7		2.35

Planted: October 5, 2007; 45 lb seed/a; 5 gal/a 10-34-0.
Jointing sample taken April 21, 2008.
Boot sample taken May 13, 2008.
Grain Harvested: July 14, 2008.
Wet Weight is reported at field moisture.
Dry Weight is adjusted to 15% moisture content.
Grain Yield is adjusted to 12% seed moisture content.

Table .--Summary: Dryland Wheat Strips Variety Performance Tests at Walsh, 2006-2008.

Firm	Variety	Grain Yield					Yield as % of Trial Average				
		2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------bu/a----------					----------%----------				
Agseco	TAM 111	16	49	6	28	24	100	107	120	113	109
Agseco	TAM 110	17	43	3	23	21	106	93	60	77	87
Agseco	Keota	--	51	5	28	--	--	111	100	105	--
Agseco	Protection	--	49	4	27	--	--	107	80	93	--
AgriPro	Jagalene	18	46	3	25	22	113	100	60	80	91
Colorado State	Hatcher	14	51	3	27	23	88	111	60	85	86
Colorado State	Prairie Red	--	43	5	24	--	--	93	100	97	--
Colorado State	Above	16	47	4	26	22	100	102	80	91	94
Colorado State	Ankor	17	47	6	27	23	106	102	120	111	109
Colorado State	Bond CL	16	48	8	28	24	100	104	160	132	121
Kansas State	Danby	--	48	3	26	--	--	104	60	82	--
Watley	TAM 112	--	46	4	25	--	--	100	80	90	--
Average		16	46	5	26	22					

Grain Yields were adjusted to 12.0 % seed moisture content.

Winter Wheat Planting Date and Seeding Rate Study for Southeastern Colorado

Kevin Larson, Dennis Thompson, and Deborah Harn

Currently there is a winter wheat planting date controversy about the deadline for winter wheat planting and government program compliance. The wheat planting date compliance cutoff for Southeastern Colorado was recently extended from October 5 to October 15. This date appears to be arbitrarily selected and not based on scientific research. Our neighboring states of Kansas and Oklahoma have much later winter wheat planting date compliance deadlines. The deadline for the Panhandle of Oklahoma is November 15, a full month later than Colorado, and the deadline for Southwestern Kansas is October 20. Our winter wheat planting date and seeding rate study will ascertain the optimum planting date and seeding rate window for winter wheat production.

Materials and Methods

For our planting date and seeding rate study, we used the winter wheat variety Hatcher. We planted five planting dates: PD1, September 17; PD2, October 1; PD3, October 15; PD4, October 29; and PD5, November 12, 2007. We tested four seeding rates: 30, 60, 90, and 120 lb/a (0.52, 1.04, 1.56, and 2.08 million seeds/a). The experimental design for our study was a split-plot design (planting date as main plots, and seeding rates as subplots) with four replications. We applied N fertilizer at 50 lb/a to the site with a sweep plow with an anhydrous attachment. For weed control, we applied Express, 0.33 oz/a and 2,4-D, 0.38 lb/a in early spring. We bedded the field in order to furrow irrigate the site for stand establishment. We measured Russian Wheat Aphid (RWA) infestation by sampling 25 tillers per treatment. The percentage of tillers infested with RWA was the sum of tillers with aphids and tillers damaged from RWA. Forage samples (2.0 ft by 2.5 ft) were harvested at jointing: PD1, March 31; PD2, April 4; PD3, April 15; PD4, April 28; and PD5, April 30. Forage samples were harvested at boot: PD1, May 2; PD2, May 5; PD3, May 13; and PD4 and PD5, May 19. We weighed the forage samples, dried them in an oven at 100 C until no more weight loss occurred, and recorded the dry weighs. Forage yields were adjusted to 15% moisture. We harvested grain from the 10 ft. by 44 ft. plots on July 10 with a self-propelled combine equipped with a digital scale. Grain yields were adjusted to 12% seed moisture content.

Results

Forage yields for all five planting dates had significant linear responses to increasing seeding rates at jointing and at boot. The earliest planting date, September 17, produced the highest forage yields at jointing and at boot. The maximum forage yield declined with each subsequent planting date at jointing: PD1, 2600 lb/a; PD2, 2356 lb/a; PD3, 885 lb/a; PD4, 814 lb/a; and PD5, 636 lb/a. PD1 at the lowest seeding rate produced more forage at jointing than PD3 at the highest seeding rate with 1330 lb/a for PD1 and 885 lb/a for PD3. In contrast to the forage yield at jointing where PD3 produced low yields similar to the PD4 and PD5, forage yield at boot for PD3 was intermediate between the two earliest planting dates and the two latest planting dates.

PD2 had the highest grain yield of 47 bu/a at the 75 lb/a seeding rate. The grain yield response of PD1 to increasing seeding rate was a relatively flat curve. The

optimum seeding rate for PD1 was 60 lb/a. The last three planting dates had strong linear grain yield increases with increasing seeding rate. The largest grain yield response to increasing seeding rate was 10.9 bu/a for PD4.

This is the first year that no Russian Wheat Aphids (RWA) were detected in this planting date and seeding rate study. This year conditions were too dry in the area to support infestations of RWA. Typically, the highest RWA infestations occur with the lowest seeding rates and the latest planting dates.

Discussion

The first two planting dates, September 17 and October 1 produced substantially higher grain yields than the last two planting dates, October 29 and November 12. The middle planting date, October 15, was intermediate between the two earliest planting dates and the two latest planting dates. The intermediate yield of the October 15 planting date suggests the current wheat planting date deadline of October 15 is a good planting date cutoff for potentially high wheat yields. The first two planting dates, September 15 and October 1, produced their highest grain yields at moderate seeding rates, 60 to 75 lb/a. For the three later planting dates, October 15, October 29 and November 12, highest grain yields were achieved at the highest seeding rate of 120 lb/a. To achieve high grain yields when planting late, growers should consider seeding at higher rates.

Forage grazing can be extended from early April to late April by manipulating planting date and seeding rate, however, early planting with high seeding rate produced four times more than late planting. The forage production drop with late planting dates is too large to compensate for the three weeks extension in grazing. Forage production from each planting date increase with higher seeding rates. To produce high wheat forage yields, we recommend planting early with high seeding rates (90 to 120 lb/a).

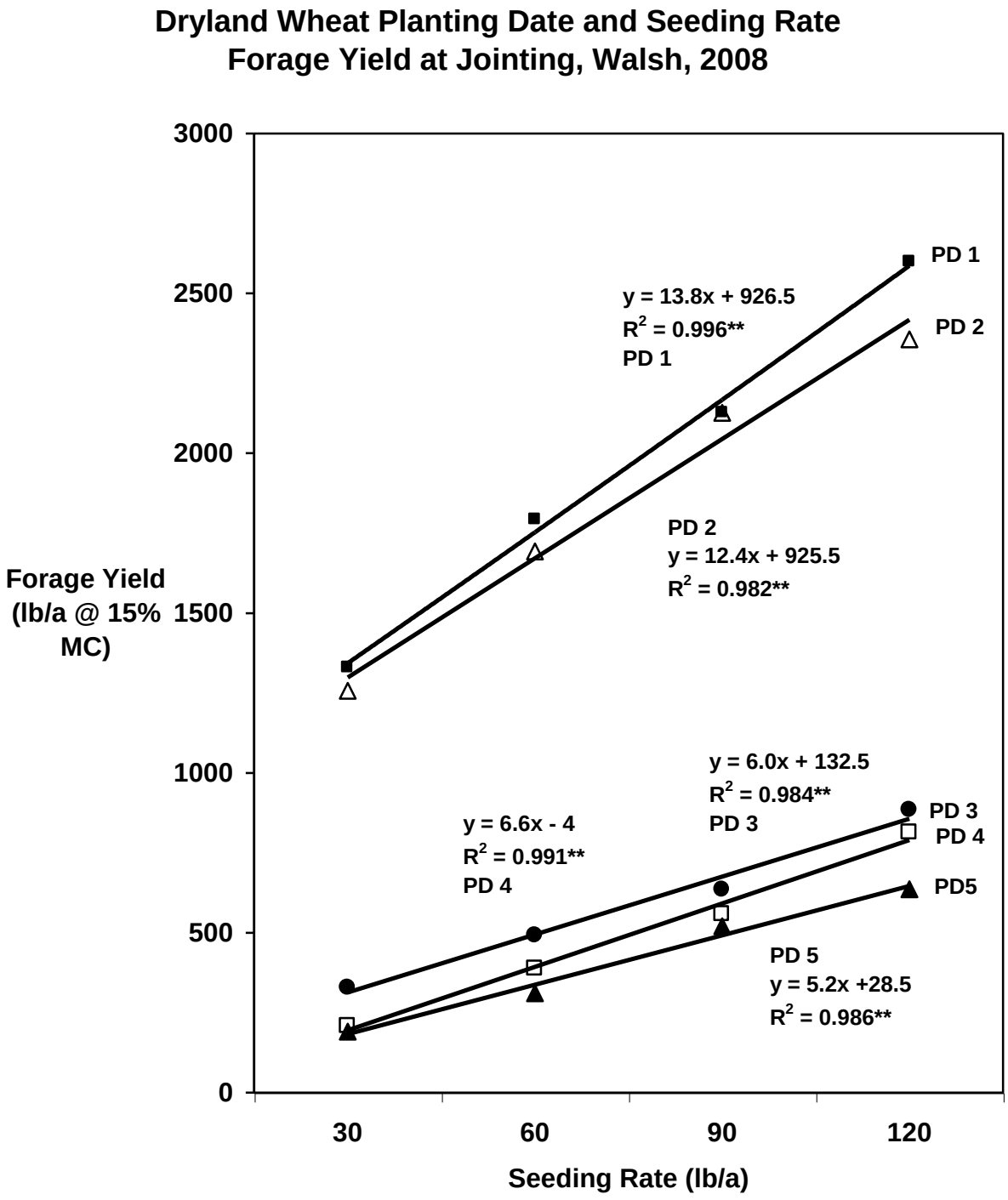

Fig. Forage yields at jointing from planting dates and seeding rates for dryland wheat at Walsh. Planting dates were PD 1, September 17; PD 2, October 1; PD 3, October 15; PD 4, October 29; and PD 5, November 12, 2007. Seeding rates were 30, 60, 90, and 120 lb/a, corresponding to 520,000, 1,040,000, 1,560,000, and 2,080,000 seeds/a. Jointing dates: PD 1, April 2; PD 2, April 7; PD 3, April 17; PD 4, April 28; and PD 5, May 2. The wheat variety was Hatcher.

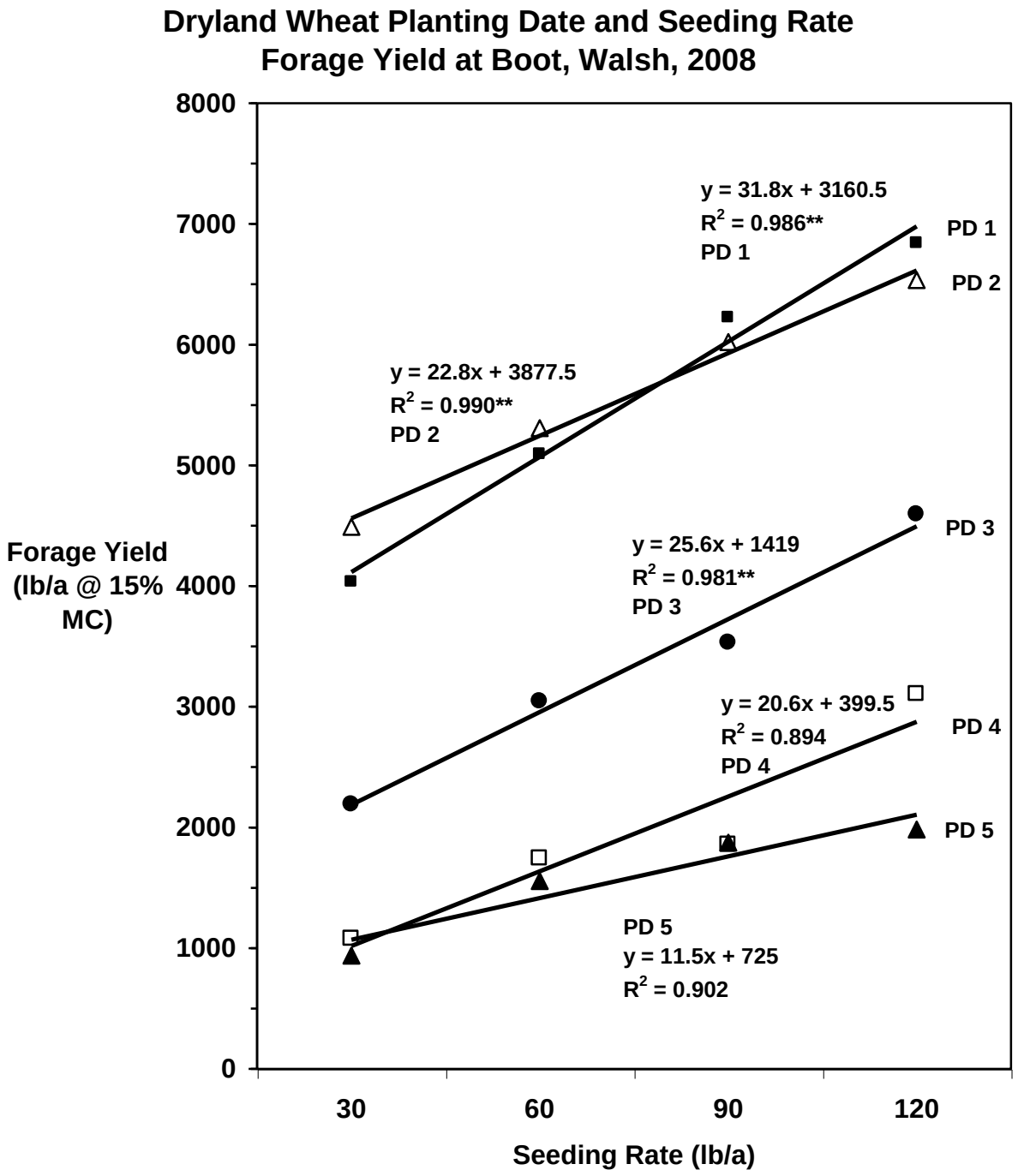

Fig. Forage yields at boot from planting dates and seeding rates for dryland wheat at Walsh. Planting dates were PD 1, September 17; PD 2, October 1; PD 3, October 15; PD 4, October 29; and PD 5, November 12, 2007. Seeding rates were 30, 60, 90, and 120 lb/a, corresponding to 520,000, 1,040,000, 1,560,000, and 2,080,000 seeds/a. Boot dates: PD 1, May 2; PD 2, May 5; PD 3, May 11; PD 4, May 16; and PD 5, May 19. The wheat variety was Hatcher.

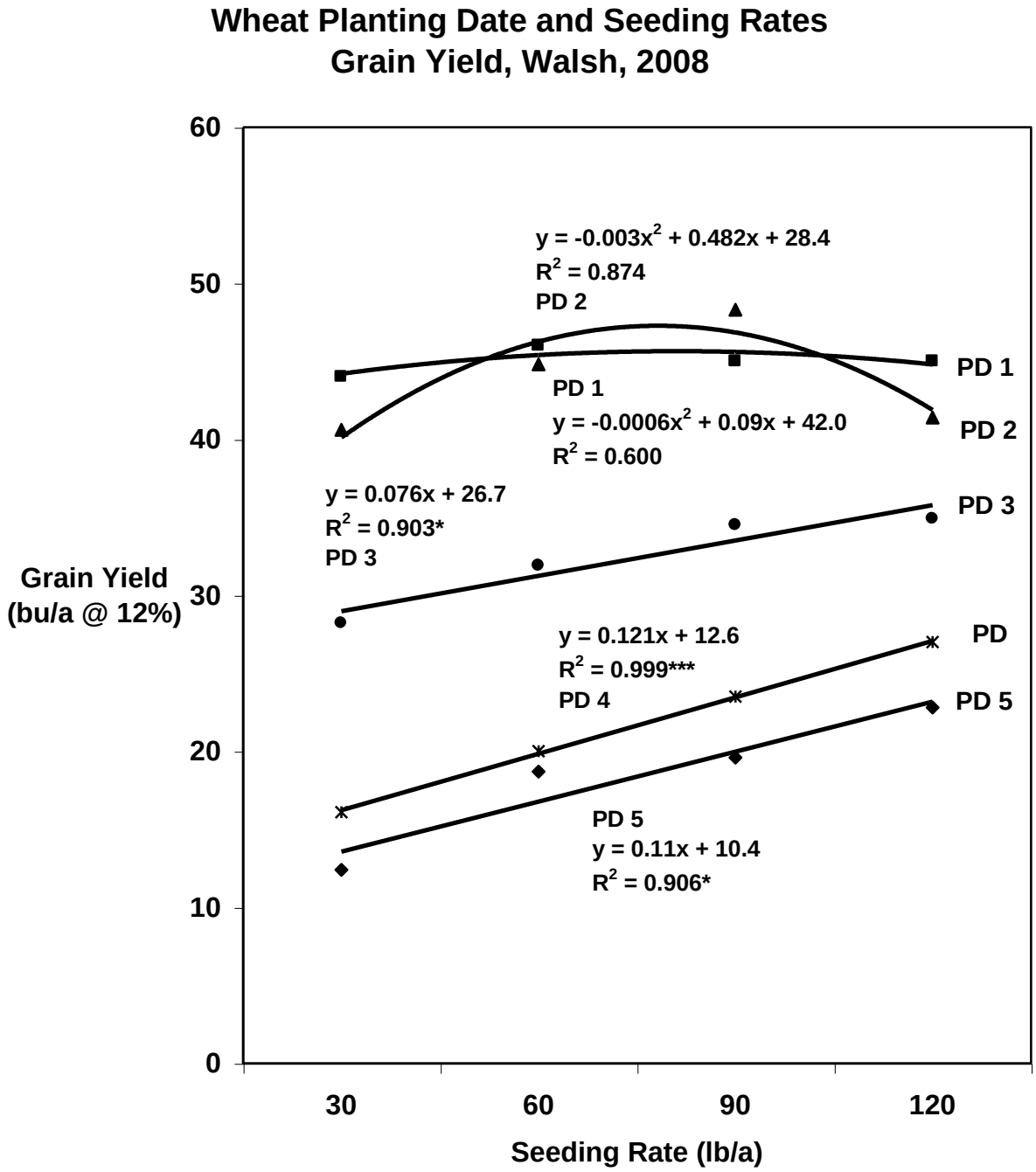

Fig. Grain yield from planting dates and seeding rates for dryland wheat at Walsh. Planting dates were PD 1, September 17; PD 2, October 1; PD 3, October 15; PD 4, October 29; and PD 5, November 12, 2007. Seeding rates were 30, 60, 90, and 120 lb/a, corresponding to 520,000, 1,040,000, 1,560,000, and 2,080,000 seeds/a. The wheat variety was Hatcher, which was harvested on July 10, 2008.

Residual P on Dryland Wheat, Long Term Study at Manter, 2008

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 46 lb P_2O_5/a with 23 bu/a, 4 bu/a higher yield than the 0 P check. Regression analysis shows the optimum P rate at about 70 lb P_2O_5/a. After four wheat crops, all P rates produced positive total net returns compared to the 0 P check: 23 lb P_2O_5/a with $28.46/a, 46 lb P_2O_5/a with $49.03/a, 69 lb P_2O_5/a with $22.22/a, 92 lb P_2O_5/a with $4.60/a, and 115 lb P_2O_5/a with $10.20/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, and 10-34-0 cost of $210/ton.

