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Agricultural Experiment Station

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

Sorghum Hybrid Performance Trials in Colorado, 2005

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K.J. Larson, A. Berrada and D.L. Thompson \1

The 2005 Colorado grain sorghum crop was estimated at 3.2 million bushels, 41% below the 2004 sorghum crop. For Colorado, the 3.2 million bushels is the second lowest in 30 years. The decrease in sorghum production this year was due to reductions in both harvested acres and average yield per acre compared to last year. There was a 50% decrease in harvested acreage from 180,000 in 2004 to 120,000 in 2005. In 2005 the average yield was 27 Bu/A, 3 Bu/A less than in 2004. The 27 Bu/A yield is 6 Bu/A less than the 5-year average. Sorghum silage production in 2004 was 266,000 tons, up 27% compared to 2003 production. Sorghum silage production for 2004 was 28% higher than the 5-year average. The increase in sorghum silage production for 2004 compared to 2003 was because of an increase in harvested acres, 14 Tons/A from 19,000 acres in 2004, and 14 Tons/A from 15,000 acres in 2003 (Colorado Agricultural Statistic Service, 2005).

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 Cooperative Extension. The sorghum trials were located at three sites in Southeastern Colorado: dryland grain sorghum trials were conducted at Vilas and Walsh; irrigated grain sorghum trials at Walsh; and irrigated forage sorghum trials at Rocky Ford and Walsh.

Tests are partially funded by entry fees paid by commercial firms. Commercial seed representatives interested in entering sorghum hybrids in any of the tests 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 2005 are shown in Table 1. Each firm selected entries for testing and furnished seed for the tests. The Agricultural Experiment Station included 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, 2005), 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;
Research Scientist, Arkansas Valley Research Center, Rock Ford;
Technician III, Plainsman Research Center, Walsh.

Table 1.--Entrants in the 2005 Colorado Sorghum Performance Trials.

Brand	Entered by
ASGROW	Monsanto, 7159 N. 247 W., P.O. Box 7, Mt. Hope, KS 67108
BUFFALO BRAND	Sharp Brothers Seed Co., P.O. Box 140, Healy, KS 67850
CAL/WEST SEEDS	CAL/WEST Seeds, Rt.1, Box 70, N. 4505 County Hwy M, West Salem, WI 54669
DEKALB	Monsanto, 7159 N. 247 W., P.O. Box 7, Mt. Hope, KS 67108
FONTANELLE	Fontanelle Hybrids, 1614 Safford Ave., Garden City, KS 67846
MYCOGEN	Mycogen Seeds, 9330 Zionville Road, Indianapolis, IN 46268
RICHARDSON SEEDS	Richardson Seeds, Ltd., P.O. Box 60, Vega TX 79092
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 2T801.

Growing Degree Days for sorghum were calculated from planting through first freeze using a maximum of 111°F and a minimum of 50°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°F from the average. When daily temperatures are less than 50°F, 50°F is used, when temperatures are above 111°F a maximum temperature of 111°F is used:

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

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 corrected 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 Yield. Forage yield in tons per acre was corrected 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.

Acknowledgments

We are sincerely grateful to the grower-cooperator, Terrill Swanson, for his assistance in the off-station trial at Vilas, Colorado.

References

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Early Maturing Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2005

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 (June 24), under dryland conditions with 2700 sorghum heat units in Silty Loam soil.

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 43,600 Seed/A. PLANTED: June 24. HARVESTED: November 2.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 75 F.

PEST CONTROL: Preemergence Herbicides: Roundup 20 Oz/A, 2,4-D 0.5 Lb/A, Atrazine 1.0 Lb/A. Post Emergence Herbicides Banvel 4 Oz/A, LoVol 5 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	0.01	179	6	2	6
July	1.01	878	26	8	37
August	1.90	763	17	3	68
September	0.24	642	15	0	98
October	1.06	276	3	0	122
Total	4.22	2738	67	13	122

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

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

COMMENTS: Planted in good soil moisture. Weed control was very good. Below normal precipitation for the growing season with very warm temperatures throughout the season. No greenbug infestation. Only a few hybrids lodged. Late freeze date. Yields and test weights were very good considering the dry season.