DISCUSSION: This is the fourth wheat crop after we applied the one-time P fertilizer rates. For the first wheat crop following P rates, 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 third crop year, there was no yield difference between the 0 P check and the 23 P_2O_5/a rate; however, this year the 23 lb P_2O_5/a treatment produced 2.6 bu/a more the 0 P check. 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 at 35 lb seeds/a in the 60 ft. by 680 ft. plots around late-September to early-October for 2001, 2003, 2005, and 2007. We harvested the plots on June 18 for 2002, June 25 for 2004, June 19 for 2006, and July 3, 2008 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						

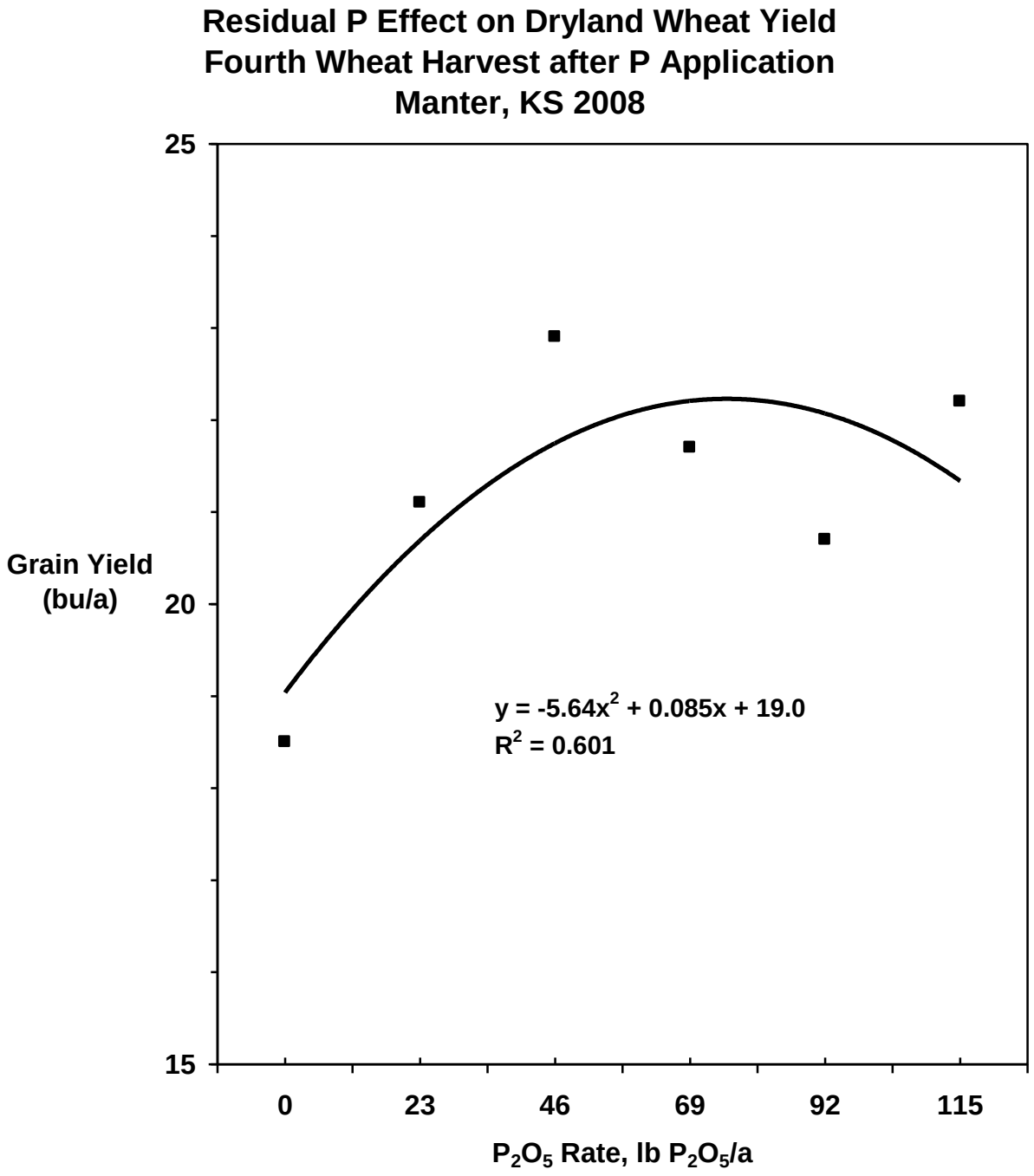

Fig. . Yield of long term P on dryland wheat, third wheat crop after P application, at Manter. P treatment are 0, 23, 46, 69, 92, and 115 lb P_2O_5/a applied with a chisel with shanks 18 in. apart to a 6 in. depth on July 13, 2001. Grain yields were adjusted to 12% seed moisture content.

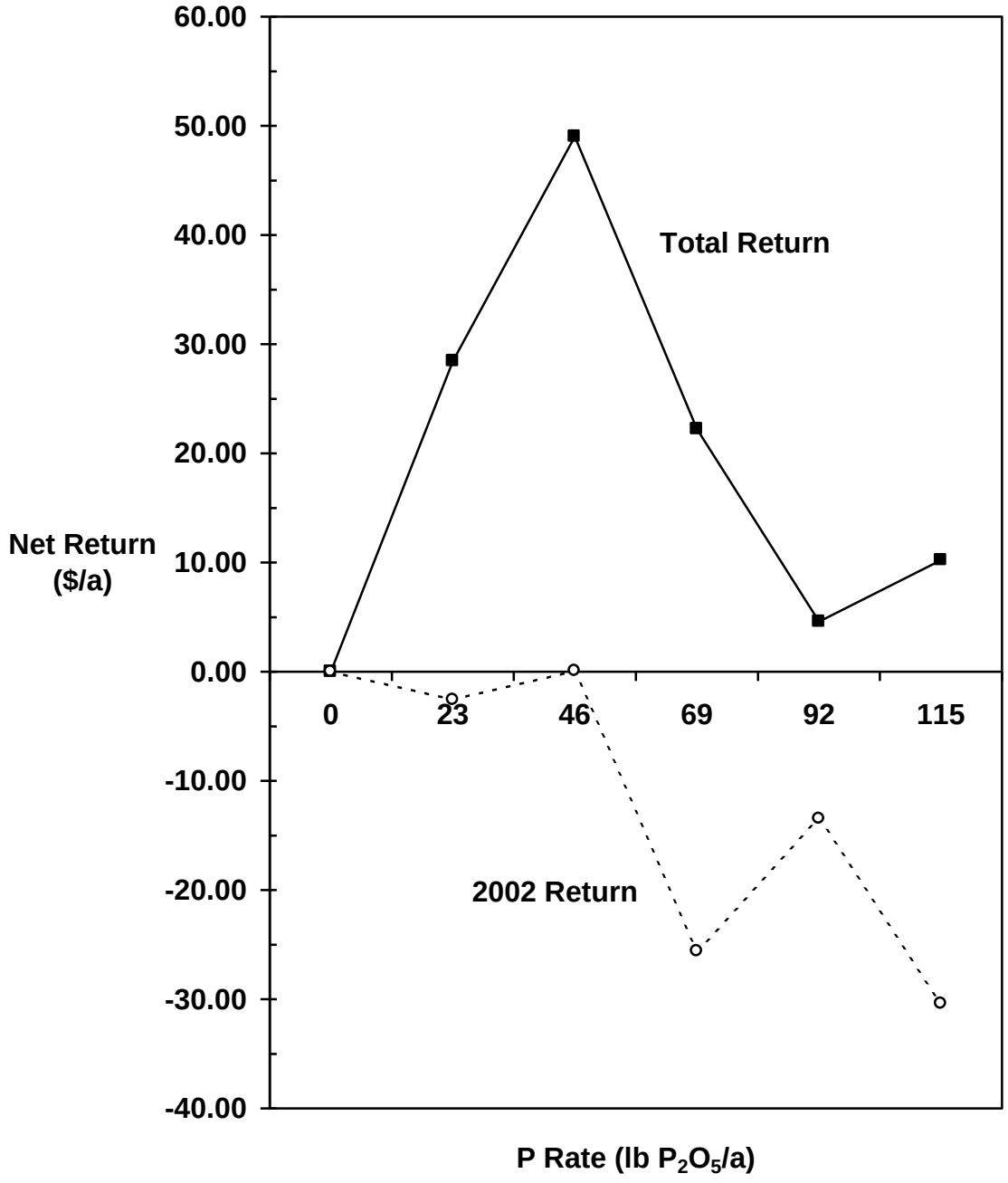

Fig. . Net return of long term P on dryland wheat, fourth wheat crop after single P application, at Manter. P treatments were 0,23, 46, 69, 92, and 115 lb P_2O_5/a applied with a chisel with shanks 18 in. apart to a 6 in. depth on July 13, 2001. Total return is sum from 2002 and 2008 wheat crops.

SORGHUM HYBRID PERFORMANCE TRIALS IN COLORADO, 2008

K.J. Larson and D.L. Thompson \1

The 2008 Colorado grain sorghum crop was estimated at 5.76 million bushels, slightly above the 2007 sorghum crop of 5.55 million bushels. For Colorado, the 5.76 million bushels is the highest in 5 years. The increase in sorghum production this year was due to 30,000 more acres harvested than last year. The 2008 average yield was 32 bu/a, 5 bu/a less than the average yield for 2007. The 2007 sorghum silage crop produced 360,000 tons from 20,000 acres yielding 18 ton/a. The sorghum silage crop this year is the highest total production in five years (National Agricultural Statistics Service, Colorado Field Office, 2008).

This publication is a progress report of the sorghum variety trials conducted by the Department of Soil and Crop Sciences at Colorado State University, Colorado Agricultural Experiment Station, and Extension. The sorghum trials were conducted at the Plainsman Research Center at Walsh in Southeastern Colorado: a dryland grain sorghum trial was conducted at Walsh; irrigated grain sorghum trials at Walsh; a dryland forage sorghum trial at Walsh; and irrigated forage sorghum trial at Walsh.

Trials are partially funded by entry fees paid by commercial firms. Commercial seed representatives interested in entering sorghum hybrids in any of the trials should contact Kevin Larson, Plainsman Research Center, Box 477, Walsh, Colorado 81090, or phone (719) 324-5643, or email Kevin.Larson@colostate.edu for further details. Names and addresses of firms submitting entries in 2008 are shown in Table 1. Each firm selected entries for testing and furnished seed for the trials. The Agricultural Experiment Station selected open-pedigree hybrids as a standard of comparison. A closed-pedigree corn hybrid was also included in the forage sorghum trials as a comparative standard and was sponsored by the Colorado State Agricultural Experiment Station.

Summary tables for weather data (on-site portable weather stations and NOAA, 2008), soil analysis, fertilization (Soil Testing Laboratory, Colorado State University), and available soil water graphs derived from gypsum block readings are provided for each trial location. Other information, where available, was included: site description, emergence date, irrigation, pest control, field history, and pertinent comments.

\1 Superintendent, Plainsman Research Center, Walsh;
Technician III, Plainsman Research Center, Walsh.

Table 1.--Entrants in the 2008 Colorado Sorghum Performance Trials.

Brand	Entered by
ASGROW	Monsanto, 7159 N. 247th W., P.O. Box 7, Mt. Hope, KS 67108
DEKALB	Monsanto, 7159 N. 247th W., P.O. Box 7, Mt. Hope, KS 67108
FOUR STAR SEED	Four Star Seed, 2929 335th St., Logan, IA 51546
GARST	Garst Seed Co., 44169 Road TT, Walsh, CO 81090
MYCOGEN	Mycogen Seeds, 9330 Zionville Road, Indianapolis, IN 46268
NC+	NC+ Hybrids, 300 Weatherly Road, Des Moines, NM 88418
PIONEER	Pioneer Hi-Bred International, Inc., 1616 S. Kentucky, Suite C-350, Amarillo, TX 79102
SORGHUM PARTNERS	Sorghum Partners, Inc., P.O. Box 189, New Deal, TX 79350
TRIUMPH	Triumph Seed Co., Inc., P.O. Box 1050, Hwy. 62 Bypass, Ralls, TX 79357
	Colorado Agricultural Experiment Station entered the following as checks: grain sorghum, TXms399 X TXR2737 (399 X 2737); forage sorghum, NB 305F; corn hybrid, MYCOGEN 2T828.

Growing Degree Days for sorghum were calculated from planting through first freeze using a maximum of 111^{o}F and a minimum of 50^{o}F for threshold temperatures (Peacock and Heinrich, 1984). They are calculated by averaging daily high and low temperatures and subtracting the base temperature of 50^{o}F from the average. When daily temperatures are less than 50^{o}F, 50^{o}F is used, when temperatures are above 111^{o}F a maximum temperature of 111^{o}F is used:

$$\frac{\text{(Daily Minimum Temp. + Daily Maximum Temp.)}}{2} - 50^{o}\text{F}$$

Experimental Methods and Evaluations

Trials were planted with a four-row cone planter and harvested with a modified, self-propelled John Deere 4420 combine equipped with a four-row row-crop head to enhance harvest of lodged tillers. Sorghum forage was cut and chopped with a single row John Deere 8 silage cutter.

Days to Emergence. Seedling emergence was determined as the number of days after planting until approximately half of the seedlings become visible down a planted row.

50% Bloom. Number of days after planting until half of the main heads had pollinating florets. Number of days to half bloom provides a good measure of relative maturity between hybrids.

50% Maturity. Number of days after planting until half of the kernels in half of the main heads reached physiological maturity, i.e., the black layer becomes visible at the base of the kernel.

Plant Height. Plant height was measured in inches from the soil to the tip of the main head.

Lodging. The percentage of tillers with broken basal stems or broken peduncles or were leaning more than a 45 degree angle were considered lodged. Since the combine was equipped with a row crop head, most of the leaning tillers were harvested.

Harvest Density. Plant population in plants per acre was counted prior to harvest.

Test Weight. Test weight was determined using a hand-held bushel weight tester. A low test weight indicates that a hybrid did not fully mature prior to the first freeze or that it suffered environmental stress, such as a water deficiency.

Grain Yield. The grain yield in bushels per acre was adjusted to 14 percent moisture content.

Yield as a % of Test Average. Yield as a percentage of test average provides a comparison between yields within a trial and allows easy comparisons among years, irrespective of annual growing conditions.

Forage Dry Matter Analysis. Whole plant samples were taken at boot for each hybrid and sent to Ward Laboratories, Inc., Kearney, Nebraska for NIR analysis.

Forage Yield. Forage yield in tons per acre was adjusted to 70% moisture content. A representative sample of fresh silage was oven-dried at 167^{o}F (75^{o}C) until there was no more weight loss, and then yields were adjusted to 70% moisture content.

Stem Sugar. The sugar content, expressed as a percent, in the stem of forage sorghums at harvest was measured with a hand refractometer.

Available Soil Water

Available soil water was measured by placing gypsum blocks at 6, 18, 30, and 42 inches below the soil surface. Electrical resistance readings were made weekly. Resistance readings vary with the amount of soil water present. Using resistance readings, available soil water was determined by extrapolating from soil water depletion curves for each particular soil.

Statistical Method

Tests were planted in a randomized complete block design with four replications. No less than three replications were harvested. Analysis of variance was applied to the results and the least significant difference (LSD) was computed at alpha = 0.20. Analysis of variance and regression were performed with CoStat Statistical Software a product of Cohort Software, Berkeley, California.

References

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Peacock, J.M. and G.M. Heinrich. 1984. Light and temperature response in sorghum. pp. 143-158. In: Agrometeorology of Sorghum and Millet in the Semi-Tropics: Proceedings of the International Symposium. November 15-20, 1982. India, ICRISAT, WMO.

Early Maturing Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids, when planted late in the season (July 7), under irrigated conditions with 2200 sorghum heat units in Silty Loam soil.

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 87,100 seed/a. PLANTED: July 7. HARVESTED: November 26.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 82 F.

IRRIGATION: Pre-irrigated by furrow approx. 6 a-in./a; and drip irrigated for 9 weeks with approximately 7 a-in./a.

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
July	1.42	714	20	4	24
August	7.03	735	12	5	55
September	0.83	466	0	0	85
October	2.75	251	0	0	109
Total	12.03	2166	32	9	109

\1 Growing season from July 7 (planting) to October 24 (first freeze, 22 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

FIELD HISTORY: Last Crop: Sunflower. FIELD PREPARATION: Disc.

COMMENTS: Planted in good soil moisture (after pre-irrigation by furrow). Weed control was very good. Above average precipitation for growing season with very dry early growing season and very wet August. No greenbug infestation. Low levels of lodging. Late freeze date. Yields were poor.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.2	23	1.8	454	0.5	3.5
8"-24"				17				
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	40	0	0
Applied	100	20	0.3	0

Yield Goal: 100 bu/a.
Actual Yield: 37 bu/a.

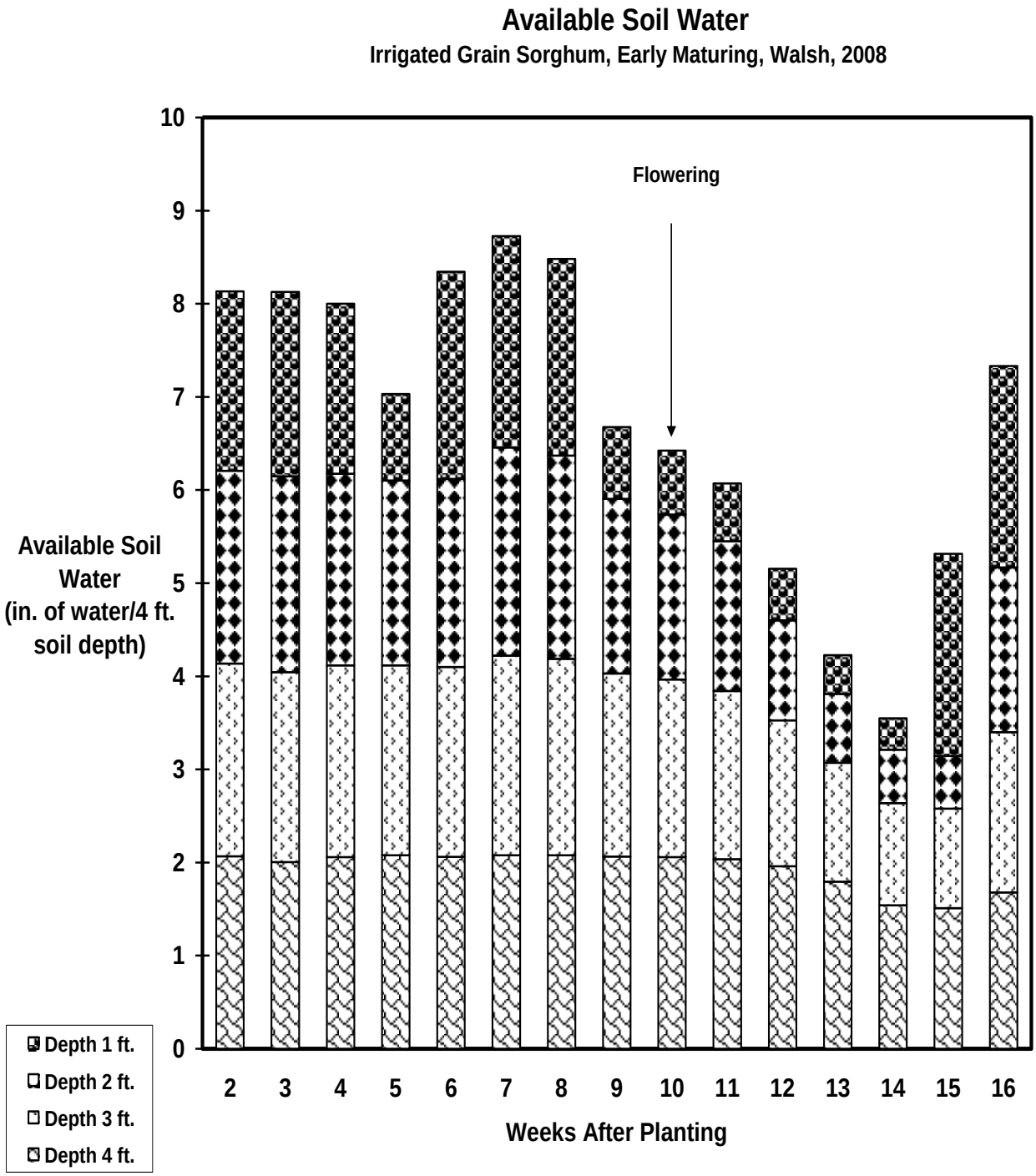

Fig. 1. Available soil water in irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 12.03 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 2.--Irrigated Grain Sorghum Early Maturing Hybrid Performance Test at Walsh, 2008. \1

Brand	Hybrid	Days to Emerge	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group	Plant Ht.	Harvest Density	Lodged Plants	Test Wt.	Grain Yield	Yield % of Test Average
							in	plants/a (1000 x)	%	lb/bu	bu/a	%
NC+	NC+ 5C35	7	59	1478	106	E	42	50.3	6	56	53	144
SORGHUM PARTNERS	KS310	7	61	1512	HD	E	44	55.0	2	54	49	133
DEKALB	DK28E	7	56	1431	105	E	39	48.8	2	55	49	132
DEKALB	DKS29-28	7	62	1521	HD	E	39	49.3	0	53	46	123
SORGHUM PARTNERS	251	7	55	1417	103	E	39	59.3	3	55	43	118
SORGHUM PARTNERS	NK5418	7	68	1597	SD	ME/M	41	54.6	0	52	45	122
NC+	NC+ 5B89	8	64	1547	SD	ME	44	47.6	3	51	36	97
ASGROW	Pulsar	8	64	1547	SD	ME	42	41.0	2	52	31	84
SORGHUM PARTNERS	X303	8	64	1547	SD	ME/E	39	31.0	0	52	28	75
DEKALB	DK39Y	8	66	1582	SD	ME	41	38.3	0	51	26	69
DEKALB	DKS37-07	7	75	1646	LM	M/ME	45	52.7	1	50	19	51
SORGHUM PARTNERS	X510	7	77	1657	LM	M	44	53.8	5	50	18	50
Average		7	64	1540	SD	ME	42	48.5	2	53	37	
LSD 0.20											5.3	

\1 Planted: July 7; Harvested: November 26, 2008.

Yields are adjusted to 14.0% seed moisture content.

DAP: Days After Planting or maturation of seed at first freeze (22 F, October 24).

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

GDD: Growing Degree Days for sorghum.

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

Table 3.--Summary: Grain Sorghum Early Maturing Hybrid Performance Tests, 2006-2008.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------bu/a----------					----------%----------				
ASGROW	Pulsar	--	109	31	70	--	--	108	84	96	--
DEKALB	DK28E	87	--	49	68	--	136	--	132	134	--
DEKALB	DKS29-28	76	103	46	75	75	118	102	123	113	114
DEKALB	DKS37-07	--	108	19	64	--	--	107	51	79	--
NC+	NC+ 5C35	--	101	53	77	--	--	101	144	123	--
NC+	NC+ 5B89	54	108	36	72	66	84	108	97	103	96
SORGHUM PARTNERS	251	--	79	43	61	--	--	78	118	98	--
SORGHUM PARTNERS	KS310	--	101	49	75	--	--	100	133	117	--
SORGHUM PARTNERS	X303	--	84	28	56	--	--	84	75	80	--
Average		62	101	37	69	67					

Grain Yields were adjusted to 14.0 % seed moisture content.

Irrigated at Walsh for 2006, 2007, and 2008.

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2800 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 10. HARVESTED: November 25.

EMERGENCE DATE: 8 days after planting. SOIL TEMP: 80 F.