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"	7.7	0.5	1.9	14	6.2	490	1.0	5.8
8"-24"				16				
Comment	Alka	VLo	Hi	Hi	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	0	20	0.3	0

Yield Goal: 45 Bu/A.
Actual Yield: 62 Bu/A.

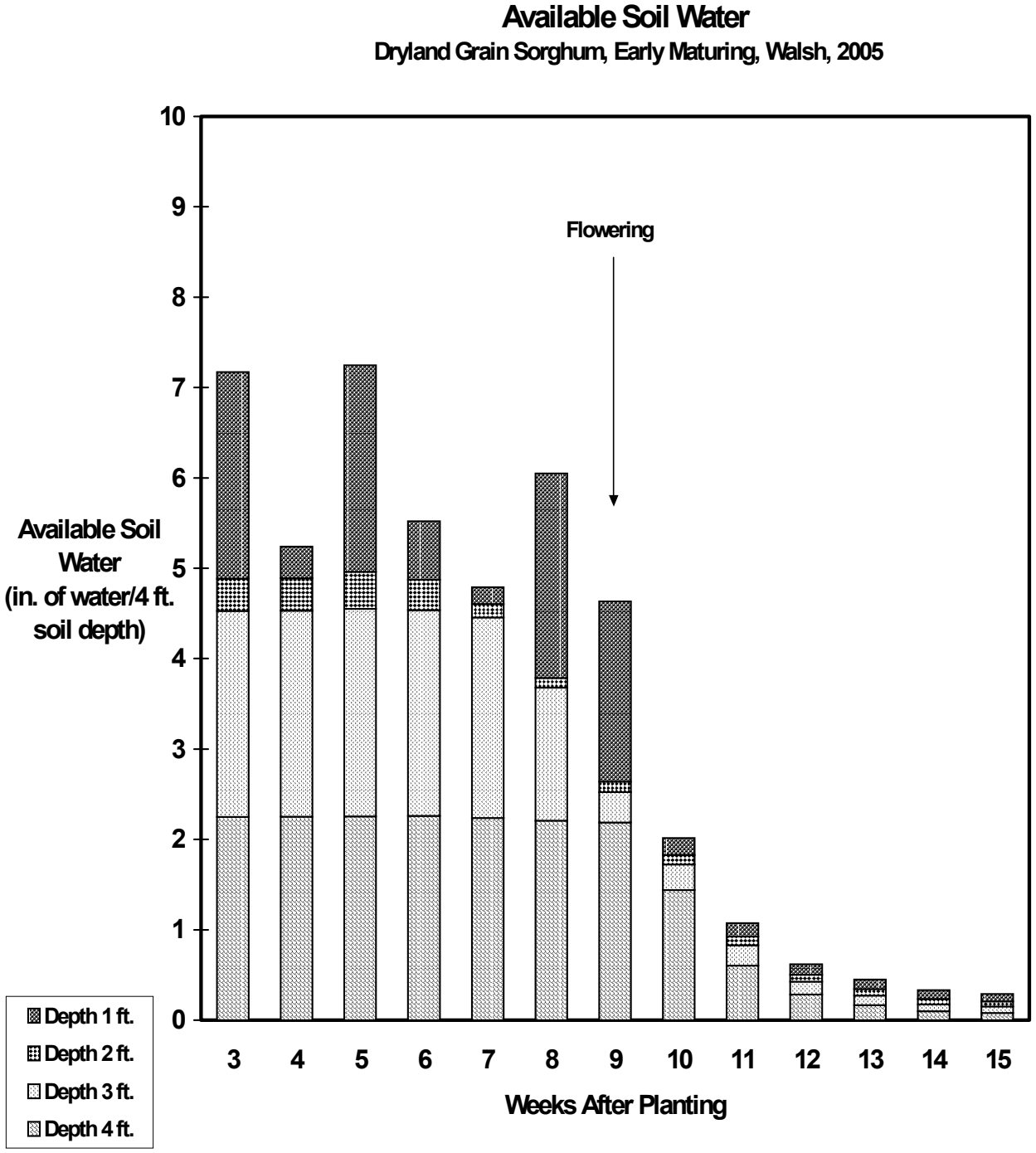

Fig. 1. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 4.22 in. Any increase in available soil water between weeks is from rain.