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

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

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
June	0.78	485	11	2	20
July	1.65	890	25	5	51
August	7.03	735	12	5	82
September	0.83	466	0	0	112
October	2.75	251	0	0	136
Total	13.04	2827	48	12	136

\1 Growing season from June 10 (planting) to October 24 (first freeze, 22 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture (pre-irrigated with furrow irrigation). Weed control was good. Above average precipitation for growing season with very dry early growing season and very wet August. No greenbug infestation. One hybrid had 40% lodging. Late freeze date. Yields and test weights were very good despite the dry conditions.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	8.0	0.8	2.8	15	1.2	523	0.5	4.3
8"-24"				10				
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	40	0	0
Applied	50	20	0	0

Yield Goal: 40 bu/a.
Actual Yield: 66 bu/a.

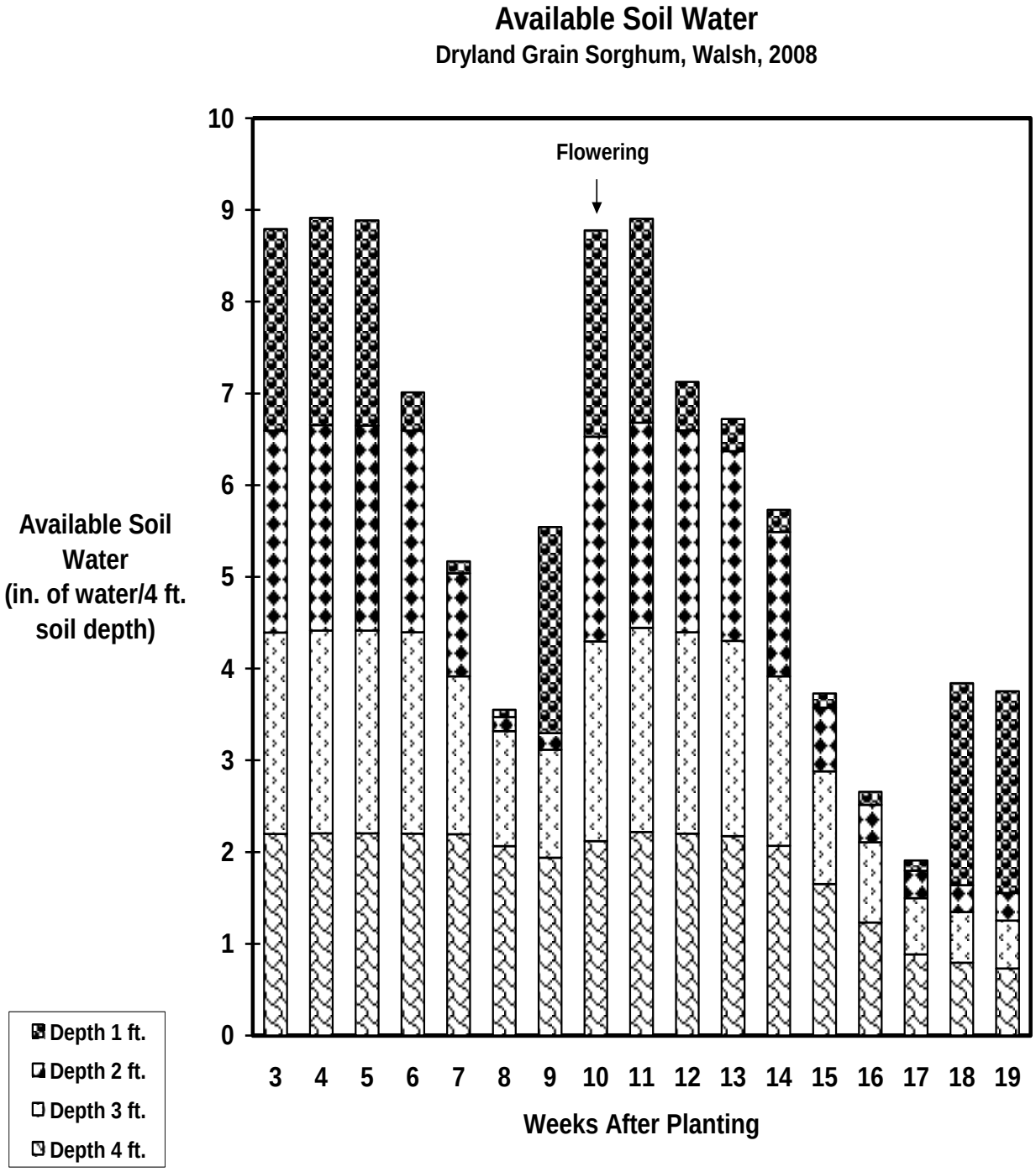

Fig. 2. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.04 in. Any increase in available soil water between weeks is from rain.

Table 4.--Dryland Grain Sorghum Hybrid Performance Test at Walsh, 2008. \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	%
ASGROW	Pulsar	7	62	1698	112	E	44	26.9	6	60	75	112
NC+	NC+ 5C35	8	58	1607	106	E	37	23.8	3	61	71	107
DEKALB	DKS29-28	8	61	1678	113	E	33	24.2	1	60	65	98
DEKALB	DK28E	8	55	1514	105	E	32	23.2	1	58	51	77
SORGHUM PARTNERS	251	8	55	1514	102	E	33	23.7	2	60	49	74
SORGHUM PARTNERS	X303	8	61	1678	112	E	35	19.8	2	59	49	74
DEKALB	DKS37-07	8	69	1830	115	ME	42	25.4	10	59	75	112
DEKALB	DKS36-16	8	68	1818	115	ME	41	22.5	1	58	73	110
NC+	NC+ 5B89	8	67	1806	115	ME	39	22.5	6	58	69	105
NC+	NC+ 5B90	7	67	1806	115	ME	38	23.3	38	60	66	99
DEKALB	DK39Y	8	63	1721	114	ME	36	22.7	1	58	63	95
SORGHUM PARTNERS	KS310	8	64	1747	114	ME/E	42	23.1	3	59	63	95
SORGHUM PARTNERS	NK5418	7	70	1840	117	M	40	23.5	1	59	77	116
NC+	NC+ 6B50	7	73	1894	118	M	42	24.6	1	58	75	113
NC+	NC+ Y363	8	72	1870	117	M/ME	44	21.7	1	59	73	110
SORGHUM PARTNERS	X510	7	76	1966	122	M	42	22.7	4	58	72	108
NC+	NC+ 7C22	8	71	1854	117	M	42	24.0	2	60	71	107
(Check)	399 X 2737	7	80	2066	128	ML	42	24.2	0	56	58	87
Average		8	66	1773	114	ME	39	23.4	5	59	66	
LSD 0.20											6.6	

\1 Planted: June 10; Harvested: November 25, 2008.

Yields are corrected 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.

This study was pre-irrigated with about 8 in./a of furrow irrigation to ensure stand establishment.

Table 5.--Summary: Dryland Grain Sorghum Hybrid Performance Tests at Walsh, 2006-2008.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------bu/a----------					----------%----------				
ASGROW	Pulsar	10	63	75	69	49	163	108	112	110	128
DEKALB	DK-44	6	61	--	34	--	93	104	--	99	--
DEKALB	DKS37-07	5	62	75	69	47	78	105	112	109	98
DEKALB	DKS36-16	--	60	73	67	--	--	102	110	106	--
DEKALB	DKS29-28	--	61	65	63	--	--	104	98	101	--
NC+	NC+ 5B89	7	62	69	66	46	117	105	109	107	110
NC+	NC+ 5C35	17	55	71	63	48	290	93	107	100	163
NC+	NC+ Y363	5	60	73	67	46	82	103	110	107	98
NC+	NC+ 6B50	3	61	75	68	46	55	104	113	109	91
NC+	NC+ 7C22	--	66	71	69	--	--	112	107	110	--
SORGHUM PARTNERS	KS310	--	54	63	59	--	--	92	95	94	--
SORGHUM PARTNERS	X303	--	50	49	50	--	--	86	74	80	--
SORGHUM PARTNERS	251	--	50	49	50	--	--	86	74	80	--
SORGHUM PARTNERS	NK5418	--	72	77	75	--	--	123	116	120	--
(Check)	399 X 2737	2	42	58	50	34	40	71	87	79	66
Average		5	59	66	63	43					

Grain Yields were corrected to 14.0% seed moisture content.

The site was pre-irrigated with furrow irrigation in 2008.

Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids under irrigated conditions with 2700 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 87,100 seed/a. PLANTED: June 16. HARVESTED: November 26.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 82 F.

IRRIGATION: Pre-irrigated by furrow approx. 6 a-in/a and drip irrigated for 13 weeks with approximately 10 a-in./a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 24 oz/a, 2,4-D 0.5 lb/a. Post Emergence Herbicides: Atrazine 1.0 lb/a, Banvel 3 oz/a, COC 32 oz/a. CULTIVATION: Once. 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	0.78	339	8	0	14
July	1.65	890	25	5	45
August	7.03	735	12	5	76
September	0.83	466	0	0	106
October	2.75	251	0	0	130
Total	13.04	2681	45	10	130

\1 Growing season from June 16 (planting) to October 24 (first freeze, 22 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

FIELD HISTORY: Last Crop: Sunflower. FIELD PREPARATION: Disc.

COMMENTS: Planted in good soil moisture (pre-irrigated with furrow irrigation). Weed control was good. Above average precipitation for growing season with very dry early growing season and very wet August. Late freeze date. No greenbug infestation. One hybrid had 75% lodging. Grain yields were good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.2	23	1.8	454	0.5	3.5
8"-24"				17				
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	40	0	0
Applied	150	20	0.3	0

Yield Goal: 130 bu/a.
Actual Yield: 82 bu/a.

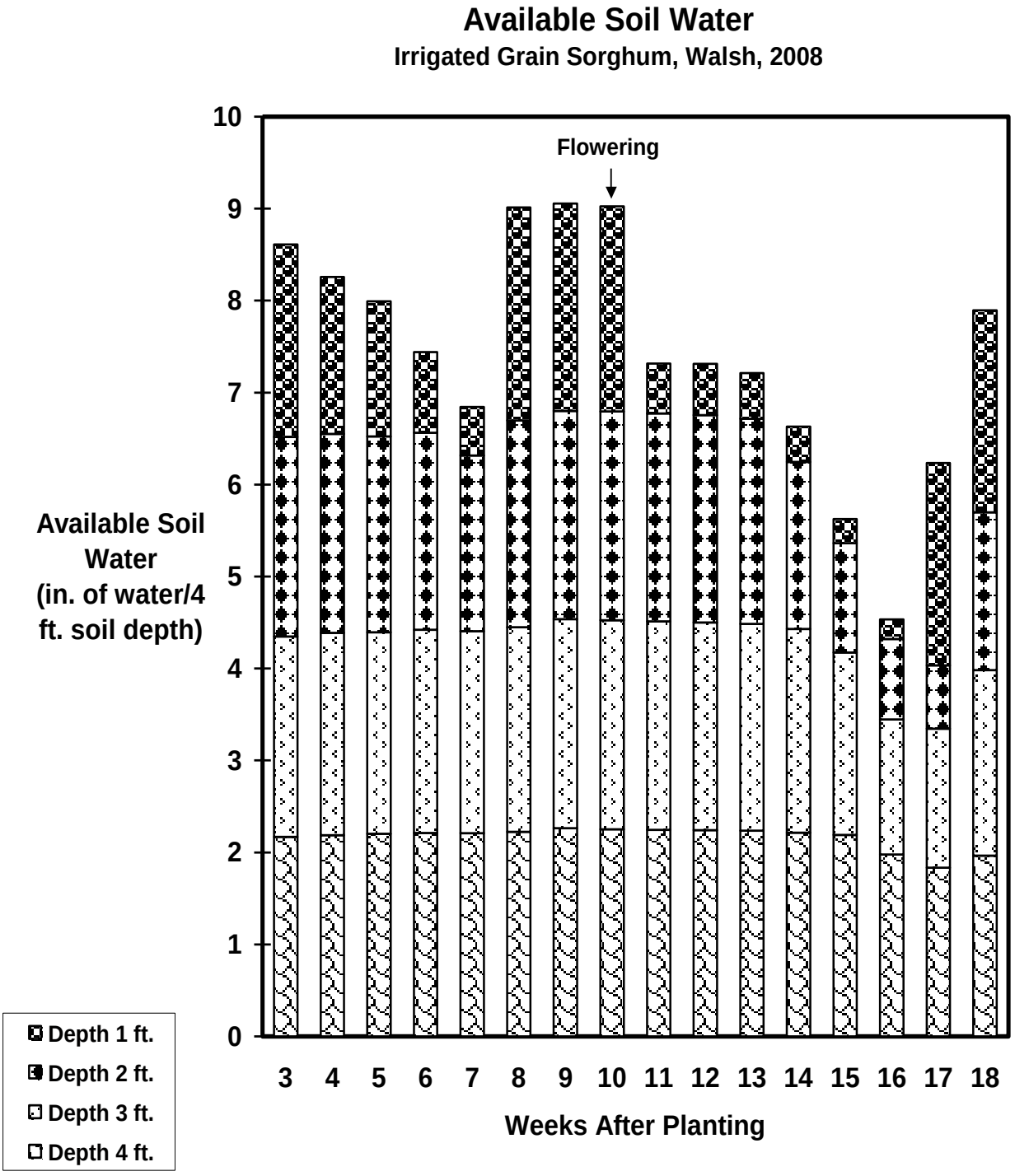

Fig. 3. Available soil water in irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.04 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 6.--Irrigated Grain Sorghum Hybrid Performance Test at Walsh, 2008. \1

Brand	Hybrid	Days to Emerge	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group	Plant Ht.	Harvest Density	Lodged Plants	Test Wt.	Grain Yield	Yield % of Test Average
							in	plants/a (1000 X)	%	lb/bu	bu/a	%
NC+	NC+ 5C35	7	57	1575	103	E	42	50.0	8	60	89	108
SORGHUM PARTNERS	251	7	54	1505	100	E	34	40.3	3	59	72	88
SORGHUM PARTNERS	NK 5418	7	68	1775	113	ME/M	41	43.4	0	57	100	121
DEKALB	DKS36-16	7	66	1775	112	ME	44	49.2	1	60	93	112
NC+	NC+ Y363	8	68	1775	116	ME	45	24.0	2	58	87	106
SORGHUM PARTNERS	KS310	7	66	1723	113	ME/E	41	43.8	3	57	85	103
DEKALB	DKS37-07	7	69	1796	114	ME	45	50.0	5	60	85	103
NC+	NC+ 5B89	8	60	1643	109	ME	40	34.5	23	58	80	96
NC+	NC+ 5B90	7	61	1659	111	ME	41	38.7	75	60	79	96
SORGHUM PARTNERS	X303	8	59	1623	109	ME/E	49	32.1	1	57	52	63
SORGHUM PARTNERS	X510	7	72	1870	119	M	45	36.4	4	59	90	109
NC+	NC+ 6B50	7	72	1870	118	M	45	37.2	3	58	88	107
NC+	NC+ 7C22	7	69	1817	117	M	40	39.9	2	57	84	102
DEKALB	DKS53-67	7	74	1919	123	ML	47	42.2	8	59	86	104
DEKALB	DKS44-20	8	73	1896	121	ML/M	47	46.1	12	59	78	94
DEKALB	DKS54-03	7	76	1963	127	L	50	47.2	4	58	82	100
(Check)	399 X 2737	7	76	1963	127	L/ML	45	41.8	0	58	79	95
DEKALB	DKS54-00	8	78	2011	HD	L	49	37.2	6	57	76	92
Average		7	68	1787	115	ME	44	40.8	9	58	82	
LSD 0.20											6.7	

\1 Planted June 16; Harvested: November 26, 2008.

Yields are corrected to 14.0% seed moisture content.

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

Seed Maturation: 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: Irrigated Grain Sorghum Hybrid Performance Tests at Walsh, 2006-2008.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------bu/a----------					----------%----------				
ASGROW	A 571	64	126	--	95	--	77	108	--	93	--
DEKALB	DKS54-00	84	131	76	104	97	102	111	92	102	102
DEKALB	DKS37-07	--	126	85	106	--	--	107	103	105	--
DEKALB	DKS36-16	--	116	93	105	--	--	99	112	106	--
DEKALB	DKS53-67	--	138	86	112	--	--	117	104	111	--
NC+	NC+ 7C22	88	124	84	104	99	106	106	102	104	105
NC+	NC+ 6B50	101	123	88	106	104	122	105	107	106	111
NC+	NC+ Y363	--	118	87	103	--	--	100	106	103	--
NC+	NC+ 5B89	--	126	80	103	--	--	107	96	102	--
NC+	NC+ 5C35	--	97	89	93	--	--	83	108	96	--
SORGHUM PARTNERS	X303	--	93	52	73	--	--	79	63	71	--
SORGHUM PARTNERS	251	--	84	72	78	--	--	72	88	80	--
SORGHUM PARTNERS	KS310	--	110	85	98	--	--	94	103	99	--
SORGHUM PARTNERS	NK5418	--	120	100	110	--	--	102	121	112	--
(Check)	399 X 2737	73	117	79	98	90	87	100	95	98	94
Average		83	118	82	100	94					

Grain Yields were corrected to 14.0% seed moisture content.

Limited Sprinkler Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids under limited sprinkler irrigated conditions with 2800 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30" row spacing, at least 1000' long. SEEDING DENSITY: 80,000 seed/a. PLANTED: June 10. HARVESTED: November 23.

IRRIGATION: Sprinkler irrigated with 9.3 a-in./a, applied with seven rotations.

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

FIELD HISTORY: Last Crop: Wheat. 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--------		
June	0.78	485	11	2	20
July	1.65	890	25	5	51
August	7.03	735	12	5	82
September	0.83	466	0	0	112
October	2.75	251	0	0	136
Total	13.04	2827	48	12	136

\1 Growing season from June 10 (planting) to October 24 (first freeze, 22 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good marginal moisture. Weed control was good. Above average precipitation for growing season with very dry early growing season and very wet August. Late freeze date. No greenbug infestation. Three hybrids lodged more than 25%. Grain yields were good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.5	31	5.9	478	0.8	5.2
8"-24"				21				
Comment	Alka	VLo	VHi	VHi	Lo	VHi	Lo	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------lb/a----------			
Recommended	0	20	0	0
Applied	125	20	0.3	0

Yield Goal: 100 bu/a.
Actual Yield: 71 bu/a.

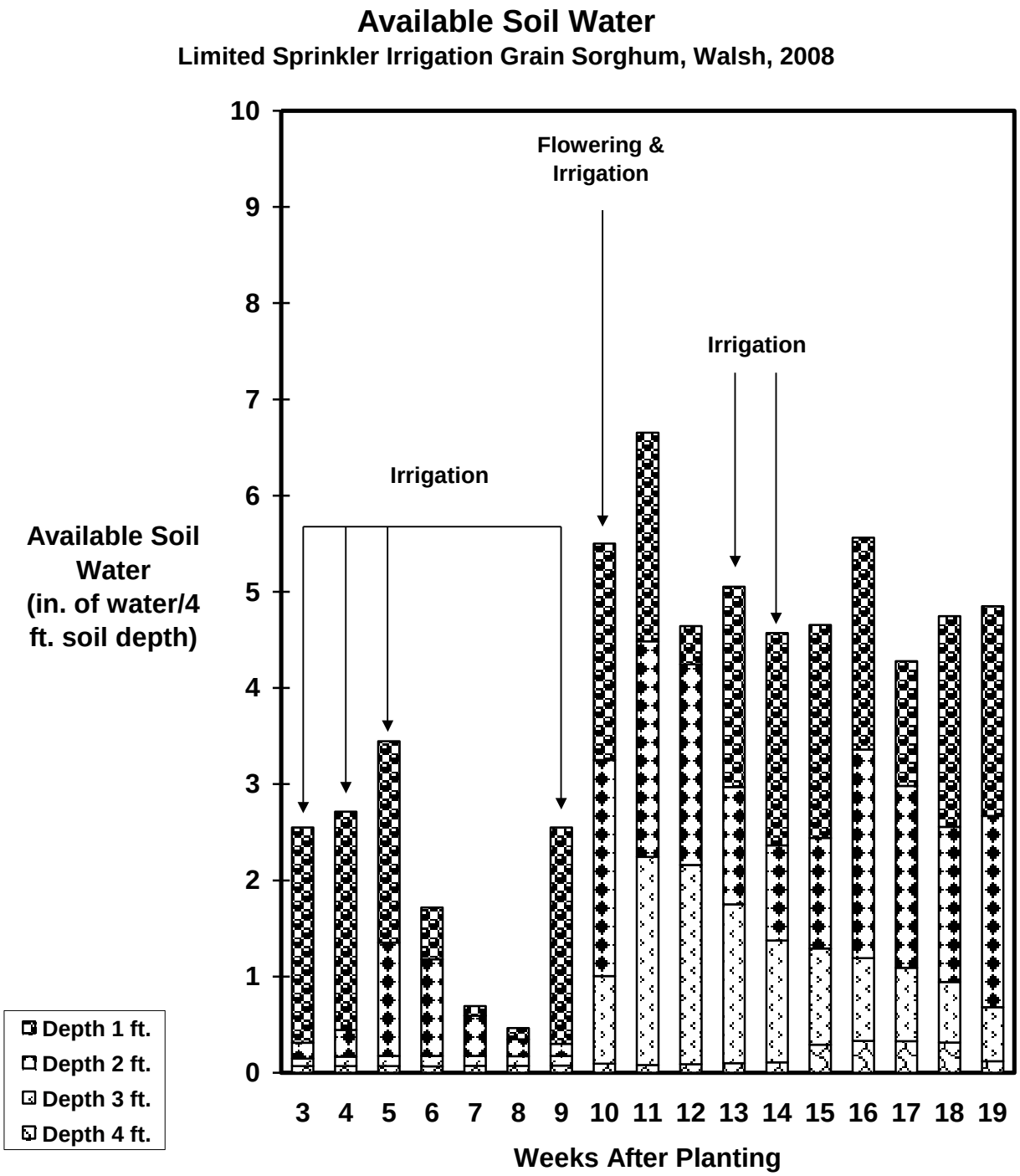

Fig. 4. Available soil water in irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.04 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 8.Limited Sprinkler Irrigation Grain Sorghum, Plainsman Research Center, Walsh, 2008.

Brand	Hybrid	50% Bloom DAP	50% Bloom GDD	50% Mature DAP	50% Mature Group	Plant Lodg	Plant Density	Seed Moisture Content	Test Wt.	Grain Yield	Yield % of Test Average
						%	plants/a (1000X)	%	lb/bu	bu/a	%
GARST	5676	59	1625	109	E	3	40.0	12.3	60	67	94
NC+	NC+ 5B37	62	1698	110	E	3	56.4	12.6	61	61	86
TRIUMPH	TR 418	56	1548	104	E	3	42.0	12.5	59	60	84
FOUR STAR SEED	4STAR 207	64	1747	112	ME	3	54.4	12.5	59	81	114
PIONEER	85G03	67	1806	113	ME	3	46.8	12.8	59	77	109
NC+	NC+ 7C22	68	1818	114	ME	8	41.6	12.5	59	76	107
PIONEER	86G08	65	1770	112	ME	20	57.2	12.4	60	75	105
NC+	NC+ 5B89	63	1721	111	ME	29	47.6	11.8	60	71	100
TRIUMPH	TR 452	67	1806	113	ME	58	48.8	12.8	60	66	93
TRIUMPH	TR 459	66	1790	115	ME	8	51.2	12.6	59	64	90
GOLDEN HARVEST	H-390W	74	1921	129	M	2	44.4	12.4	60	88	124
MYCOGEN	627	74	1921	118	M	4	55.6	12.7	58	76	107
TRIUMPH	TR 442	75	1942	117	M	18	57.6	12.2	59	72	102
NC+	NC+ 6B50	75	1942	122	M	18	54.8	12.7	59	72	101
FOUR STAR SEED	4STAR X056	73	1870	119	M	4	53.6	12.8	60	72	101
MYCOGEN	M3838	73	1894	129	M	3	46.8	12.9	60	70	98
FOUR STAR SEED	4STAR 222	74	1921	127	M	25	52.8	13.0	59	59	83
Average		68	1808	116		12	50.1	12.6	59	71	
LSD 0.20										8.8	

Planted: June 10; Harvested: November 23.

50% Flowering Date: minimum date on which a hybrid flowers on half of its population.

50% Maturity Date: minimum date on which a hybrid had mature seed on half of its population.

The limited sprinkler irrigation grain sorghum received 9.3 acre-in of applied water.

Yields are adjusted to 14.0% seed moisture content.

Table 9.--Summary: Limited Irrigation Grain Sorghum Hybrid Performance Tests at Walsh, 2006-2008.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------bu/a----------					----------%----------				
FOUR STAR SEED	4Star 207	--	94	81	88	--	--	108	114	111	--
FOUR STAR SEED	4Star 222	--	106	59	83	--	--	122	83	103	--
MYCOGEN	M3838	44	93	70	82	69	85	107	98	103	97
MYCOGEN	627	54	--	76	65	--	104	--	107	106	--
PIONEER	87G57	52	78	--	65	--	100	90	--	95	--
PIONEER	86G08	--	93	75	84	--	--	107	105	106	--
TRIUMPH	TRX0X783	57	93	--	75	--	110	107	--	109	--
TRIUMPH	TR 438	57	82	--	70	--	110	94	--	102	--
TRIUMPH	TR 442	60	86	72	79	73	114	99	102	101	105
TRIUMPH	TR 459	47	--	64	56	--	89	--	90	90	--
Average		52	87	71	79	70					

Grain Yields were corrected to 14.0% seed moisture content.

Dryland Forage Sorghum Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids under dryland conditions with 2400 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 69,700 seed/a. PLANTED: June 30. HARVESTED: October 27.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 80 F.

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

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

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

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------no. of days--------		
June	0.00	24	0	0	1
July	1.65	890	25	5	32
August	7.03	735	12	5	63
September	0.83	466	0	0	93
October	2.75	251	0	0	117
Total	12.26	2366	37	10	117

\1 Growing season from June 30 (planting) to October 24 (first freeze, 22F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture (pre-irrigated with furrow irrigation). Above average precipitation for growing season with very dry early growing season and very wet August. Weed control was good. No greenbug infestation. Lodging was minor. Forage yields were very good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.4	15	0.9	524	0.7	4.7
8"-24"				15				
Comment	Alka	VLo	VHi	Mod	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------lb/a----------			
Recommended	0	40	0	0
Applied	50	20	0	0

Yield Goal: 10 ton/a.
Actual Yield: 15.8 ton/a @ 70% MC.

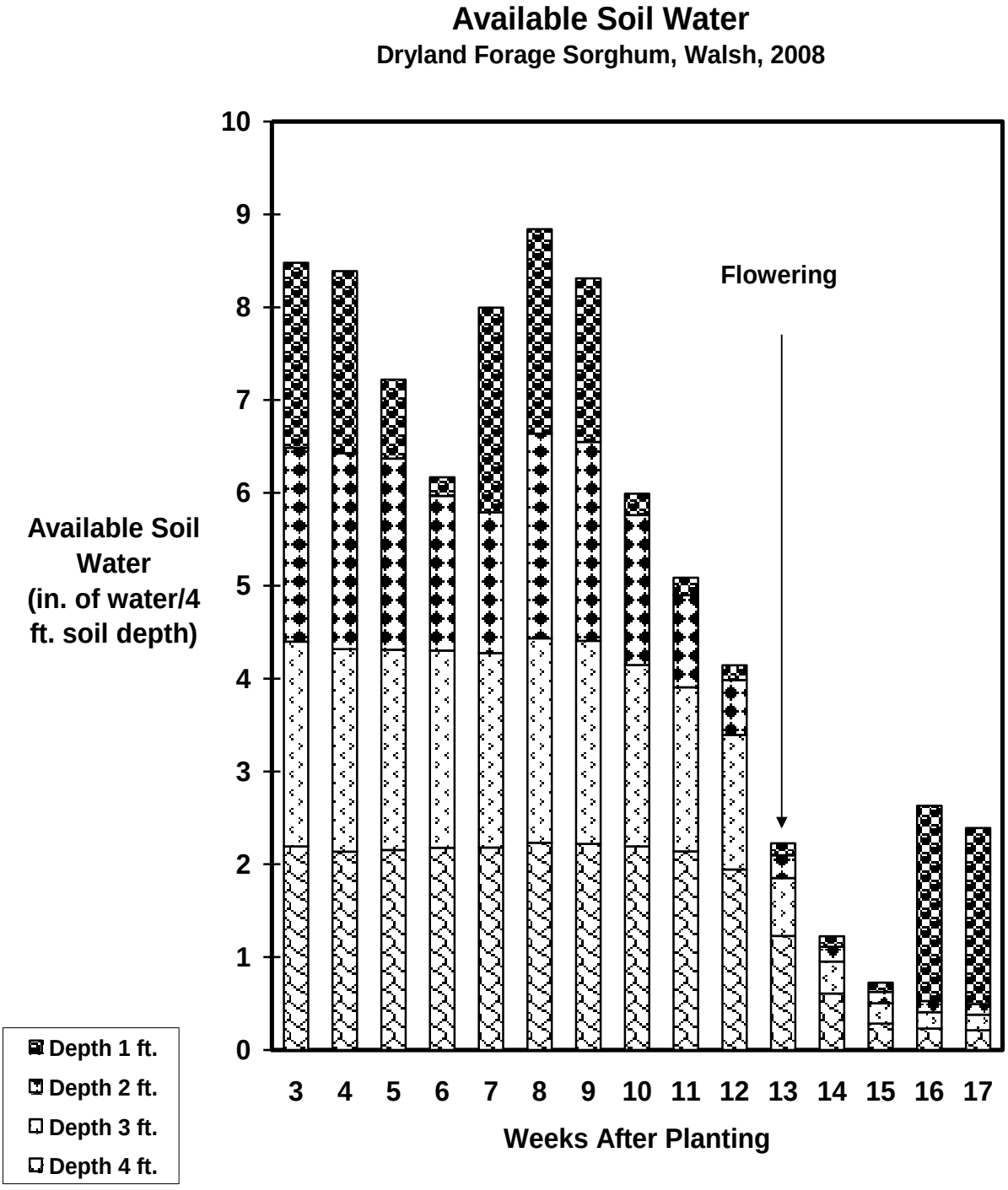

Fig. 5. Available soil water in dryland forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 12.26 in. Any increase in available soil water between weeks is from rain.

Table 10.--Dryland Forage Sorghum Hybrid Performance Trial at Walsh, 2008. \1

Brand	Hybrid	Forage Type \2	Days to Emerg	Days to 50% Bloom	Harvest Density	Plant Ht.	Stage \3 at Harvest	Stem Sugar	Plant Lodg	Forage Yield	Yield % of Test Avg.
					plants/a (1000 X)	in		%	%	tons/a	%
SORGHUM PARTNERS	NK300	FS	6	89	38.0	72	EM	17	0	19.0	120
SORGHUM PARTNERS	SS405	FS	7	96	40.1	116	PM	13	2	17.3	110
(Check)	NB 305F	FS	8	87	32.8	96	MM	18	7	16.2	103
SORGHUM PARTNERS	HIKANE II	FS	7	75	40.5	103	LM	15	3	15.5	98
SORGHUM PARTNERS	X915	FS	7	94	39.9	106	PM	10	2	15.0	95
SORGHUM PARTNERS	Sordan Headless	SS	7	103	39.1	99	FL	12	2	16.5	104
SORGHUM PARTNERS	Sordan 79	SS	7	71	39.2	115	HD	13	3	15.1	96
SORGHUM PARTNERS	Trudan 8	HS	7	68	36.0	104	HD	13	3	16.1	102
SORGHUM PARTNERS	Trudan Headless	HS	7	100	34.7	101	FL	12	2	15.4	97
SORGHUM PARTNERS	Trudan BMR	HS	7	103	33.9	84	FL	9	4	11.8	74
MISS. STATE UNIV.	M81-E	SW	7	99	32.9	107	PM	13	5	18.5	117
MISS. STATE UNIV.	Topper 76-6	SW	8	99	33.3	87	PM	18	4	15.9	100
MISS. STATE UNIV.	Dale	SW	8	94	31.0	99	PM	14	3	15.0	95
MISS. STATE UNIV.	Theis	SW	8	96	29.8	100	PM	14	3	14.1	89
MYCOGEN	2T828	Corn	5	64	27.0	89	SD	10	0	15.9	101
Average		FS	7	89	35.2	99	LM	13	3	15.8	
LSD 0.20										2.87	

\1 Planted: June 30; Harvested: October 27.

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

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

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

This study was pre-irrigated with about 8 in./a of furrow irrigation to ensure stand establishment.

Table 11.--Summary: Dryland Forage Sorghum Hybrid Performance Tests at Walsh, 2006-2008.

		Forage Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------tons/a----------					----------%----------				
MISS. STATE UNIV.	M81-E	--	12.4	18.5	15.5	--	--	108	117	113	--
MISS. STATE UNIV.	Topper 76-6	--	12.3	15.9	14.1	--	--	107	100	104	--
MISS. STATE UNIV.	Dale	--	11.4	15.0	13.2	--	--	99	95	97	--
MISS. STATE UNIV.	Theis	--	9.7	14.1	11.9	--	--	85	89	87	--
SORGHUM PARTNERS	NK 300	4.4	13.1	19.0	16.1	12.2	80	112	120	116	104
SORGHUM PARTNERS	HIKANE II	6.5	12.5	15.5	14.0	11.5	118	107	98	103	108
SORGHUM PARTNERS	Sordan 79	7.3	11.2	15.1	13.2	11.2	133	96	96	96	108
(Check)	NB 305F	4.7	14.0	16.2	15.1	11.6	85	120	103	112	103
(Check)	Corn	4.5	6.7	15.9	11.3	9.0	82	57	101	79	80
Average		5.5	11.7	15.8	13.8	11.0					

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

The site was pre-irrigated with furrow irrigation in 2008.

Table 12.--Dryland Forage Sorghum Hybrid Dry Matter Analysis at Walsh, 2008.

Brand	Hybrid	Forage Type \1	Days to Boot	Boot Plant Ht	CP	ADF	NDF	NDFD	TDN	RFV	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				in	----------%----------						-----MCal/lb-----		
SORGHUM PARTNERS	NK300	FS	81	54	8.5	37.0	54.3	77	60.3	103	0.60	0.34	0.62
SORGHUM PARTNERS	X915	FS	86	82	5.6	39.2	56.1	76	57.9	97	0.56	0.31	0.59
SORGHUM PARTNERS	HIKANE II	FS	62	66	11.4	39.5	56.1	73	57.5	96	0.56	0.30	0.56
(Check)	NB 305F	FS	73	71	8.2	42.6	62.2	70	54.0	83	0.68	0.41	0.68
SORGHUM PARTNERS	SS405	FS	86	98	4.1	46.5	67.7	62	49.6	72	0.43	0.19	0.50
SORGHUM PARTNERS	Sordan Headless	SS	96	95	5.4	41.9	58.4	72	54.8	90	0.52	0.26	0.68
SORGHUM PARTNERS	Sordan 79	SS	59	71	11.4	42.2	60.0	67	54.4	87	0.51	0.26	0.55
SORGHUM PARTNERS	Trudan BMR	HS	96	71	4.8	40.0	56.0	82	56.9	96	0.55	0.29	0.58
SORGHUM PARTNERS	Trudan Headless	HS	96	92	5.2	42.2	59.8	72	54.4	87	0.51	0.26	0.55
SORGHUM PARTNERS	Trudan 8	HS	56	69	9.1	44.7	62.3	66	51.6	81	0.47	0.22	0.52
MISS. STATE UNIV.	Dale	SW	86	81	7.2	37.2	52.7	89	60.2	106	0.60	0.34	0.62
MISS. STATE UNIV.	Topper 76-6	SW	87	80	6.6	38.3	58.1	75	58.9	95	0.50	0.25	0.55
MISS. STATE UNIV.	Theis	SW	87	90	6.0	40.1	57.1	79	56.9	94	0.55	0.29	0.58
MISS. STATE UNIV.	M81-E	SW	89	86	6.3	42.1	64.8	69	54.5	81	0.51	0.26	0.55
MYCOGEN	2T828	Corn	62	78	11.8	40.5	58.0	64	56.7	92	0.54	0.28	0.57
Average		FS	80	79	7.4	40.9	58.9	73	55.9	91	0.54	0.28	0.58

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

Infrared analysis performed on whole plant samples taken at boot.

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

Irrigated Forage Sorghum Hybrid Performance Trial at Walsh, 2008

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

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

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 113,250 seed/a. PLANTED: June 30. HARVESTED: October 28.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 80 F.

IRRIGATION: Two furrow irrigations: June 23 and Septmeber 17, total applied 12 a-in./a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 24 oz/a, 2,4-D 0.5 lb/a. Post Emergence Herbicides: Atrazine 1.0 lb/a, Banvel 3 oz/a, COC 32 oz/a. CULTIVATION: Once. 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	0.00	24	0	0	1
July	1.65	890	25	5	32
August	7.03	735	12	5	63
September	0.83	466	0	0	93
October	2.75	251	0	0	117
Total	12.26	2366	37	10	117

\1 Growing season from June 30 (planting) to October 24 (first freeze, 22F).
\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. Above average precipitation for growing season with very dry early growing season and very wet August.Weed control was good. No greenbug infestation. Lodging was minor. Forage yields were good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.4	15	0.9	524	0.7	4.7
8"-24"				15				
Comment	Alka	VLo	VHi	Mod	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------lb/a----------			
Recommended	0	40	0	0
Applied	50	20	0	0

Yield Goal: 18 ton/a.
Actual Yield: 16.9 ton/a @ 70% MC.

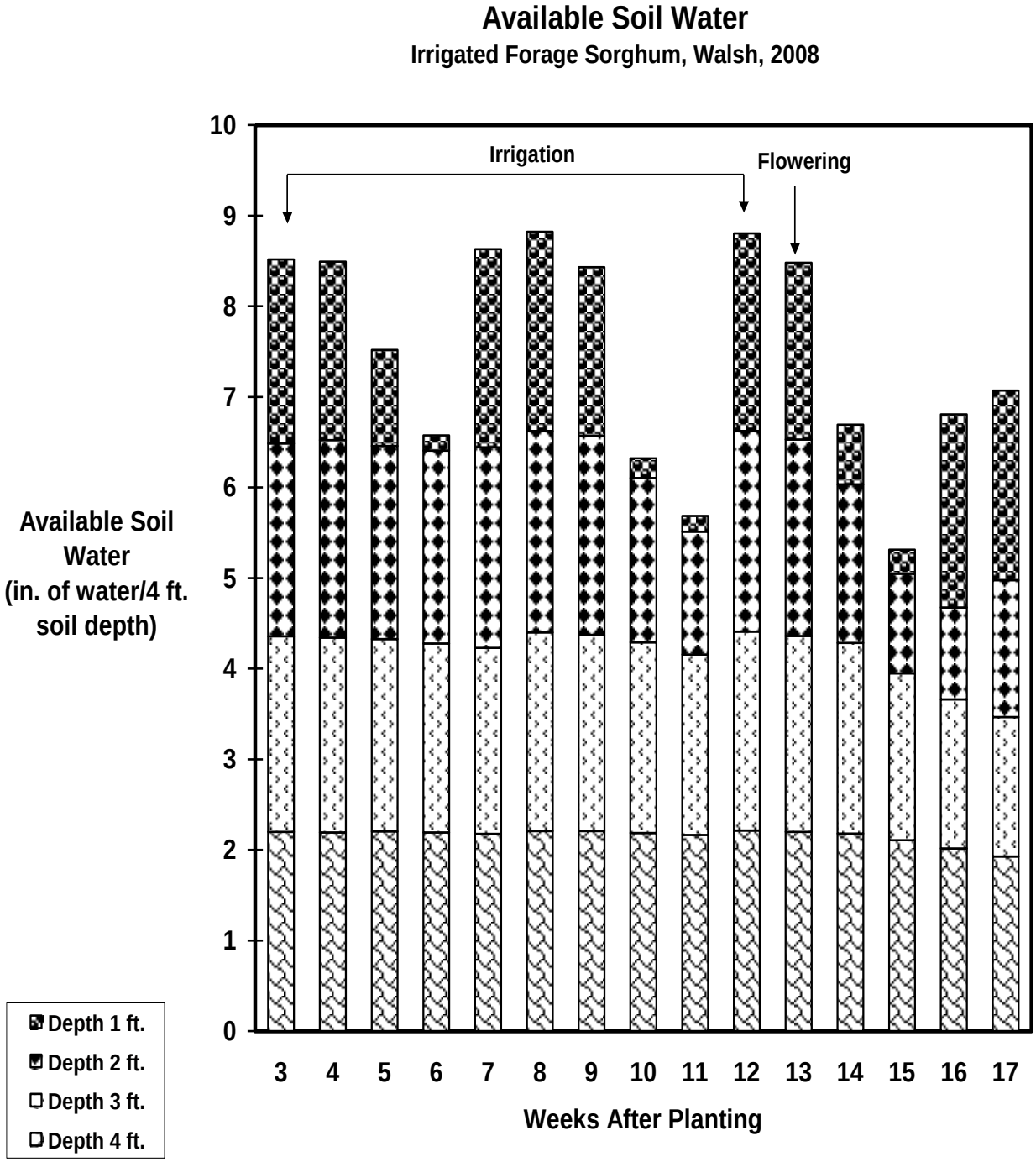

Fig. 6. Available soil water in irrigated forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 12.26 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 13.--Irrigated Forage Sorghum Hybrid Performance Trial at Walsh, 2008. \1

Brand	Hybrid	Forage Type \2	Days to Emerg	Days to 50% Bloom	Harvest Density	Plant Ht.	Stage \3 at Harvest	Stem Sugar	Plant Lodg	Forage Yield	Yield % of Test Avg.
					plants/a (1000 X)	in		%	%	tons/a	%
SORGHUM PARTNERS	NK300	FS	6	89	52.9	82	EM	16	2	19.4	115
SORGHUM PARTNERS	SS405	FS	7	96	55.9	114	PM	14	5	16.9	100
SORGHUM PARTNERS	HIKANE II	FS	7	75	52.3	104	LM	14	4	16.6	98
(Check)	NB 305F	FS	8	86	43.5	100	MM	17	2	16.4	97
SORGHUM PARTNERS	X915	FS	7	94	47.7	110	PM	11	6	16.0	94
SORGHUM PARTNERS	Sordan Headless	SS	7	103	57.3	114	FL	10	2	18.0	107
SORGHUM PARTNERS	Sordan 79	SS	7	71	49.2	112	HD	14	2	17.1	101
SORGHUM PARTNERS	Trudan Headless	HS	8	100	42.0	109	FL	13	2	16.8	99
SORGHUM PARTNERS	Trudan 8	HS	7	69	54.6	105	HD	9	1	16.2	96
SORGHUM PARTNERS	Trudan BMR	HS	7	103	51.0	98	FL	11	1	13.4	80
MISS. STATE UNIV.	Dale	SW	7	96	52.7	112	PM	14	4	18.2	108
MISS. STATE UNIV.	Topper 76-6	SW	8	100	53.7	98	PM	18	4	17.4	103
MISS. STATE UNIV.	M81-E	SW	8	103	36.4	107	PM	12	5	17.2	102
MISS. STATE UNIV.	Theis	SW	8	94	43.2	113	PM	13	4	15.5	92
MYCOGEN	2T828	Corn	5	64	34.4	94	SD	10	0	18.5	109
Average		FS	7	90	48.5	105	LM	13	3	16.9	
LSD 0.20										2.98	

\1 Planted: June 30; Harvested: October 28.