Table 2.--Dryland Grain Sorghum Early Maturing Hybrid Performance Test at Walsh, 2005. \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	%
DEKALB	DK-28E	7	53	1441	101	E	36	32.9	0	59	74	119
ASGROW	Reward	6	56	1524	104	E	34	31.8	4	58	70	112
DEKALB	DKS 29-28	7	56	1524	104	E	35	33.7	0	58	69	110
FONTANELLE	GE 2413	6	55	1494	102	E	36	29.8	3	57	61	98
TRIUMPH	TR 433	7	60	1616	108	ME	40	33.3	9	58	53	86
(Check)	399 X 2737	6	72	1899	HD	ML	40	32.1	0	54	47	75
Average		7	59	1583	104	E	37	32.3	3	57	62	
LSD 0.20											9.6	

\1 Planted: June 24; Harvested: November 2.

Yields are corrected to 14.0% seed moisture content.

DAP: Days After Planting or maturation of seed at first freeze (24 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, 2003-2005.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2003	2004	2005	2-Year Avg	3-Year Avg	2003	2004	2005	2-Year Avg	3-Year Avg
		----------Bu/A----------					----------%----------				
ASGROW	Reward	123	100	70	85	98	105	116	112	114	111
DEKALB	DK-28E	122	93	74	84	96	104	108	119	114	110
DEKALB	DKS 29-28	134	97	69	83	100	114	113	110	112	112
SORGHUM PARTNERS	KS 310	128	93	--	111	74	109	108	--	109	--
SORGHUM PARTNERS	K35-Y5	123	77	--	100	67	105	89	--	97	--
SORGHUM PARTNERS	251	102	97	--	100	66	87	113	--	100	--
(Check)	399 X 2737	88	37	47	42	57	75	43	75	59	64
Average		117	86	62	74	88					

Grain Yields were corrected to 14.0 % seed moisture content.
Irrigated at Walsh for 2003 and 2004, dryland for 2005.

Dryland Grain Sorghum Hybrid Performance Trial at Vilas, 2005

COOPERATORS: Terrill Swanson Farm, Vilas, and Kevin Larson, Superintendent, Plainsman Research Center, Walsh, Colorado.

PURPOSE: To identify high yielding hybrids under dryland conditions with 3150 sorghum heat units in a Sandy Clay soil.

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 43,600 Seed/A. PLANTED: June 6. HARVESTED: November 4.

EMERGENCE DATE: 7 days after planting. SOIL TEMP: 67 F.

PEST CONTROL: Preplant Herbicides: Gylphosate 26 Oz/A, Banvel 2 Oz/A, 2,4-D 6 Oz/A. Post Emergence Herbicides: Banvel 4 Oz/A, 2,4-D 5 Oz/A. CULTIVATION: Once. INSECTICIDE: 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	0.81	592	17	2	24
July	1.01	878	26	8	55
August	1.90	763	17	3	86
September	0.24	642	15	0	116
October	1.06	276	3	0	140
Total	5.02	3151	78	13	140

\1 Growing season from June 6 (planting) to October 24 (first freeze, 24 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture. Weed control was very good. Below normal precipitation for the growing season. Temperatures were quite warm throughout the season. Late freeze date. No greenbug infestation. None of the hybrids lodged. Grain yields were very good considering the dry weather.

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

Summary: Soil Analysis.