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

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

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

Table 14.--Summary: Irrigated Forage Sorghum Hybrid Performance Tests at Walsh, 2006-2008.

		Forage Yield					Yield as % of Test Average				
Brand	Hybrid	2006	2007	2008	2-Year Avg	3-Year Avg	2006	2007	2008	2-Year Avg	3-Year Avg
		----------tons/a----------					----------%----------				
MISS. STATE UNIV.	M81-E	--	27.9	17.2	22.6	--	--	118	102	110	--
MISS. STATE UNIV.	Topper 76-6	--	26.5	17.4	22.0	--	--	112	103	108	--
MISS. STATE UNIV.	Dale	--	24.4	18.2	21.3	--	--	103	108	106	--
MISS. STATE UNIV.	Theis	--	22.1	15.5	18.8	--	--	93	92	93	--
SORGHUM PARTNERS	NK 300	19.3	24.8	19.4	22.1	21.2	125	104	115	110	115
SORGHUM PARTNERS	HIKANE II	12.8	21.8	16.6	19.2	17.1	82	92	98	95	91
SORGHUM PARTNERS	Sordan 79	18.8	24.8	17.1	21.0	20.2	121	104	101	103	109
(Check)	NB 305F	10.2	25.6	16.4	21.0	17.4	66	108	97	103	90
(Check)	Corn	16.5	21.1	18.5	19.8	18.7	107	89	109	99	102
Average		15.5	23.7	16.9	20.3	18.7					

Forage Yields were corrected to 70% moisture content based on oven-dried sample.

Table 15.--Irrigated Forage Sorghum Hybrid Dry Matter Analysis at Walsh, 2008.

Brand	Hybrid	Forage Type \1	Days to Boot	Boot Plant Ht	CP	ADF	NDF	NDFD	TDN	RFV	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				in	----------%----------						-----MCal/lb-----		
SORGHUM PARTNERS	NK300	FS	81	56	5.6	39.2	57.2	77	57.8	95	0.56	0.31	0.59
SORGHUM PARTNERS	HIKANE II	FS	62	66	10.0	39.9	57.0	76	57.0	94	0.55	0.29	0.58
SORGHUM PARTNERS	X915	FS	86	93	6.4	39.8	57.1	76	57.2	94	0.55	0.30	0.58
(Check)	NB 305F	FS	73	72	7.6	39.9	59.3	77	57.0	91	0.55	0.29	0.58
SORGHUM PARTNERS	SS405	FS	86	104	3.3	46.1	67.3	66	50.0	73	0.44	0.19	0.50
SORGHUM PARTNERS	Sordan 79	SS	60	73	11.3	42.5	61.3	67	54.1	85	0.51	0.25	0.55
SORGHUM PARTNERS	Sordan Headless	SS	96	93	5.2	43.8	61.6	70	52.7	83	0.48	0.23	0.53
SORGHUM PARTNERS	Trudan BMR	HS	96	75	3.8	41.7	58.8	81	55.1	89	0.52	0.27	0.56
SORGHUM PARTNERS	Trudan Headless	HS	96	98	4.3	42.1	59.3	73	54.5	88	0.51	0.26	0.55
SORGHUM PARTNERS	Trudan 8	HS	56	71	11.1	41.9	59.5	71	54.8	88	0.52	0.26	0.56
MISS. STATE UNIV.	Dale	SW	85	90	4.5	39.9	54.4	90	57.1	99	0.55	0.29	0.58
MISS. STATE UNIV.	Theis	SW	87	94	5.0	40.9	59.2	77	55.9	90	0.53	0.28	0.57
MISS. STATE UNIV.	Topper 76-6	SW	86	85	5.1	41.0	61.3	73	55.8	86	0.53	0.28	0.57
MISS. STATE UNIV.	M81-E	SW	89	94	4.4	42.2	64.0	71	54.4	81	0.51	0.26	0.55
MYCOGEN	2T828	Corn	62	81	11.4	40.7	57.8	68	56.2	92	0.54	0.28	0.57
Sorghum Average		FS	80	83	6.6	41.4	59.7	74	55.3	89	0.52	0.27	0.56

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

Infrared analysis performed on whole plant samples taken at boot.

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

Expanding Bio-Based Energy Crop Options for Dryland Systems

Kevin Larson, Dennis Thompson, Deborah Harn, James Wittler, Timothy Macklin

Semi-Annual Report, November 2008

Evaluation of Forage and Sweet Sorghums Second Cropping Year

Procedure: Forage and Sweet Sorghums

Four sweet sorghum varieties and four forage sorghum hybrids were planted into a dryland no-till system on June 30, 2008. The site was pre-irrigated because there was insufficient winter and spring moisture for seed germination and growth. Early in the season, notes were taken at emergence and plant densities were measured. Gypsum block were install and soil moisture readings were recorded every week. To derive a formula to estimate *in situ* ethanol yield of these sweet and forage sorghums, we made forage yield estimates and stock sugar content readings. For the forage yield estimates, we measured plant density, plant height, stock diameter, and plant weight. To determine the internode that corresponds to percent sugar of entire stock, we measured the 3nd, 5th, 7th, and 9th internodes for stock diameter with a digital caliper and percent sugar with a hand refractometer at boot, flowering, milk, and dough (only one hybrid, Sordan 79, reached the dough stage). Plants were milled with a manual cane press to extract overall stock juice. This juice was measured with refractometer to determine sugar percentage of overall stock juice for each hybrid/variety at all four developmental stages, or the most advanced development stage at first freeze. Two plants were harvested at each developmental stage: the stock of one plant was press for overall percent sugar, and the second plant was deconstructed and the leaves, head, and stock were weighed and oven-dried to determine dry weight and plant moisture of leaves, head, and stock. This entire dryland forage study was harvested with a silage chopper on October 27, 2008 (Table 1). The silage from each plot was weighed and a representative sample of each hybrid/variety was oven-dried for moisture content and silage yields were adjusted to 70% moisture content.

Last year, we found that our manual cane press would only expel an average of 17% of the theoretical stock juice, and this varied greatly with stock diameter. Our manual cane press was good for determining the overall Brix readings for the entire stock, but not for total juice yields. We were unable to find a small-scale, commercially available hydraulic press that would produce commercially acceptable extraction levels of stock juice. However, we did determine that total stock sugar could be extracted by finely chopping the stocks, adding water, and heating the mixture to 80C for 30 minutes, then pressing the mixture with a fruit press to extract the juice (N. Larson, 2007, reprinted in this booklet). By repeating the above procedure on the same chopped stocks, we obtained stock sugar amounts similar to theoretical stock sugar amounts derived by Brix readings at the 6th internode and measuring stock water (water loss from drying wet stocks). Stock water divided by 100-Brix/100 is stock juice. Stock juice minus stock water is stock sugar.

To derive potential ethanol production of the sweet and forage sorghum hybrids, we converted the moisture adjusted silage yield obtained at each developmental stage to get dry silage yield, times the whole plant moisture to get wet silage yield, times the wet stock to plant ratio to get wet stock yield, times the stock moisture to get stock

water, times the average Brix readings from the 5th and 7th internodes to get stock juice (lb/a), divided by the juice conversion from pounds to gallons (0.335(Brix) + 8.325) to get stock juice (gal/a), times potential ethanol (Brix(0.6)-1) to get potential ethanol yield (gal/a).

Results and Discussion: Forage and Sweet Sorghums

Last year, refractometer readings of stock juice were taken at the 2nd, 4th, 6th, and 8th internodes at boot, flowering, early milk, and late milk to determine which internode readings most closely corresponded to the percent sugar of the overall stock juice. Last year, we found that the internode that corresponded to the percent sugar of the overall stock juice was the 7th internode. This year, to better target the best corresponding internode, we took stock readings at the 3rd, 5th, 7th and 9th internodes. This year, the percent sugar for the overall stock juice for forage and sweet sorghums was best represented by the refractometer readings from the 5th internode at all four developmental stages (Table 2). Reviewing the internode refractometer readings for the past two seasons indicates that the 6th internode provided the best representation of percent sugar for the whole stock, 7th internode for 2007 and 5th internode for 2008, (Fig. 1).

This year, the parameters we used to measure forage yield estimates were: 1) the average stock diameter of the 5th and 7th internodes (in.), 2) stock count from 11ft. of one row (2.5ft. x 11ft.), and 3) plant height (in.). To derive a constant for estimated silage yields based on these parameters, we used the parameter product divided by the silage yield calculated at each developmental stage. We found that sorghum class (SS, Sorghum x Sudan; FS, Forage Sorghum, and SW, Sweet Sorghum) differentiated more than developmental stages. The constants we obtained for the sorghum classes from boot through soft dough were 0.004402 for SS, 0.005384 for FS, and 0.006262 for SW (Table 3). These constants times the parameter products provided good estimates of silage yields ($F(8,8) = 2.3496$, $P = 0.2483$). In 2007, the constants were 0.007838 for SS, 0.01054 for FS, and 0.006231 for SW. The class constants that we calculated this year are much lower than the constants obtained last, except for the class constant for sweet sorghums (0.006262 in 2008, and 0.006231 in 2007). With the exception of the class constants for sweet sorghum, the class constants are too variable between years to provide a reasonable estimate of silage yields.

The final harvest juice constant for all the hybrids/varieties tested provided acceptable estimates of the potential ethanol yield ($F(7,7) = 0.7334$, $P = 0.6928$) (Table 4). This year, the juice constants are much larger than the juice constants obtained last year; for example, the average juice constants for sweet sorghums at final harvest were 193.2 for 2008 and 124.6 for 2007 (Tables 4 and 5). The juice constants are too variable between years to provide a reasonable estimate of juice yields and resultant ethanol yields. The problem of predicting ethanol yield (Table 6) is further compounded by our model's inability to predict silage yield, since estimated ethanol yield is a product of estimated silage yield. Our silage and ethanol yield model from measuring plant height, plant density, stock diameter, and stock Brix does not provide adequate yield constants to make it a suitable predictive tool.

Evaluation of High Starch and Conventional Starch Grain Sorghum Second Cropping Year

Procedure: Grain Sorghum

This year we planted six high starch and twelve conventional starch grain sorghums into a no-till dryland system on June 10, 2008 (Table 7). This year we will evaluate five high starch and six conventional starch grain sorghum hybrids for ethanol production. The site was pre-irrigated because there was insufficient winter and spring moisture for seed germination and growth. Early in the season, notes were taken at emergence and plant densities were measured. Gypsum block were install and soil moisture readings were recorded every week. For each hybrid, we recorded the date when 50% of the stocks flowered and the date when 50% of the stock had mature seeds. With the harvested grain from this study, we will conduct the same tests and procedures that we conducted the previous year.

In 2007, we planted and evaluated five high starch and seven conventional starch grain sorghums into a dryland no-till system on June 5, 2007. We took the measurements and notes stated previous for the grain study prior to grain harvest, and we harvested the study on October 29, 2007. At grain harvest, we measured plant height, plant lodging, and grain yield. We took grain samples from each hybrid and measured grain moisture and test weight. Grain yields are adjusted to 14% seed moisture content. From these grain samples we measured ethanol yield by milling the grain, adding water and enzymes and heating the mash to convert the starch into sugar, pitching in the yeast and fermenting the mash, and distilling the mash (beer), and measuring the volume, weight and proof of the distill ethanol.

Results and Discussion: Grain Sorghum

The five high starch grain sorghums are designated by their NC+ brand. The high starch grain sorghums produced equivalent grain yields compared to the conventional starch grain sorghums (Table 8). There was no difference in overall ethanol production between high starch and conventional starch grain sorghum hybrids (Table 9). Ethanol production per bushel averaged identical yields of 2.42 gal/bu for both high starch and conventional starch grain sorghum hybrids. Total ethanol production averaged within 0.1 gal/a for both high starch and conventional starch grain sorghums. A comparison of the high starch to conventional starch grain sorghums revealed that there were no differences between the average grain yield, ethanol production (gal/bu), and total ethanol production (gal/a).

Conditions were extremely dry at planting; therefore, we chose NC+ 5B89 for our field production of high starch grain sorghum for the commercial ethanol plant comparison of high starch and conventional starch grain sorghums. We selected NC+ 5B89 because it was the highest yielding, early maturing, high starch grain sorghum hybrid tested in 2007. Unfortunately, the ethanol plant at Walsh closed down before they could compare ethanol production between high starch and conventional starch grain.

Table 1.--Dryland Forage Sorghum Hybrid Performance Trial at Walsh, 2008. \1

Brand	Hybrid	Forage Type \2	Days to Emerg	Days to 50% Bloom	Harvest Density	Plant Ht.	Stage \3 at Harvest	Stem Sugar	Plant Lodg	Forage Yield	Yield % of Test Avg.
					plants/a (1000 X)	in		%	%	tons/a	%
SORGHUM PARTNERS	NK300	FS	6	89	38.0	72	EM	17	0	19.0	120
SORGHUM PARTNERS	SS405	FS	7	96	40.1	116	PM	13	2	17.3	110
(Check)	NB 305F	FS	8	87	32.8	96	MM	18	7	16.2	103
SORGHUM PARTNERS	HIKANE II	FS	7	75	40.5	103	LM	15	3	15.5	98
SORGHUM PARTNERS	X915	FS	7	94	39.9	106	PM	10	2	15.0	95
SORGHUM PARTNERS	Sordan Headless	SS	7	103	39.1	99	FL	12	2	16.5	104
SORGHUM PARTNERS	Sordan 79	SS	7	71	39.2	115	HD	13	3	15.1	96
SORGHUM PARTNERS	Trudan 8	HS	7	68	36.0	104	HD	13	3	16.1	102
SORGHUM PARTNERS	Trudan Headless	HS	7	100	34.7	101	FL	12	2	15.4	97
SORGHUM PARTNERS	Trudan BMR	HS	7	103	33.9	84	FL	9	4	11.8	74
MISS. STATE UNIV.	M81-E	SW	7	99	32.9	107	PM	13	5	18.5	117
MISS. STATE UNIV.	Topper 76-6	SW	8	99	33.3	87	PM	18	4	15.9	100
MISS. STATE UNIV.	Dale	SW	8	94	31.0	99	PM	14	3	15.0	95
MISS. STATE UNIV.	Theis	SW	8	96	29.8	100	PM	14	3	14.1	89
MYCOGEN	2T828	Corn	5	64	27.0	89	SD	10	0	15.9	101
Average		FS	7	89	35.2	99	LM	13	3	15.8	
LSD 0.20										2.87	

\1 Planted: June 30; Harvested: October 27.

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

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

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

This study was pre-irrigated with about 8 in./a of furrow irrigation to ensure stand establishment.

Table 2.-Internode Brix Reading Compared to Whole Stock Juice Brix Reading, Walsh, 2008.

Hybrid	Internode 3	Internode 5	Internode 7	Internode 9	**Whole Stock**	internode 3	internode 5	internode 7	internode 9
	%sugar					difference from actual			
Boot									
Sordan 79	2.8	3.9	4.3	6.0	**4.4**	-1.6	-0.5	-0.1	1.6
HiKane II	3.6	3.9	4.9	6.9	**4.6**	-1.0	-0.7	0.3	2.3
NB 305F	7.3	8.4	7.1	6.3	**6.7**	0.6	1.7	0.4	-0.4
NK 300	6.9	7.6	8.7	7.1	**7.8**	-0.9	-0.2	0.9	-0.7
Average	5.2	**6.0**	6.3	6.6	**5.9**	-0.7	**0.1**	0.4	**0.7**
Flowering									
Sordan 79	4.4	5.5	5.8	6.4	**5.3**	-0.9	0.2	0.5	1.1
HiKane II	5.8	7.2	8.3	8.6	**8.4**	-2.6	-1.2	-0.1	0.2
NB 305F	11.2	13.9	14.2	10.5	**12.5**	-1.3	1.4	1.7	-2.0
NK 300	10.3	11.5	12.0	10.5	**12.0**	-1.7	-0.5	0.0	-1.5
Average	7.9	**9.5**	10.1	9.0	**9.6**	-1.6	**0.0**	0.5	-0.6
Milk									
Sordan 79	8.4	11.5	13.8	15.1	**12.1**	-3.7	-0.6	1.7	3.0
HiKane II	14.5	15.4	14.8	16.9	**16.5**	-2.0	-1.1	-1.7	0.4
NB 305F	15.0	16.9	18.7	18.9	**18.8**	-3.8	-1.9	-0.1	0.1
Average	12.6	14.6	**15.8**	17.0	**15.8**	-3.2	-1.2	**0.0**	1.2
Soft Dough									
Sordan 79	9.0	9.8	**11.6**	13.6	**11.5**	-2.5	-1.7	**0.1**	2.1
Boot									
Theis	8.5	9.9	8.8	8.7	**9.4**	-0.9	0.5	-0.6	-0.7
Dale	9.4	11.5	10.6	8.3	**8.3**	1.1	3.2	2.3	0.0
Topper 76	10.0	12.0	8.8	7.3	**10.2**	-0.2	1.8	-1.4	-2.9
M81E	6.6	8.8	7.1	7.5	**8.5**	-1.9	0.3	-1.4	-1.0
Average	8.6	10.6	**8.8**	8.0	**9.1**	-0.5	1.5	**-0.3**	-1.2
Flowering									
Theis	10.8	12.9	15.5	15.5	**13.8**	-3.0	-0.9	1.7	1.7
Dale	11.0	12.8	14.9	14.2	**13.1**	-2.1	-0.3	1.8	1.1
Topper 76	13.4	16.0	16.9	17.0	**15.4**	-2.0	0.6	1.5	1.6
M81E	8.4	10.2	11.0	11.3	**10.2**	-1.8	0.0	0.8	1.1
Average	10.9	**13.0**	14.6	14.5	**13.1**	-2.2	**-0.2**	1.5	1.4
Average	**9.0**	**10.6**	**11.2**	**11.4**	**10.8**	**-1.8**	**-0.3**	**0.4**	**0.6**

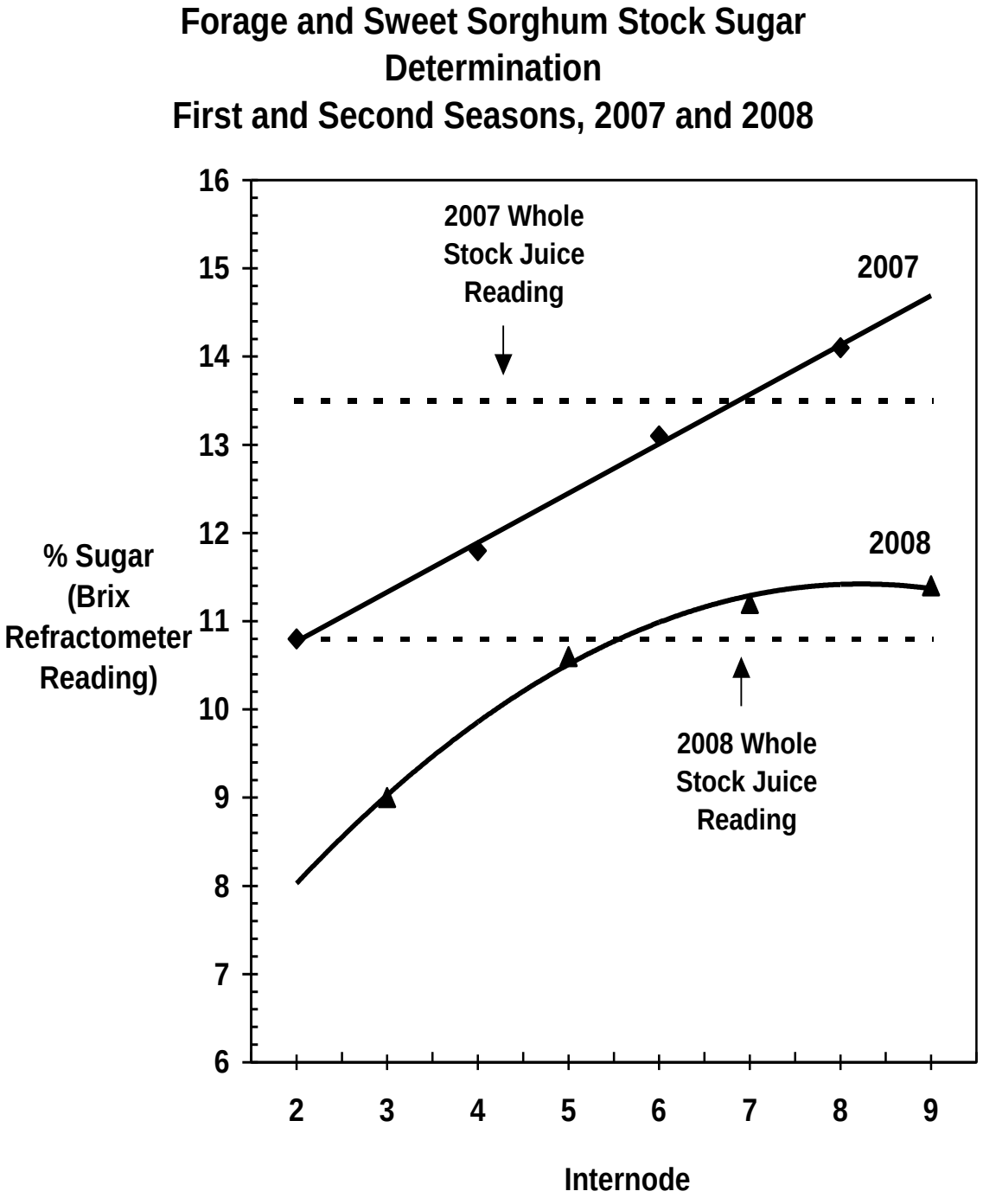

Fig. 1. Forage and sweet sorghum internode stock sugar determination. Average Brix readings (% sugar) of stock juice from four forage and four sweet sorghum hybrids were taken from boot to soft dough at 2, 4, 6, and 8 internodes for 2007 and 3, 5, 7, and 9 internodes for 2008 and compared to whole stock juice readings.