Depth	pH	Salts	OM	N	P	K	Zn	Fe
		mmhos/cm	%	----------ppm----------				
0-8"	7.2	0.3	0.7	4	0.9	151	0.5	7.8
8"-24"				3				
Comment	Alka	Vlo	Lo	Lo	VLo	Hi	Lo	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------Lb/A----------			
Recommended	27	40	0	0
Applied	50	20	0	0

Yield Goal: 60 Bu/A.
Actual Yield: 66 Bu/A.

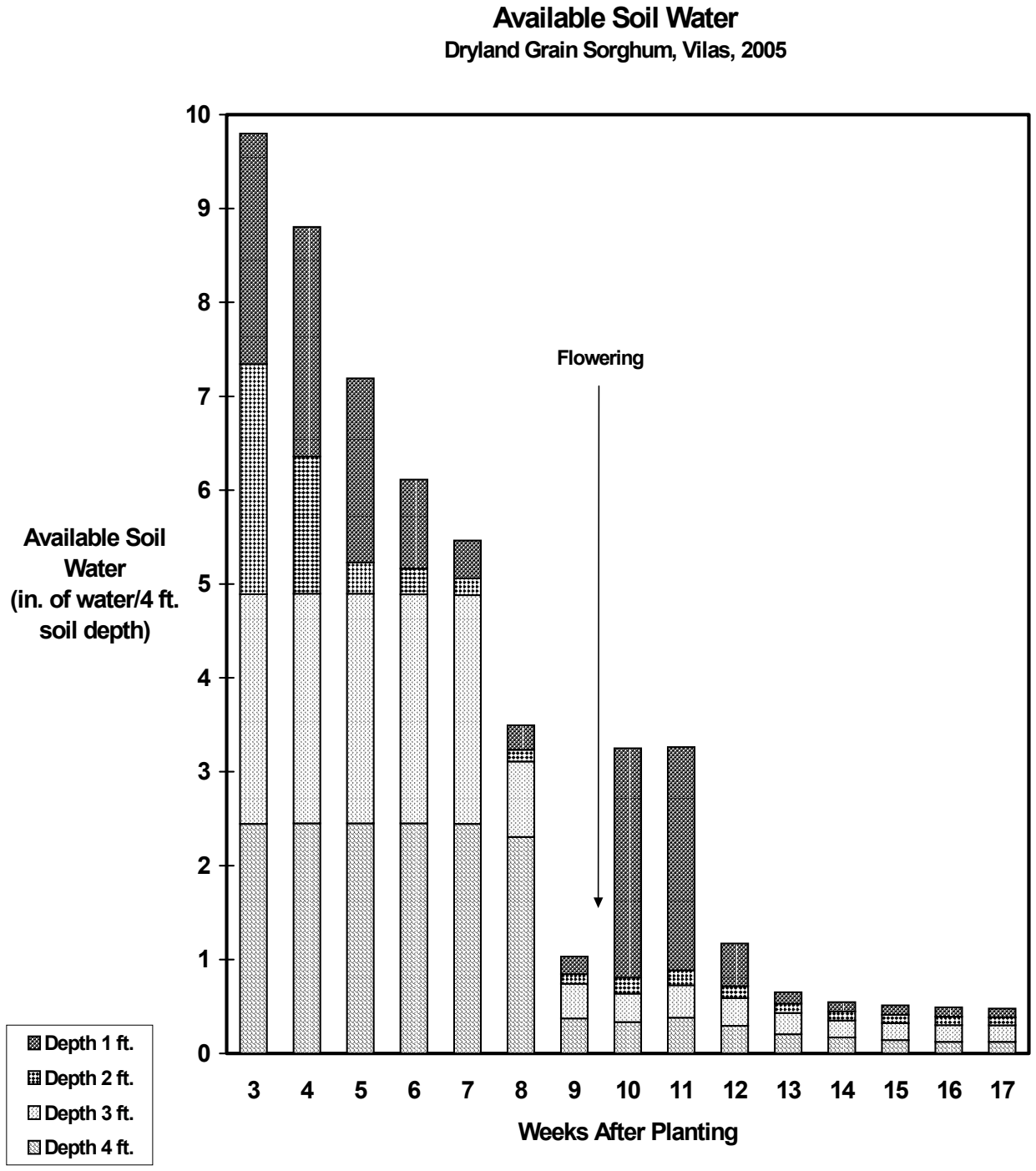

Fig. 2. Available soil water in dryland grain sorghum at Vilas. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 5.02 in. Any increase in available soil water between weeks is from rain.

Table 4.--Dryland Grain Sorghum Hybrid Performance Test at Vilas, 2005. \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	%
FONTANELLE	GE 3245	8	57	1551	103	E	33	22.5	0	61	66	101
FONTANELLE	GE 4532	7	68	1816	113	ME	41	25.6	0	61	72	110
ASGROW	Seneca	7	69	1842	115	ME/M	39	25.2	0	61	71	108
DEKALB	DK-44	7	68	1816	114	ME/M	41	24.0	0	60	69	105
DEKALB	DKS 37-07	8	61	1618	110	ME	39	20.5	0	62	68	104
ASGROW	Pulsar	8	63	1673	108	ME	34	18.4	0	61	59	90
(Check)	399 X 2737	7	83	2259	132	ML	38	22.8	0	57	57	87
Average		7	67	1796	114	ME	38	22.7	0	60	66	
LSD 0.20											5.2	

\1 Planted: June 6; Harvested: November 4.

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 5.--Summary: Dryland Grain Sorghum Hybrid Performance Tests at Vilas, 2003-2005.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2003	2004	2005	2-Year Avg	3-Year Avg	2003	2004	2005	2-Year Avg	3-Year Avg
		----------Bu/A----------					----------%----------				
ASGROW	Seneca	17	33	71	52	40	107	116	108	112	110
ASGROW	Pulsar	21	24	59	42	35	129	85	90	88	101
DEKALB	DK-44	20	31	69	50	40	124	110	105	108	113
PIONEER	85G01	26	35	--	31	--	159	126	--	143	--
SORGHUM PARTNERS	NK 7633	20	35	--	28	--	122	123	--	123	--
(Check)	399 X 2737	15	15	57	20	29	94	73	87	80	85
Average		16	28	66	47	37					

Grain Yields were corrected to 14.0 % seed moisture content.

Dryland Grain Sorghum Hybrid Performance Trial at Walsh, 2005

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

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

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 43,600 Seed/A. PLANTED: May 26. HARVESTED: November 2.

EMERGENCE DATE: 10 days after planting. SOIL TEMP: 66 F.

PEST CONTROL: Preemergence Herbicides: Roundup, 20 Oz/A; 2,4-D, 0.5 Lb/A, Atrazine 1.0 Lb/A. Post Emergence Herbicides: Banvel 4.0 Oz/A, LoVol 5 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--------		
May	1.28	57	0	0	5
June	1.16	679	17	2	35
July	1.01	878	26	8	66
August	1.90	763	17	3	97
September	0.24	642	15	0	127
October	1.06	276	3	0	151
Total	6.65	3295	78	13	151

\1 Growing season from May 26 (planting) to October 24 (first freeze, 24 F).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

COMMENTS: Planted in good soil moisture. Weed control was very good. Below normal precipitation for the growing season with very warm temperatures throughout the season. No greenbug infestation. None of the hybrids lodged. Late freeze date. Yields and test weights were very good considering the dry season.

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"	7.7	0.5	1.9	14	6.2	490	1.0	5.8
8"-24"				16				
Comment	Alka	Vlo		Hi	Hi	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	0	20	0.3	0

Yield Goal: 50 Bu/A.
Actual Yield: 58 Bu/A.