Table 3.-Dryland Forage and Sweet Sorghums, Parameters and Constants for Silage Estimate, 2008.

Sorghum Class	Developmental Stage	Measured Parameters Product	Measured Silage Yield	Developmental Stage Constant	Measured Parameters Product	Class Constant	Estimated Silage Yield
			tons/a				tons/a
SS	Boot	1562.4	4.26	0.002727	1562.4	0.004402	6.88
SS	Flower	2049.0	7.94	0.003875	2049.0	0.004402	9.02
SS	Milk	2726.5	12.98	0.004761	2726.5	0.004402	12.00
SS	Soft Dough	2821.5	15.13	0.005362	2821.5	0.004402	12.42
Average SS		2289.9	10.08	0.004402	2289.9	0.004402	10.08
FS	Boot	1765.9	8.44	0.004778	1765.9	0.005384	9.51
FS	Flower	2293.3	12.75	0.005544	2293.3	0.005384	12.35
FS	Milk	2822.0	15.86	0.005620	2822.0	0.005384	15.19
Average FS		2293.7	12.35	0.005384	2293.7	0.005384	12.35
SW	Boot	1867.1	10.28	0.005541	1867.1	0.006262	11.69
SW	Flower	2310.6	15.87	0.006945	2310.6	0.006262	14.47
Average SW		2088.9	13.08	0.006262	2088.9	0.006262	13.08

Sorghum Class: SS, Sorghum X Sudan Grass; FS, Forage Sorghum; SW, Sweet Sorghum.
Measured Parameters: average of fifth and seventh internode diameters (in.) x stock count (11ft of one row, 2.5ft. x 11ft.) x plant height (in.).
Silage Yield: tons/a at 70% moisture content based on oven-dried sample.

Table 4.-Forage and Sweet Sorghums: Silage, Plant Measurements, and Juice Factor Determinations at Final Harvest, 2008.

Hybrid/ Variety	Stage	Silage Yield	Dry Silage Yield	Whole Plant Moist.	Wet Silage Yield	Wet Stock to Plant	Wet Stock Yield	Stock Moist.	Stock Water	Stock Brix	Stock Sugar Yield	Stock Juice Yield	Stock Juice Conver.	Stock Juice Yield	Juice Factor
		tons/a (70% MC)	lb/a	ratio	lb/a	ratio	lb/a	ratio	lb/a	%	lb/a	lb/a	lb/gal	gal/a	
Sordan 79	SD	15.13	9078	0.7421	35200	0.7597	26741	0.7846	20981	10.7	2514	23495	8.6835	2707	178.9
HiKane II	MM	15.48	9288	0.7333	34825	0.7968	27748	0.7507	20831	15.1	3706	24537	8.8309	2778	179.4
NB 305F	MM	16.24	9744	0.7402	37506	0.7479	28051	0.7532	21128	17.8	4576	25704	8.9213	2881	177.4
NK 300	FL	18.99	11394	0.7861	53268	0.6751	35961	0.8214	29539	11.8	3952	33491	8.7203	3841	202.3
Avg. SS & FS	**MM**	**16.46**	**9876**	**0.7504**	**40200**	**0.7449**	**29625**	**0.7775**	**23120**	**13.9**	**3687**	**26807**	**8.7890**	**3052**	**184.5**
Theis	FL	14.14	8484	0.7405	32694	0.8127	26570	0.7543	20042	14.2	3317	23359	8.8007	2654	187.7
Dale	FL	15.03	9018	0.7510	36217	0.7720	27960	0.7561	21140	13.9	3412	24552	8.7907	2794	185.9
Topper 76-6	FL	15.85	9510	0.7399	36563	0.7497	27411	0.7480	20504	16.5	4051	24555	8.8778	2765	174.4
M81-E	FL	18.47	11082	0.7799	50350	0.7999	40275	0.7997	32208	10.6	3820	36028	8.6801	4150	224.7
Avg. SW	**FL**	**15.87**	**9524**	**0.7528**	**38956**	**0.7836**	**30554**	**0.7645**	**23474**	**13.8**	**3650**	**27124**	**8.7873**	**3091**	**193.2**
Overall Average		**16.17**	**9700**	**0.7516**	**39578**	**0.7642**	**30090**	**0.7710**	**23297**	**13.8**	**3669**	**26965**	**8.7882**	**3071**	**188.8**

Whole Plant Moisture and Stock Moisture are from oven-dried deconstructed plant sample.
Wet Stock to Plant ratio is from deconstructed plant sample.
Stock Juice Yield (lb/a) is Stock Water divide by 100-Brix/100.
Stock Juice Conversion (lb/gal) is Stock Juice Yield (lb/a) divided by lb/gal at various Brix readings, 0.335(Brix) + 8.325 lb/gal, i.e., stock sugar + stock water in lb/gal.
Stock Juice Yield (gal/a) is Stock Juice Yield (lb/a) divided by Stock Juice Conversion (lb/gal).
Juice Factor is Stock Juice Yield (gal/a) divided by Silage Yield (tons/a @ 70% MC).

Table 5.-Dryland Forage and Sweet Sorghums, Silage and Stock Juice Yield, Walsh, 2007.

Brand	Hybrid/ Variety	Stage	Plant Density	Stock Sugar	Silage Yield	Stock Juice Yield	Eth. Yield	Juice Factor	Theor. Stock Juice Yield	Theor. Ethanol Yield
			plants/a X1000	%	ton/a	gal/a	gal/a		gal/a	gal/a
Forage Sorghum										
Sorghum Partners	Sordan 79	ED	54.9	12.9	15.1	154	10.9	128.1	1935	137.3
Sorghum Partners	HiKane II	ED	54.9	14.0	18.8	349	26.9	113.0	2119	163.2
(Check)	NB 305F	ED	50.5	15.7	20.9	365	31.5	91.7	1912	165.1
Sorghum Partners	NK300	ED	48.1	14.0	16.0	122	9.4	91.5	1464	112.7
Average Forage Sorghum		**ED**	**52.1**	**14.2**	**17.7**	**247**	**19.7**	**106.1**	**1858**	**144.6**
Sweet Sorghum										
Miss. State Univ.	Theis	EM	41.3	16.0	17.2	290	25.5	141.2	2432	214.0
Miss. State Univ.	Dale	FL	48.9	17.3	19.2	372	35.3	104.1	1995	189.8
Miss. State Univ.	Topper 76-6	BT	47.7	20.8	16.4	167	19.1	113.4	1865	213.3
Miss. State Univ.	M81-E	Pre BT	47.3	15.2	16.9	173	14.5	139.2	2358	197.1
Average Sweet Sorghum		**FL**	**46.3**	**17.3**	**17.4**	**250**	**23.6**	**124.5**	**2162**	**203.6**
Average			49.2	15.7	17.6	249	21.6	115.3	2010	174.1
LSD 0.20				0.84	2.82	66.4	5.73		333.1	28.76

Planted: June 5 at 69.7 seeds/a x 1000. Harvest Area: 21.75 ft. x 2.5 ft.
Stage: Pre BT, pre boot; BT, boot; FL, flowering; EM, early milk; LM, late milk; ED, early dough.
Silage Yield was adjusted to 70% moisture content based on oven-dried sample.

Table 6 .-Dryland Forage and Sweet Sorghums, Final Harvest Silage and Potential Ethanol Yield, Walsh, 2008.

Brand	Hybrid/ Variety	Harvest Stage	Silage Yield	Juice Factor	Juice Yield	Stock Brix Reading	Potential Alcohol	Potential Ethanol Yield	Final Harvest Juice Factor	Estimated Juice Yield	Estimated Potential Ethanol Yield
			tons/a 70% MC		gal/a	%	% v/v	gal/a		gal/a	gal/a
Forage Sorghum											
Sorghum Partners	Sordan 79	SD	15.13	178.9	2707	10.7	5.42	146.7	188.8	2857	154.8
Sorghum Partners	HiKane II	MM	15.48	179.4	2778	15.1	8.06	223.9	188.8	2923	235.6
(Check)	NB 305F	MM	16.24	177.4	2881	17.8	9.68	278.9	188.8	3066	296.8
Sorghum Partners	NK300	FL	18.99	202.3	3841	11.8	6.08	233.6	188.8	3585	218.0
Sweet Sorghum											
Miss. State Univ.	Theis	FL	14.14	187.7	2654	14.2	7.52	199.6	188.8	2670	200.8
Miss. State Univ.	Dale	FL	15.03	185.9	2794	13.9	7.34	205.1	188.8	2838	208.3
Miss. State Univ.	Topper 76-6	FL	15.85	174.4	2765	16.5	8.90	246.1	188.8	2992	266.3
Miss. State Univ.	M81-E	FL	18.47	224.7	4150	10.6	5.36	222.5	188.8	3487	186.9
Average			16.17	188.8	3071	13.8	7.30	219.6	188.8	3052	220.9
LSD 0.20			2.87								

Planted: June 30 at 69.7 seeds/a x 1000; Silage Harvested: October 27.
Harvest Stage: BT, boot; FL, flowering; PM, pre-milk; EM, early milk; MM, mid milk; LM, late milk; ED, early dough; SD, soft dough; HD, hard dough.
Juice Factor is the product of all the conversions from Silage Yield (tons/a @ 70% MC) to Juice Yield (gal/a).
Stock Brix Reading is the average refractometer juice reading from the 5th and 7th internodes.
Potential Ethanol Yield is Juice Yield times potential alcohol % v/v, Brix(0.6) - 1.

Table 7.--Dryland Grain Sorghum Hybrid Performance Test at Walsh, 2008. \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	%
ASGROW	Pulsar	7	62	1698	112	E	44	26.9	6	60	75	112
NC+	NC+ 5C35	8	58	1607	106	E	37	23.8	3	61	71	107
DEKALB	DKS29-28	8	61	1678	113	E	33	24.2	1	60	65	98
DEKALB	DK28E	8	55	1514	105	E	32	23.2	1	58	51	77
SORGHUM PARTNERS	251	8	55	1514	102	E	33	23.7	2	60	49	74
SORGHUM PARTNERS	X303	8	61	1678	112	E	35	19.8	2	59	49	74
DEKALB	DKS37-07	8	69	1830	115	ME	42	25.4	10	59	75	112
DEKALB	DKS36-16	8	68	1818	115	ME	41	22.5	1	58	73	110
NC+	NC+ 5B89	8	67	1806	115	ME	39	22.5	6	58	69	105
NC+	NC+ 5B90	7	67	1806	115	ME	38	23.3	38	60	66	99
DEKALB	DK39Y	8	63	1721	114	ME	36	22.7	1	58	63	95
SORGHUM PARTNERS	KS310	8	64	1747	114	ME/E	42	23.1	3	59	63	95
SORGHUM PARTNERS	NK5418	7	70	1840	117	M	40	23.5	1	59	77	116
NC+	NC+ 6B50	7	73	1894	118	M	42	24.6	1	58	75	113
NC+	NC+ Y363	8	72	1870	117	M/ME	44	21.7	1	59	73	110
SORGHUM PARTNERS	X510	7	76	1966	122	M	42	22.7	4	58	72	108
NC+	NC+ 7C22	8	71	1854	117	M	42	24.0	2	60	71	107
(Check)	399 X 2737	7	80	2066	128	ML	42	24.2	0	56	58	87
Average		8	66	1773	114	ME	39	23.4	5	59	66	
LSD 0.20											6.6	

\1 Planted: June 10; Harvested: November 25, 2008.

Yields are corrected 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.

This study was pre-irrigated with about 8 in./a of furrow irrigation to ensure stand establishment.

Table 8.--Dryland Grain Sorghum Hybrid Performance Test at Walsh, 2007. \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	%
ASGROW	Pulsar	9	64	1683	105	E	41	24.4	0	61	63	108
NC+	NC+ 5B89	8	65	1712	103	E	41	27.1	0	62	62	105
DEKALB	DKS29-28	9	62	1624	100	E	38	27.9	0	61	61	104
NC+	NC+ 5C35	7	61	1592	98	E	38	22.5	0	60	55	93
SORGHUM PARTNERS	KS310	7	66	1743	104	E	39	29.0	0	61	54	92
SORGHUM PARTNERS	X303	8	61	1592	99	E	39	27.5	0	62	50	86
SORGHUM PARTNERS	251	8	54	1401	92	E	35	30.2	0	60	50	86
SORGHUM PARTNERS	NK5418	8	69	1845	107	ME/M	38	26.3	0	61	72	123
NC+	NC+ 7C22	8	70	1879	109	ME	43	29.4	0	62	66	112
DEKALB	DKS37-07	9	72	1944	112	ME	41	24.4	0	62	62	105
DEKALB	DK44	8	71	1914	111	ME/M	40	21.7	0	61	61	104
SORGHUM PARTNERS	NK4420	9	72	1944	112	ME	38	27.9	0	62	61	103
NC+	NC+ Y363	8	69	1845	107	ME	42	25.2	0	61	60	103
DEKALB	DKS36-16	8	68	1810	107	ME	40	30.2	0	62	60	102
NC+	NC+ 6B50	9	80	2191	122	M	42	27.9	0	60	61	104
(Check)	399 X 2737	8	83	2267	126	ML	38	25.9	0	59	42	71
Average		8	68	1812	107	ME	40	26.7	0	61	59	
LSD 0.20											4.1	

\1 Planted: June 5; Harvested: October 29, 2007.

Yields are corrected 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 9.--Dryland Grain Sorghum Hybrid Performance and Ethanol Production Trial at Walsh, 2007. \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	Ethanol Prod.	Total Ethanol Prod.
							in	plants/a (1000 X)	lb/bu	bu/a	gal/bu	gal/a
High Starch Hybrids												
NC+	NC+ 7C22	8	70	1879	109	ME	43	29.4	62	66	2.46	161.1
NC+	NC+ 5B89	8	65	1712	103	E	41	27.1	62	62	2.41	149.2
NC+	NC+ Y363	8	69	1845	107	ME	42	25.2	61	60	2.47	148.7
NC+	NC+ 6B50	9	80	2191	122	M	42	27.9	60	61	2.37	144.8
NC+	NC+ 5C35	7	61	1592	98	E	38	22.5	60	55	2.37	129.4
Standard Starch Hybrids												
SORGHUM PARTNERS	NK5418	8	69	1845	107	ME/M	38	26.3	61	72	2.43	175.9
ASGROW	Pulsar	9	64	1683	105	E	41	24.4	61	63	2.42	153.4
DEKALB	DKS29-28	9	62	1624	100	E	38	27.9	61	61	2.50	152.5
SORGHUM PARTNERS	NK4420	9	72	1944	112	ME	38	27.9	62	61	2.50	151.8
DEKALB	DKS37-07	9	72	1944	112	ME	41	24.4	62	62	2.35	145.0
SORGHUM PARTNERS	KS310	7	66	1743	104	E	39	29.0	61	54	2.41	130.1
SORGHUM PARTNERS	251	8	54	1401	92	E	35	30.2	60	50	2.32	116.7
Average		8	67	1784	106	ME	40	26.9	61	61	2.42	146.6
LSD 0.20										4.1		
Average High Starch (NC+ Hybrids)		8	69	1844	108	ME	41	26.4	61	61	2.42	146.6
Average Standard Starch Hybrids		8	66	1741	105	E	39	27.2	61	61	2.42	146.5

\1 Planted: June 5; Harvested: October 29, 2007.

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.

Ethanol Production was derived from 7 lb grain samples that was milled, cooked, malted, fermented, and distilled.

Maximizing Sugar Extraction from Sweet Sorghum Stocks

Neil Larson

Maximizing sugar extraction from sweet sorghum stocks is the first step in determining the efficacy of ethanol production from the stock juice of sweet sorghums. On an experimental scale, we have attempted to extract stock juice with a manual cane press. This method proved to be labor intensive and low yielding. Less than 17% of the theoretical stock juice was extracted with this hand-milling method. The purpose of this study was to identify a simple, yet thorough, small-scale stock sugar extraction method.

Materials and Methods

We hand harvested about 20 plants of the sweet sorghum variety Theis at the flowering stage. After stripping the leaves and topping the heads, the stocks were first chopped then shredder in a portable chipper/shredder. We hand-stirred the chopped stock to make it a uniform mixture. For each treatment, we weighed 1000 g of chopped stocks to which we added 2000 ml of water. The four treatments we used to extract the sugar were: 1) water, 2) water at pH 3, 3) water heated to 80 ^{o}C, and 4) water at pH 3 and heated to 80 ^{o}C. N-phuric acid was used to lower the water and chopped stock mixtures to pH 3. All treatments were held at their respected states for 30 min., then the samples were poured into a fruit press and the juice was expelled with 479 Pa (10 lb/ft.^{2}) of torque. After pressing the chopped stocks, another 2000 ml of water was added and the treatments were repeated for two more runs. All treatments and runs were repeated two times. For each treatment run, the pressed juice was weighed, volume measured, and a % sugar reading was taken with a hand-held Brix refractometer.

Total available stock sugar (theoretical sugar extraction) is all the sugar in the juice in the stock. The juice in the stock is comprised of water and sugar. To determine the % sugar in the stock, we hand milled a whole stock with a cane press and took a % sugar reading of the milled juice with a hand-held Brix refractometer. To determine total water in the stock, we weighed two fresh plants, stripped the leaves and removed the heads, and weighed the leaves, heads, and stocks separately. We oven-dried the leaves, heads, and stocks at 100 ^{o}C for three days. We weighed the oven-dried samples to determine dry weighs. The total amount of water in the stock is the fresh weight minus the dry weight. The total stock sugar is the total water weight multiplied by the % sugar of the stock juice.

Results

The water at pH 3 and heated to 80 ^{o}C combination treatment produced the highest amount of sugar extracted from 1000 g of chopped sweet sorghum stocks, 163.6 g of sugar after three runs (Table 1). After three runs, the water only treatment was the only treatment that did not surpass the theoretical sugar extraction level (Fig. 1). More than 95% of the theoretical sugar extraction and over 80% of the maximum sugar extraction were obtained on the first run by heating the water and chopped stocks to 80 ^{o}C for 30 min. These sugar extraction rates increase to over 94% of the maximum sugar extraction when fresh water is added to the chopped stocks and

heated to 80 ^{o}C again. There was a 2 to 4% sugar extraction increase by lowering the water and chopped stocks to pH 3. Sugar extracted from the third run for all the treatments ranged from 3.6 to 7.1% of the maximum sugar extraction.

Discussion

All the stock sugar extraction treatments we tested far exceeded the rates obtained by milling whole stocks with a manual cane press. The average juice extraction with a manual cane press was only about 17% of the theoretical juice extraction rate. Since over 94% of the maximum sugar was extracted after two runs of heating the water and chopped stocks, this treatment would be a good choice for sugar extraction on a small scale. We do not believe that it was worth the time, trouble, and expense for the slight sugar extraction gained by lowering the water and chopped stocks to pH 3.

Acknowledgement

I would like to thank my father, Kevin Larson, for his guidance and assistance on this project.

Table 1.-Sugar Extraction from Chopped Stocks of Sweet Sorghum var. Theis.

Sugar Extraction Treatment	Sugar Extraction Run	Rep. 1 Sugar from 1.0kg of Stocks	Rep. 2 Sugar from 1.0kg of Stocks	Average Sugar from 1.0kg of Stocks	Sugar % of Maximum
		g	g	g	%
Water	First	105.9	96.3	101.1	61.80
Water	Second	18.7	30.2	24.4	14.93
Water	Third	3.9	11.8	7.8	4.80
Total		**128.5**	**138.3**	**133.4**	**81.53**
Water pH 3	First	108.2	97.8	103.0	62.95
Water pH 3	Second	27.1	31.0	29.1	17.77
Water pH 3	Third	8.0	15.3	11.7	7.13
Total		**143.3**	**144.1**	**143.7**	**87.85**
Water 80^{o}C	First	140.4	124.5	132.5	80.97
Water 80^{o}C	Second	20.9	22.7	21.8	13.31
Water 80^{o}C	Third	1.8	10.1	5.9	3.62
Total		**163.1**	**157.2**	**160.2**	**97.90**
Water 80^{o}C & pH 3	First	139.8	122.3	131.0	80.11
Water 80^{o}C & pH 3	Second	20.7	29.3	25.0	15.27
Water 80^{o}C & pH 3	Third	1.7	13.4	7.6	4.62
Total		**162.3**	**164.9**	**163.6**	**100.00**
Theoretical Sugar Extraction		**140.2**	**135.2**	**137.7**	**84.17**

Stocks (without leaves and heads) of sweet sorghum var. Theis were first chopped then shredded with a with a portable shredder/chopper.
The first treatment runs started with 1.0kg of chopped stocks and 2.0L of clean water, held for 30 min., and pressed with a fruit press.
All subsequent runs for a treatment were repeated with the same chopped stocks and 2.0L of clean water.
Juice extractions (sugar) were read with a handheld refractometer.
Theoretical Sugar Extraction is stock moisture (from an oven-dried fresh weight sample) plus sugar content (from refractometer reading of stock juice milled by a cane press.)

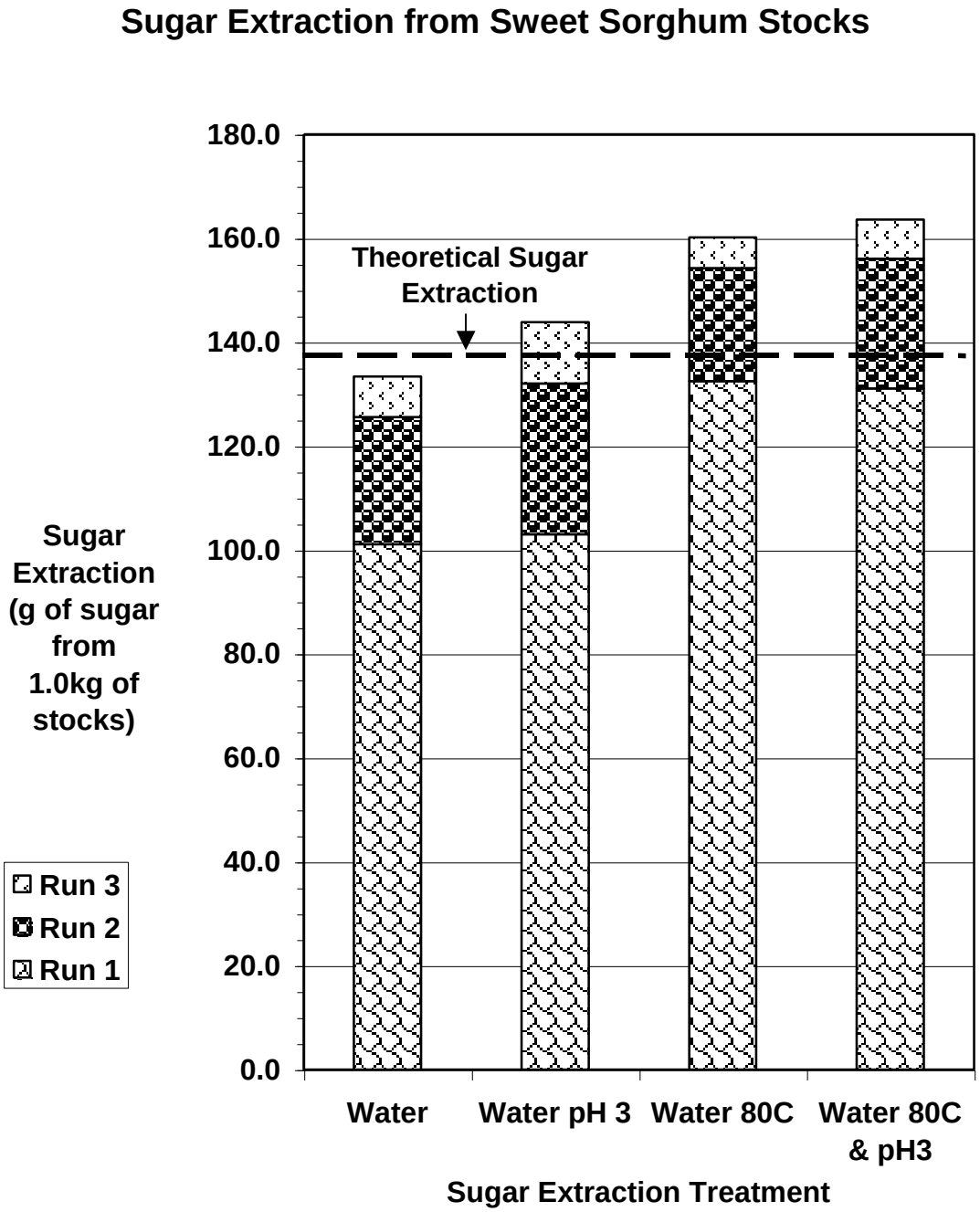

Fig. 1 .Sugar extraction from sweet sorghum stocks. The sweet sorghum hybrid was Theis, which was hand-harvested at flowering. Stocks, without leaves and heads, were chopped then shredded. Two liters of water was added to each 1000g sample of shredded stocks. Each treatment run was held for 30 min. and then juice was removed with a fruit press. Theoretical Sugar Extraction was determined by adding total stock water weight (fresh weight – oven-dried weight) and total stock sugar (total stock water weight x % stock sugar from Brix reading of hand-press stocks).

Limited Sprinkler Irrigation Corn Study at Walsh, 2008

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 18 hybrids tested, Pioneer 33D49 was the highest yielding hybrid with 159 bu/a. For this limited irrigation corn trial, we applied 20 in./a of water, 10 in./a more than our normal amount, because of the lack of early season moisture.

PLOT: Four rows with 30" row spacing, at least 600' long. SEEDING DENSITY: 24,000 seeds/a. PLANTED: May 14. HARVESTED: November 13.

IRRIGATION: Fifteen sprinkler rotations applied 20.0 a-in/a of total water.

PEST CONTROL: Pre Herbicides: Balance 1.75 oz/a, Atrazine 1.0 lb/a, Glystar Plus 24 oz/a, LoVol 0.5 lb/a; Post Herbicides: Status 10 oz/a, Accent 0.67 oz/a. CULTIVATION: None. INSECTICIDE: 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--------		
May	0.08	301	5	0	15
June	1.02	716	16	2	45
July	1.65	890	25	5	76
August	7.03	735	12	5	107
September	0.83	466	0	0	137
October	2.75	251	0	0	161
Total	13.36	3359	58	12	161

\1 Growing season from May 14 (planting) to October 24 (first freeze, 22 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 poor soil moisture. Weed control was good. Very dry growing season, except for a very wet August. The nonresistant corn borer hybrid had relatively low amounts of stock holes and lodging from second-generation corn borer larvae. Grain yields were good, despite the dry season.

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"	7.9	0.7	2.5	31	5.9	478	0.8	5.2
8"-24"				21				
Comment	Alka	VLo	VHi	VHi	Lo	VHi	Lo	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization for Sprinkler Site.

Fertilizer	N	P_2O_5	Zn	Fe
	----------lb/a----------			
Recommended	0	20	0	0
Applied	150	20	0.3	0

Yield Goal: 140 bu/a.
Actual Yield: 149 bu/a.

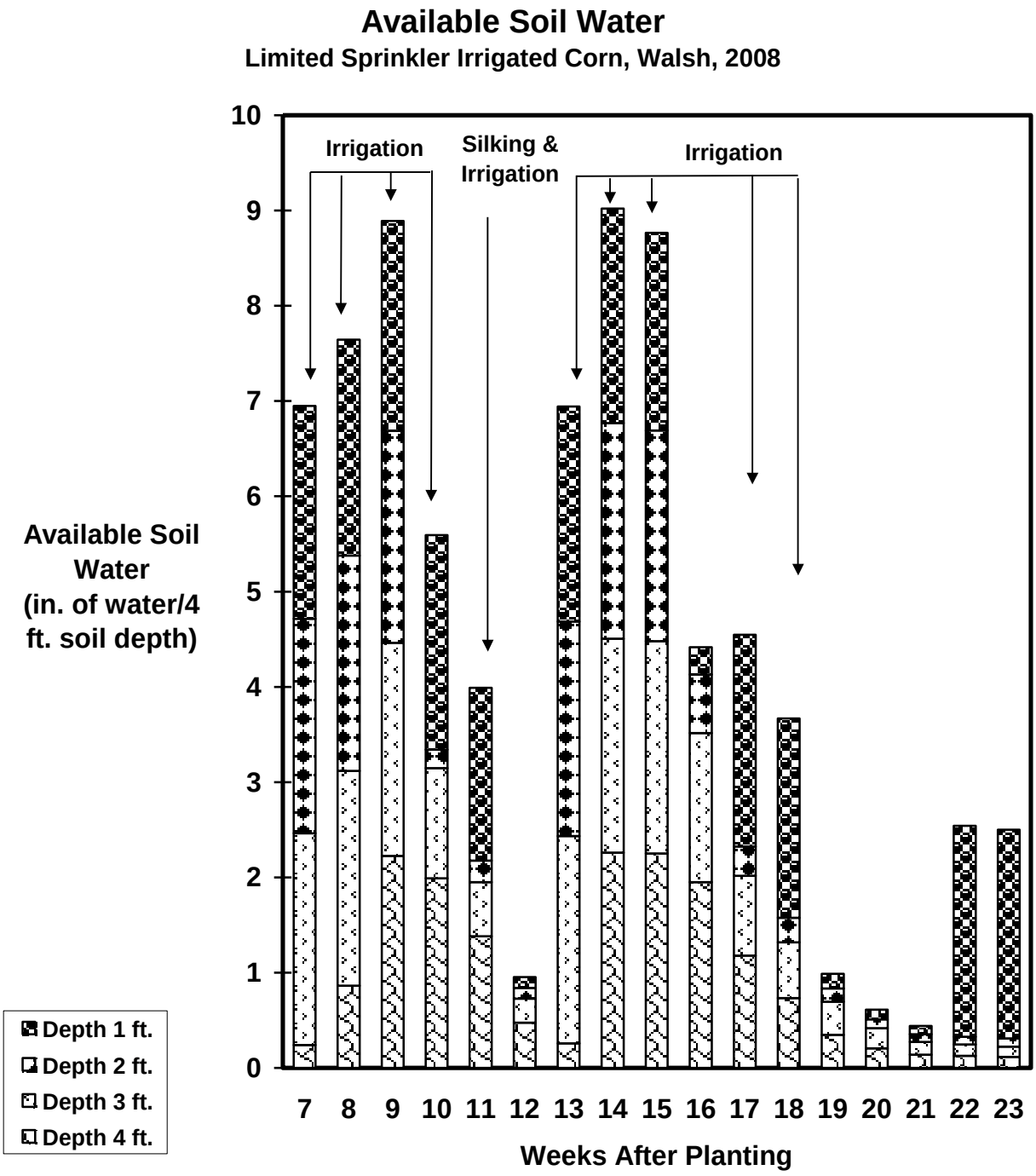

Fig. . Available soil water in limited sprinkler irrigation corn at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 13.36 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table .Limited Sprinkler Irrigation Corn, Plainsman Research Center, 2008.

Firm	Hybrid	50% Silking Date	Plant Density	Seed Moisture	Test Weight	Grain Yield
			plants/a (X 1000)	%	lb/bu	bu/a
PIONEER	33D49	31-Jul	21.2	17.7	61	159
GARST	83E90-3000GT	30-Jul	22.2	17.6	59	158
MYCOGEN	2T807YG	28-Jul	22.2	16.5	60	156
TRIUMPH	7215H	30-Jul	22.0	17.1	60	155
FOUR STAR SEED	7860HXRRLL	30-Jul	21.8	16.6	60	154
FOUR STAR SEED	6881VT3	28-Jul	23.4	17.1	59	153
NC+ HYBRIDS	NC+ 5453VT3	29-Jul	21.6	16.9	60	151
NC+ HYBRIDS	NC+ 4252VT3	28-Jul	22.0	16.0	60	150
TRIUMPH	7514X	28-Jul	22.0	16.6	60	150
TRIUMPH	1608VT3	28-Jul	21.4	17.0	59	148
PIONEER	32T84	26-Jul	23.0	17.4	61	148
GARST	84N16 CB/LL	28-Jul	23.8	16.4	58	148
NC+ HYBRIDS	NC+ 5436VT3	28-Jul	22.6	16.4	60	147
MYCOGEN	2T783YGLL	30-Jul	20.0	17.1	60	146
FOUR STAR SEED	6863VT3	28-Jul	21.0	16.5	61	142
MYCOGEN	2T777 (Non Bt)	28-Jul	20.4	16.2	59	142
TRIUMPH	1109VT3	27-Jul	20.6	16.2	60	140
MYCOGEN	2T828YG	30-Jul	20.0	17.1	61	139
Average		29-Jul	21.7	16.8	60	149
LSD 0.20						6.3

Planted: May 14; Harvested: November 13, 2008.
Grain Yield adjusted to 15.5% moisture content.
Fifteen sprinkler rotations applied a total of 20.0 acre-in./acre of water.

Corn Borer Resistant and Nonresistant Hybrid Comparisons, Walsh, 2008

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

PURPOSE: To evaluate corn borer resistant hybrids (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. Compared to damage recorded in last year, the nonresistant corn borer hybrid had fewer stock holes and lodging damage caused by the second-generation corn borer larvae. Overall corn borer damage was the lowest record since the inception of this study. Grain yields were very good, but we also applied more irrigation than we normally apply.

DISCUSSION: All 17 Bt hybrids tested showed excellent resistance to corn borer, albeit a very low corn borer damage season. The nonresistant corn borer hybrid had stock holes on only 8% of its plants and only 3% of plants lodged due to corn borer damage. This level of corn borer lodging is the lowest level of corn borer damage for the 13 years we have been testing corn borer resistant hybrids. The low levels of corn borer damage may be attributable to our region's extensive use of corn borer resistant hybrids. With only one year of very low corn borer levels, we do not advocate the disuse of corn borer resistant hybrids. Nonetheless, if these very low infestation levels continue, it may be economically sound to replace some acreage with less expensive, nonresistant corn borer hybrids. Growers can monitor the corn borer infestation levels in their refuges as an indicator as to where and when this switch is practical. Currently, 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 20 inches of irrigation. The extra 10 inches of irrigation was, in part, to offset the lack of winter, spring and early-summer precipitation.

Table .Limited Sprinkler Irrigated Corn, Corn Borer Ratings, Plainsman Research Center, 2008.

Firm	Hybrid	50% Silking Date	Plant Density	1st Gen Shot Holes	2nd Gen Stock Holes	2nd Gen Plant Lodging	Test Weight	Grain Yield
			plants/a (X 1000)				lb/bu	bu/a
PIONEER	33D49	31-Jul	21.2	0	0	0	61	159
GARST	83E90-3000GT	30-Jul	22.2	0	0	0	59	158
MYCOGEN	2T807YG	28-Jul	22.2	0	0	0	60	156
TRIUMPH	TRX8621HXRR	30-Jul	22.0	0	0	0	60	155
FOUR STAR SEED	7860HXRRLL	30-Jul	21.8	0	0	0	60	154
FOUR STAR SEED	6881VT3	28-Jul	23.4	0	0	0	59	153
NC+ HYBRIDS	NC+ 5453VT3	29-Jul	21.6	0	0	0	60	151
NC+ HYBRIDS	NC+ 4252VT3	28-Jul	22.0	0	0	0	60	150
TRIUMPH	TRX8551HXTRR	28-Jul	22.0	0	0	0	60	150
TRIUMPH	1608VT3	28-Jul	21.4	0	0	0	59	148
PIONEER	32T84	26-Jul	23.0	0	0	0	61	148
GARST	84N16 CB/LL	28-Jul	23.8	0	0	0	58	148
NC+ HYBRIDS	NC+ 5436VT3	28-Jul	22.6	0	3	3	60	147
MYCOGEN	2T783YGLL	30-Jul	20.0	0	0	0	60	146
FOUR STAR SEED	6863VT3	28-Jul	21.0	0	3	0	61	142
MYCOGEN	2T777 (Non Bt)	28-Jul	20.4	8	8	3	59	142
TRIUMPH	1109VT3	27-Jul	20.6	0	0	0	60	140
MYCOGEN	2T828YG	30-Jul	20.0	0	0	0	61	139
Average		29-Jul	21.7	0	1	0	60	149
LSD 0.05				1.8	3.1	2.4		6.3

Planted: May 14; Harvested: November 13, 2008.
Grain Yield adjusted to 15.5% moisture content.
Fifteen sprinkler rotations applied a total of 20.0 acre-in./acre of water.

Fungicide Application on Asymptomatic Sprinkler Irrigated Corn

Donald Wood and Kevin Larson

Recently there have been anecdotal stories concerning the success of fungicide applications to asymptomatic corn, particularly since the spread of Gray Leaf Spot into Eastern Colorado. Some have reported that a fungicide application to apparently healthy corn increased grain yields. To test this practice, we compared five hybrids of corn with and without fungicide application applied at tasselling.

Materials and Methods

Don Wood planted six corn hybrids (PIONEER 33B54, PIONEER 33M16, PIONEER 32T84, PIONEER 33D49, PIONEER 33P83, and PIONEER 33H27) on May 16, the entire length of the center pivot. To these apparently healthy corn hybrids, he had 14 oz/a of Quilt fungicide aerially applied to half of the circle and left other half untreated. He harvested the plots of fungicide treated and untreated hybrids on November 26 and weight them in a weigh cart. We took moisture and test weights of the treated and untreated hybrids in order to adjust and compare their grain yield at standard moisture (15.5%). For Gray Leaf Spot ratings, we used the ratings presented in “Pioneer Brand Products and Services 2008-2009”.

Results and Discussion

After the fungicide application, Don Wood reported that he could visually see a difference in plant health (it remained green longer) for the treated half circle compared to the untreated half circle. At grain harvest, some corn hybrids produced more yield with applied fungicide and some hybrids produced less yield with applied fungicide. One hybrid, PIONEER 33B54, produced 6.6 bu/a more with fungicide treatment than without fungicide. However, another hybrid, PIONEER 33H27, produced 5.0 bu/a less with fungicide treatment. As a possible explanation for the divergent response to the fungicide application, we consulted Pioneer’s disease ratings for our tested hybrids. We found that there was a strong correlation between resistance to Gray Leaf Spot and grain yield performance for our tested hybrids. Hybrids with Gray Leaf Spot ratings of 4 and below averaged 5.0 bu/a more with applied fungicide; whereas, hybrids with ratings of 5 and above averaged 1.7 bu/a less with applied fungicide compared to their untreated sides.

It may be beneficial to applied fungicides to asymtomatic corn to increase yields when the hybrids Gray Leaf Spot ratings are 4 and below. However, the yield increase with applied fungicide may not offset the cost of the fungicide application. In our test, the average yield increase of 5 bu/a (at $5/bu corn price) was not enough to pay for the $31.64/a expense of the Quilt application.

Application of Fungicide on Sprinkler Irrigated Corn, Wood Farm, Two Buttes, 2008.

Firm	Hybrid	Applied Fungicide	Moisture Content	Test Weight	Grain Yield	Gray Leaf Spot	Fungicide Yield Difference
			%	lb/bu	bu/a	1 = poor 9 = excel	bu/a
PIONEER	32T84	Yes	16.3	59.5	236.6	6	2.0+
	32T84	No	16.5	59.5	234.6	6	
PIONEER	33D49	Yes	16.3	60.5	232.1	5	2.3-
	33D49	No	16.5	60.0	234.4	5	
PIONEER	33B54	Yes	16.6	59.5	228.5	4	6.6 +
	33B54	No	16.7	59.0	221.9	4	
PIONEER	33P83	Yes	15.8	60.0	222.1	4	3.4+
	33P83	No	16.2	61.0	218.7	4	
PIONEER	33M16	Yes	16.2	59.5	221.4	6	1.5-
	33M16	No	16.4	59.5	222.9	6	
PIONEER	33H27	Yes	16.5	59.0	213.4	5	5.0-
	33H27	No	16.4	59.0	218.4	5	
Average			16.4	59.7	225.4	5	0.5+
Average with Fungicide			16.3	59.7	225.7	5	
Average without Fungicide			16.5	59.7	225.2	5	
Gray Leaf Spot rating 4 or less							5.0+
Gray Leaf Spot rating 5 or higher							1.7-

The fungicide was 14 oz/a of Quilt aerially applied at tasseling.
Planted: May 16, 2008; Harvested: November 26, 2008.
Grain Yield adjusted to 15.5% moisture content.
Gray Leaf Spot rating from "Pioneer Brand Products and Services 2008-2009" booklet.

Low Salt and 10-34-0 Comparison of Seedrow Applied P on Irrigated Corn

Kevin Larson, Dennis Thompson, and Deborah Harn

The salt index of 10-34-0 is high enough that relatively low rates will adversely affect corn germination when seedrow applied. Lower salt index P fertilizers will reduce the risk of germination problems when seedrow applied. Fertilizer companies selling low salt index P products often advertise their low salt fertilizers as more effective fertilizers, that is, their products supply more plant nutrients at lower product rates than standard fertilizers. To test their advertisement claims, we compared seedrow rates of a standard P fertilizer (10-34-0) to a low salt index fertilizer (9-24-3).

Materials and Methods

We applied three rates of standard P fertilizer (10-34-0) and low salt index P fertilizer (9-24-3) with the seed at planting (seedrow applied). The three P seedrow applied rates were: 5 lb P_2O_5/a (9-24-3 at 1.87 gal/a; 10-34-0 at 1.25 gal/a), 10 lb P_2O_5/a (9-24-3 at 3.75 gal/a; 10-34-0 at 2.5 gal/a), and 20 lb P_2O_5/a (9-24-3 at 7.5 gal/a; 10-34-0 at 5.0 gal/a). We planted corn at 23,000 seeds/a of MYCOGEN 2T783 on May 15, 2008. We irrigated a total of 20 in./a of water on the corn crop with fifteen rotations of the sprinkler. For weed control, we applied pre-emergence herbicides: Balance 1.75 oz/a, Atrazine 1.0 lb/a, Glystar Plus 24 oz/a, and LoVol 0.5 lb/a. For post emergence control, we applied Status 10 oz/a and Accent 0.67 oz/a. We took soil samples from six locations in the field and sent a pooled sample to the CSU Soil Lab for analysis. The recommendation from the soil analysis for our yield goal of 140 bu/a was that the only nutrient needed was 20 lb P_2O_5/a. We harvested the grain with a self-propelled combine on November 17, 2008 and weighed the plots in a digital weigh cart. Grain yields were adjusted to 15.5% moisture content.

Table .-Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe	Mn
		mmhos/cm	%	ppm					
0-8”	7.9	0.7	2.5	31	5.9	478	0.8	5.2	9.4
8-24”				21					

Results and Discussion

The low salt P fertilizer (9-24-3) produced consistently high yields throughout our P rate range. Our lowest P rate, 5 lb P_2O_5/a, was sufficient P fertilizer for the low salt treatment to achieve a maximum yield level. The standard P fertilizer (10-34-0) required two times the seedrow P rate to achieve the same maximum yield level. Even though twice the P rate was needed with the 10-34-0 fertilizer on a P_2O_5/a basis, the 10-34-0 fertilizer required only 0.63 gal/a more than the 9-34-0 fertilizer to reached the same yield level. When we focus on the cost of our P fertilizers to achieve the same yield level, we find that 10-34-0 is a more economical choice than 9-24-3. The standard

P fertilizer, 10-34-0, produced 141.8 bu/a at the 10 lb P_2O_5/a rate and costs $7.35/a; whereas, the low salt P fertilizer, 9-24-3, produced 139.4 bu/a at the 5 lb P_2O_5/a rate and costs $10.94/a.