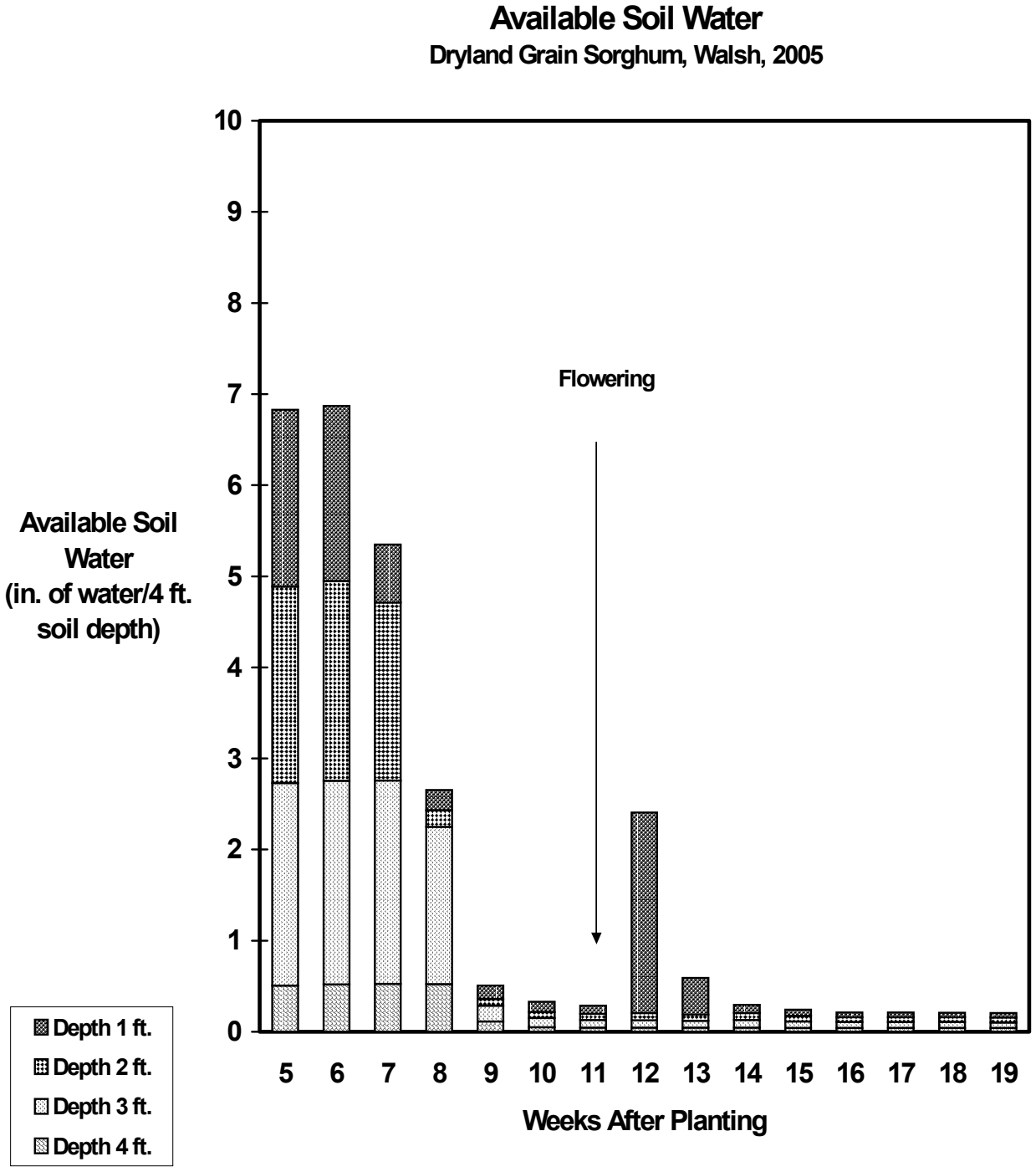

Fig. 3. Available soil water in dryland grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 6.65 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 6.--Dryland Grain Sorghum Hybrid Performance Test at Walsh, 2005. \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	%
FONTANELLE	GE 3245	11	65	1582	108	E	32	22.5	0	59	58	101
DEKALB	DKS 37-07	11	70	1743	115	ME	35	19.6	0	60	68	117
DEKALB	DK-44	10	72	1778	119	ME/M	36	21.9	0	60	61	105
ASGROW	Pulsar	11	70	1743	112	ME	32	20.3	0	60	60	104
FONTANELLE	GE 4532	10	73	1804	119	ME	38	26.1	0	60	58	100
ASGROW	Seneca	9	73	1804	120	ME/M	34	25.7	0	60	56	97
(Check)	399 X 2737	9	89	2173	138	ML	34	25.9	0	57	44	76
Average		10	73	1804	119	ME	34	23.1	0	59	58	
LSD 0.20											6.2	

\1 Planted: May 26; Harvested: November 2.