Growers that use the low salt P fertilizers suggest that the extra cost (in this case $3.59/a) compared to 10-34-0 may be offset by the low salt fertilizer's qualities: 1) less product needed (fewer fill ups), 2) less corrosive (equipment lasts longer), 3) greater stability (doesn't readily salt out), and 4) higher rates can be seedrow applied (doesn't readily cause germination problems).

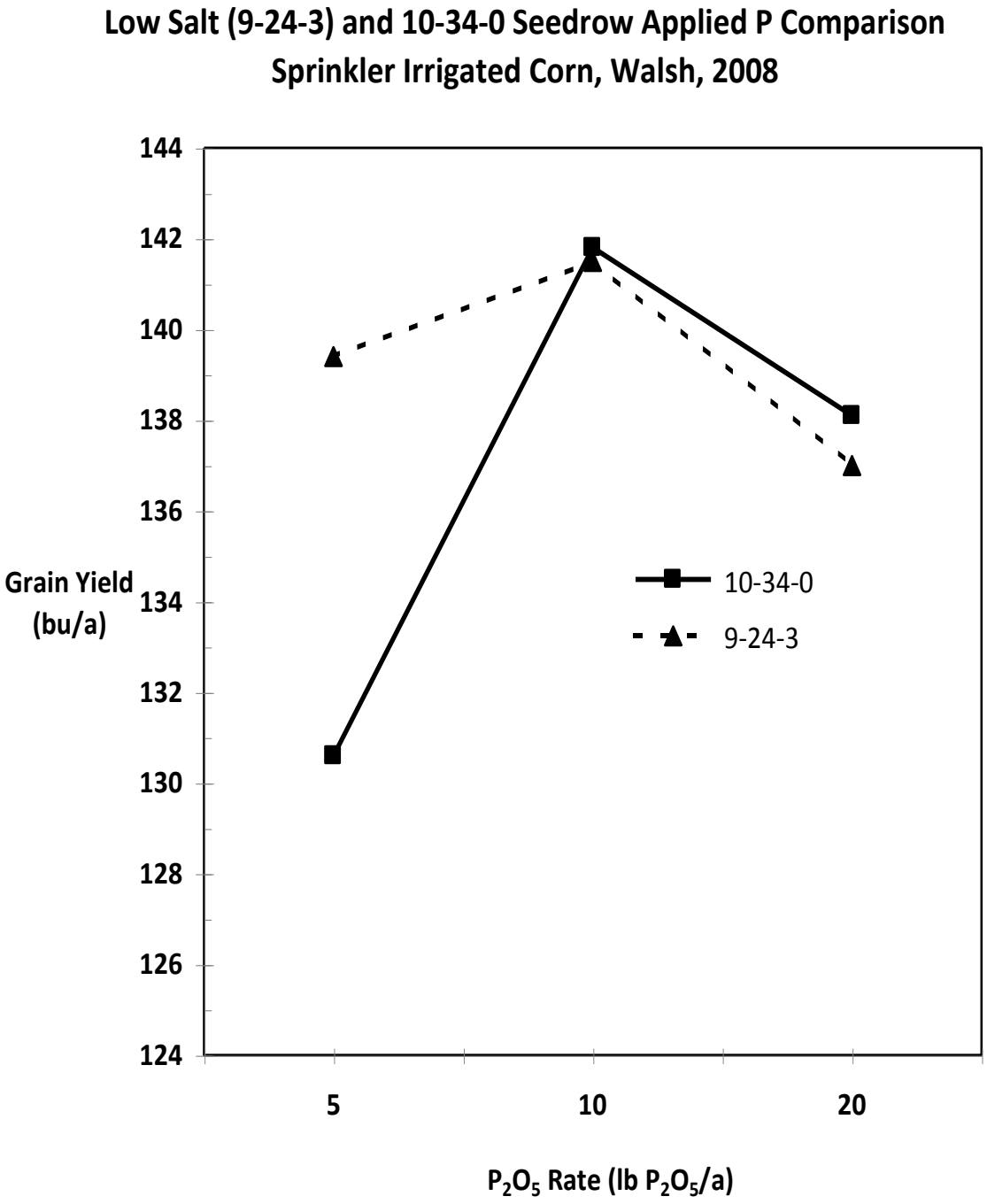

Fig. . Low salt (9-24-3) and 10-34-0 seedrow applied comparison on sprinkler irrigated corn. The seedrow applied rates were 5 lb P_2O_5/a (9-24-3 at 1.87 gal/a; 10-34-0 at 1.25 gal/a), 10 lb P_2O_5/a (9-24-3 at 3.75 gal/a; 10 34-0 at 2.5 gal/a), and 20 lb P_2O_5/a (9-24-3 at 7.5 gal/a; 10-34-0 at 5.0 gal/a). Grain yields were adjusted to 15.5% moisture content.

Long-Term N Effects on Irrigated Sunflower-Corn Rotation, Walsh, 2008

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 rates are applied to the same treatment site for multiple years.

Materials and Methods: We planted corn, Mycogen 2T789, on May 16 at 24,000 seeds/a, and sunflower, Mycogen 8H419CL on July 7 at 26,000 seeds/a. For our N treatments, we banded liquid N (32-0-0) at 100, 150, or 200 lb N/a with two replications. We seedrow applied 20 lb P_2O_5/a and 0.25 lb Zn/a at planting to the corn but not the sunflowers. 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. 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. In order to obtain crop stands, we pre-irrigated both the corn and sunflower sites with approximately 6 in./a of furrow irrigation. After crop establishment, the remainder of irrigation was applied with subsurface drip irrigation. The corn received approximately 18 in./a of irrigation and the sunflower received approximately 14 in./a of irrigation. Other than herbicides, no other pesticides were applied. We harvested two replications of the 20 ft. by 650 ft. plots on November 17 for corn and December 8 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: Corn for both rotations had their highest yields at 200 lb N/a. The corn in the Sunflower-Corn rotation was more responsive to increasing N rates than the corn in the continuous corn rotation. Sunflower yields were highest at the 200 lb N/a rate. Compared to last year, sunflower had a somewhat similar response to increasing N rates with the 150 lb N/a rate producing the lowest yield. We cannot explain the yield decrease with the 150 lb N/a rate for the sunflower and the corn in the Sunflower-Corn rotation. This year the 200 lb N/a rate produced the highest yield; whereas, in previous years, the 100 lb N/a produced the highest yield. After reviewing the soil test recommendation, it is surprising that the 200 lb N/a rate produced the highest corn and sunflower yields. With the high soil N level, we expected that the 100 lb N/a rate would have been sufficient to realize our yield goals. The recommended N fertilizer rates for our yield goals were 56 lb N/a for sunflower and 50 lb/a for corn. Yield levels for both corn and sunflowers were lower than expected. Our yield goal for the corn was 200 bu/a, our actual average grain yield was 152 bu/a, and the yield goal for the sunflowers was 2500 lb/a, our actual average seed yield was 1743 lb/a, or 637 lb/a oil yield. We did not observe the typical percent oil decrease with increasing N, in fact, oil percentages were quite static. The oil percentages were: 36.9, 36.2, and 36.5, respectively for 100, 150, and 200 lb N/a.

Table .-Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe	Mn	Cu
		mmhos/cm	%	ppm						
0-8”	7.9	0.7	2.2	23	1.8	454	0.5	3.5	9.4	3.4
8-24”				17						

This is the third year of this long-term N on Sunflower-Corn rotation study. Last year, we added continuous corn rotation in this long-term N rate study. The continuous corn rotation was included as a typical rotation check. We started this study because of the lack of N response for dryland sunflower in our long-term N on Wheat-Sunflower-Fallow study, the role of N in reducing oil yield, and growers reports that irrigated corn following sunflower often producing their highest yields. Under dryland conditions, following sunflower in a rotation typically reduces the subsequent crop yield. 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. Moreover, we speculate that the reason irrigated corn is reported to yield well following sunflower is that the deep water extraction of sunflower loosens the soil and provides better root penetration by the corn.

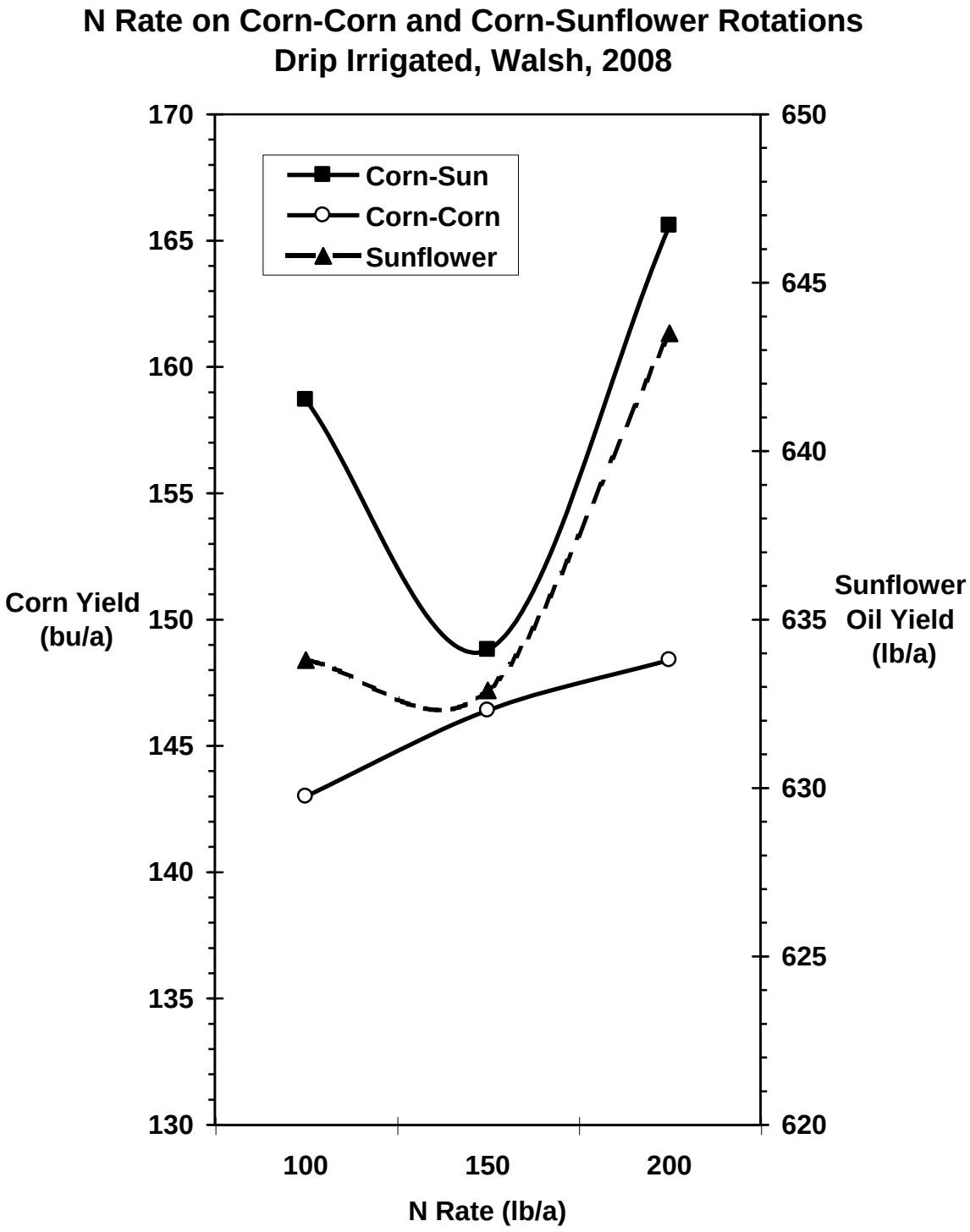

Fig. . N rate on drip irrigated sunflower and corn in Sunflower-Corn rotations at Walsh. The N rates were 100, 150, and 200 lb N/a as 32-0-0. The sunflower hybrid was MYCOGEN 8H419CL planted at 26,000 seeds/a. The corn hybrid was MYCOGEN 2T789 planted at 24,000 seeds/a.

Irrigated Mid and High Oleic Sunflower Hybrid Performance Trial at Walsh, 2008

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

PURPOSE: To identify high yielding hybrids under irrigated conditions with 2000 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30" row spacing, 650' long. SEEDING DENSITY: 26,000 Seed/A. PLANTED: July 11. HARVESTED: December 8.

IRRIGATION: Pre-irrigated by furrow with approx. 6 in./a, Subsurface Drip Irrigated with 7.8 in./a, total applied irrigation approx. 14 in/a.

PEST CONTROL: Preemergence Herbicides: Glyphosate 24 oz/a, Spartan 2.0 oz/a, Prowl H2O 40 oz/a. Post Emergence Herbicides: None. CULTIVATION: Once. 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--------		
July	0.94	585	18	5	20
August	7.03	735	12	5	51
September	0.83	466	0	0	81
October	2.75	251	0	0	105
Total	11.55	2037	30	10	105

\1 Growing season from July 11 (planting) to October 24 (first freeze, 22 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture after pre-irrigation with furrow. Above average precipitation for growing season with very dry early growing season and very wet August. Weed control was good. No insecticides were applied to control head moth because of the late planting date. Seed yields were good.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.9	0.7	2.2	23	1.8	454	0.5	3.5
8"-24"				17				
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	56	40	0	0
Applied	150	0	0	0

Yield Goal: 2500 lb/a.
Actual Yield: 1422 lb/a.

Drip Irrigated Sunflower, Mid and High Oleic Variety Trial, PRC, Walsh, 2008.

Firm	Hybrid	Mid or High Oleic	50% Flower	Plant Density	Test Wt.	Oil	Seed Yield	Oil Yield
			date	plants/a (X1000)	lb/bu	%	lb/a	lb/a
TRIUMPH	845HO	high	9/12	21.4	28	39.1	1584	620
MYCOGEN	8H449DM	high	9/10	17.4	32	39.2	1565	613
TRIUMPH	s678	mid	9/14	21.6	30	36.2	1683	610
MYCOGEN	8N453DM	mid	9/9	17.2	32	40.0	1490	596
PIONEER	63M91	mid	9/10	18.8	29	37.2	1318	490
TRIUMPH	R657	mid	9/13	21.2	27	37.4	1294	483
MYCOGEN	8H419CL	high	9/9	21.0	29	35.8	1260	451
TRIUMPH	859HOCL	high	9/11	17.6	28	32.9	1183	389
Average			9/11	19.5	29	37.2	1422	531
LSD 0.20							159.4	

Planted: July 11; Harvested: December 8, 2008.
Seed Yield adjusted to 10% seed moisture content.
Total water applied was approximately 14 in., drip irrigation was 7.8 in. and furrow irrigation (pre-irrigation) was approximately 6 in.

National Winter Canola Variety Performance and Great Plains Trials, Walsh 2008

Kevin Larson, Mike Stamm, and Dennis Thompson

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

Results and Discussion

The average winter survival rate for the winter canola varieties was 92%. The 92% winter survival is indicative of a mild winter and sufficient soil moisture (this year from a germinating irrigation). Severe winter can cause large stand losses. Typically, selecting winter canola varieties with high winter survival is a wise choice for our environment.

Canola would be a good candidate as a limited irrigated crop. We furrow irrigated the study with an irrigation in the fall. This year, we had marginal soil moisture at planting. The lack of soil moisture at planting is a common scenario. Because we frequently have dry conditions at planting, and recommend maximum planting depth for canola is only 1.5 in., irrigating after planting is a good way to assure a stand.

Flowering dates are an important consideration because they reflect timeliness of harvest and flower sensitive freeze dates. The earlier flowering varieties are ready for harvest before the later flowering varieties. This could be important because the timing of wheat and canola harvests could clash. Remember, canola is one of the worst crops for shattering; do not delay harvest when it is ready for harvest. Varieties that flower early risk late-season frost damage. The earliness of some canola varieties may help avoid harvesting conflicts with wheat, but costly freeze damage on early flowering varieties may negate the harvest scheduling benefit.

The winter was dry. However, because we irrigated the crop in the fall to establish a stand, we did not irrigate the crop in the spring, since some soil moisture was still available in the spring from the fall irrigation. The lack of winter and spring moisture was reflected in the seed yield. This year the seed yield average was 602 lb/a, less than one-third as high as last year (last year we had abundant winter moisture).

It may be time to reconsider winter canola as an oil crop option. Canola has a couple of advantages over sunflower: 1) less expensive seed cost and 2) less expensive and more effective weed control. There are three disadvantages of winter canola compared to sunflower: 1) it has a very narrow planting window (late-August to mid-September), 2) it shatters its seed (you can't delay harvest) and 3) it is a winter annual (like winter wheat, a fallow period may be needed for your rotation). Canola performs quite well as a limited irrigated crop. In fact, since winter wheat and winter canola have similar water and fertilizer requirements, the irrigation timing for canola will spread your irrigation more effectively compared to irrigating only spring crops.

Materials and Methods

We planted 57 winter canola varieties and lines for the National Winter Canola Trial and 42 winter canola varieties and lines for the High Plains Winter Canola Trial on September 11, 2007 (the High Plains Winter Canola Trial did not establish a stand due to herbicide carryover). 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. The soil pH was 7.6. We furrow

irrigated the site on 5 ft. beds until the moisture soaked across the beds. We fertilized the site with 50 lb N/a using a sweep plow prior to bed shaping and planting. No other fertilizers were applied. For weed control, we applied Treflan 24 oz/a prior to planting (incorporated with rotary hoe). The approximately 8 in/a of pre-irrigation in the fall was the only irrigation we applied. We harvested the winter canola trial on July 1, 2008. We harvested using a small grain head attached to a self-propelled combine (direct harvest) equipped with a digital scale.

Table. -National Canola Variety Trial: Walsh, Colorado, 2008.

Variety (Line)	Stand (0-10)	Winter Survival (0-10)	Flowering Date	Plant Height in.	Seed Shattering %	Seed Yield lb/acre
Hornet	7.7	10.0	25-Apr	38	0	1175
Kadore	6.8	9.3	29-Apr	32	3	1016
Rally	7.3	9.7	27-Apr	38	1	977
KS4085	7.8	9.8	26-Apr	43	0	935
KS4022	6.5	10.0	29-Apr	40	1	911
DSV07102	8.8	10.0	27-Apr	41	0	871
CWH633	6.0	9.8	25-Apr	40	1	850
CWH081	6.0	9.9	28-Apr	34	1	786
CWH632	7.0	9.9	28-Apr	40	1	772
CWH095	6.5	7.8	29-Apr	36	1	766
MH903383	8.4	9.7	25-Apr	37	2	749
Flash	8.9	8.0	29-Apr	40	0	736
Abilene	6.5	9.5	29-Apr	38	3	713
Baldur	6.8	10.0	25-Apr	38	4	703
CWH688	6.4	8.8	24-Apr	36	3	700
CWH630	8.8	10.0	28-Apr	34	5	686
CWH686	6.8	10.0	23-Apr	34	4	686
CHW631	7.2	9.8	25-Apr	37	2	680
Visby	4.7	10.0	26-Apr	36	4	647
KS3254	5.0	8.8	29-Apr	35	1	647
KS3132	6.3	10.0	29-Apr	37	4	634
Virginia	8.5	9.9	27-Apr	40	2	621
KS3077	6.8	10.0	29-Apr	40	2	621
ARC2180-1	8.0	10.0	28-Apr	36	4	614
NPZ0791R	7.8	9.8	26-Apr	36	4	612
ARC97019	5.8	10.0	29-Apr	37	1	594
BSX-501	6.2	9.3	29-Apr	39	1	594
DSV07101	7.2	9.2	27-Apr	37	3	587
KS3074	6.5	10.0	29-Apr	42	1	585
CWJ111	6.7	8.5	24-Apr	38	3	574
MH604001	5.0	6.3	25-Apr	39	3	567
KS9135	5.0	9.0	29-Apr	40	1	561
KS4158	7.3	10.0	27-Apr	37	2	554
KS3302	6.3	10.0	27-Apr	37	2	548
CWH116	5.6	9.3	29-Apr	37	3	535
ARC97018	6.2	10.0	26-Apr	38	3	528
KS7436	6.5	9.3	29-Apr	36	4	528
Taurus	6.7	8.7	24-Apr	41	4	515
DSV07100	6.0	5.5	30-Apr	33	0	511
BSX-567	6.3	10.0	28-Apr	37	1	508
Sitro	4.5	9.3	25-Apr	35	0	497
Kronos	5.8	8.8	30-Apr	40	4	495
Satori	6.0	9.7	26-Apr	34	2	488
NPZ0391R	6.8	9.8	30-Apr	37	2	475
Hybristar	5.3	7.7	25-Apr	37	0	409

ARC98007	3.5	6.8	29-Apr	37	0	409
KS3018	5.2	9.7	25-Apr	35	2	402
ARC98015	4.7	8.0	30-Apr	38	3	396
(Border Se	4.8	8.5	28-Apr	37	1	371
Wichita	3.5	9.3	26-Apr	35	2	365
CWH687	3.5	7.8	26-Apr	37	0	363
Forza	4.3	8.8	27-Apr	32	2	337
Ceres	5.7	9.0	30-Apr	35	1	337
DKW13-69	3.8	8.0	29-Apr	34	1	284
Sumner	1.3	8.8	28-Apr	33	1	101
Jetton	0.0	X	X	X	X	X
Plainsman	0.0	X	X	X	X	X
Mean	6.0	9.2	27-Apr	37	2	602
LSD 0.05	3.4	2.1	2.3		2.6	302.3

Planted: September 11, 2007; Harvested: July 1, 2008.
The seed did not germinated for both Jetton and Plainsman.