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 7.--Summary: Dryland Grain Sorghum Hybrid Performance Tests at Walsh, 2003-2005.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2003	2004	2005	2-Year Avg	3-Year Avg	2003	2004	2005	2-Year Avg	3-Year Avg
		----------Bu/A----------					----------%----------				
ASGROW	Seneca	36	66	56	61	53	144	107	97	102	116
ASGROW	Pulsar	34	64	60	62	53	135	105	104	105	115
DEKALB	DK-44	23	52	61	57	45	94	85	105	95	95
PIONEER	85G01	31	81	--	56	--	125	131	--	128	--
SORGHUM PARTNERS	NK 7633	36	55	--	46	--	146	90	--	118	--
TRIUMPH	TR 438	25	79	--	52	--	98	129	--	114	--
(Check)	399 X 2737	15	43	44	44	34	58	70	76	73	68
Average		26	61	58	60	48					

Grain Yields were corrected to 14.0 % seed moisture content.

Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2005

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

PURPOSE: To identify high yielding hybrids under irrigated conditions with 3200 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 2. HARVESTED: November 3.

EMERGENCE DATE: 9 days after planting. SOIL TEMP: 65 F.

IRRIGATION: Drip irrigated for 15 weeks with 12.6 A-in./A.

PEST CONTROL: Preemergence Herbicides: Roundup 20 Oz/A, 2,4-D 0.5 Lb/A, Atrazine 1.0 Lb/A. Post Emergence Herbicides: Banvel 4 0z/A, LoVol 5 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	1.16	677	17	2	28
July	1.01	878	26	8	59
August	1.90	763	17	3	90
September	0.24	642	15	0	120
October	1.06	276	3	0	148
Total	5.37	3236	78	13	148

\1 Growing season from June 2 (planting) to October 24 (first freeze, 24 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. Weed control was good. Below normal precipitation for the growing season with very warm temperatures throughout the season. Late freeze date. No greenbug infestation. None of the hybrids lodged. 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"	7.7	0.5	1.9	5	0.9	368	1.1	6.2
8"-24"				5				
Comment	Alka	VLo	Hi	Lo	VLo	VHi	Lo	Marg

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------Lb/A----------			
Recommended	59	40	0	0
Applied	140	20	0.3	0

Yield Goal: 125 Bu/A.
Actual Yield: 115 Bu/A.

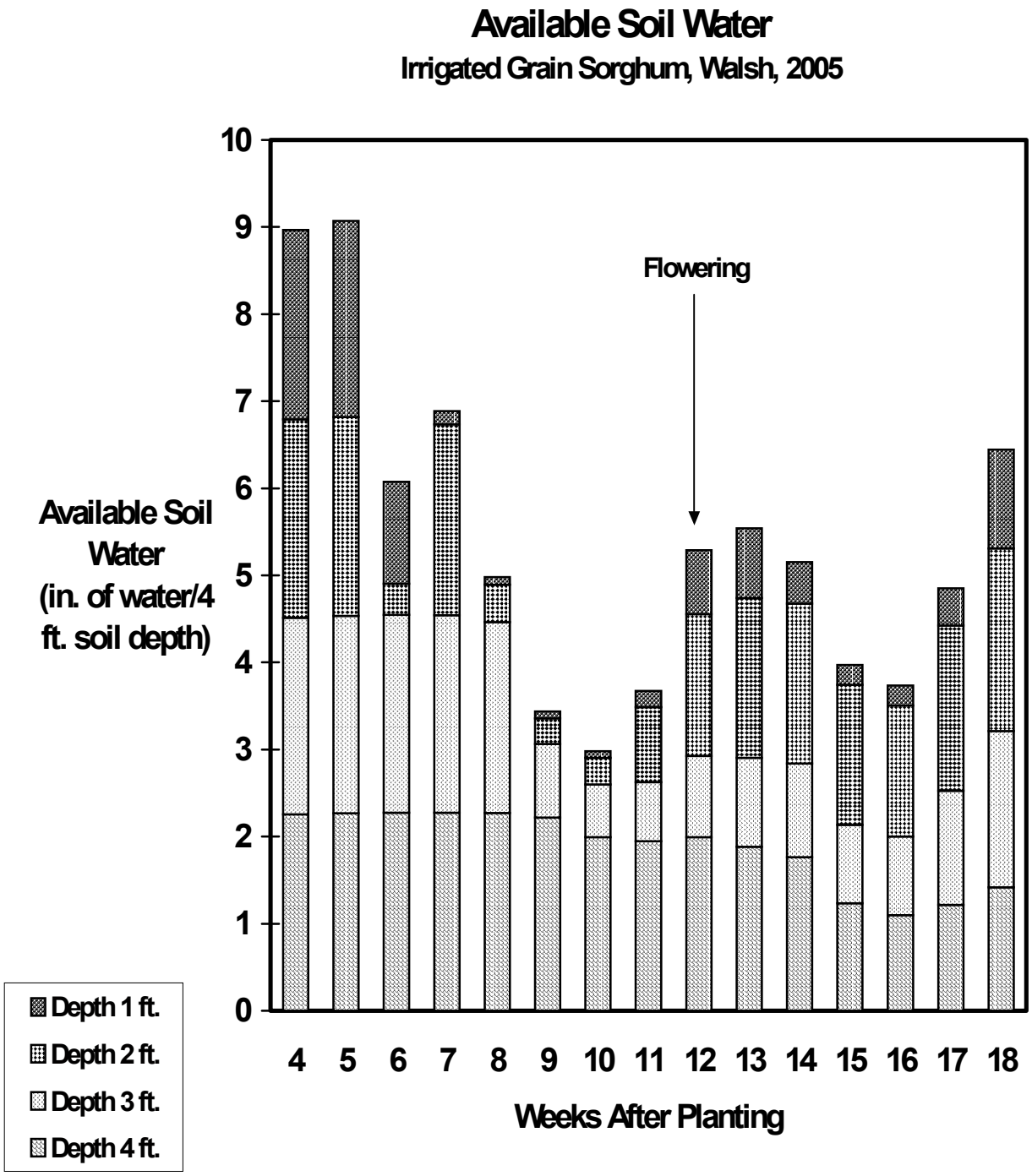

Fig. 4. Available soil water in irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 5.37 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 8.--Irrigated Grain Sorghum Hybrid Performance Test at Walsh, 2005. \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	%
ASGROW	A 567	10	75	1914	124	M/ML	50	36.0	0	59	117	103
DEKALB	DKS 54-00	9	82	2089	131	ML	51	33.7	0	57	128	112
ASGROW	A 571	8	87	2222	137	ML	51	36.8	0	55	117	103
DEKALB	DKS 53-11	10	77	1967	127	ML	49	37.6	0	60	113	100
(Check)	399 X 2737	8	85	2167	134	ML	44	35.2	0	56	102	90
Average		9	81	2072	131	ML	49	35.9	0	57	115	
LSD 0.20											7.9	

\1 Planted June 2; Harvested: November 3.

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 9.--Summary: Irrigated Grain Sorghum Hybrid Performance Tests at Walsh, 2003-2005.

		Grain Yield					Yield as % of Test Average				
Brand	Hybrid	2003	2004	2005	2-Year Avg	3-Year Avg	2003	2004	2005	2-Year Avg	3-Year Avg
		----------Bu/A----------					----------%----------				
ASGROW	A 567	--	117	117	117	--	--	105	103	104	--
ASGROW	A 571	132	107	117	112	119	106	96	103	100	102
DEKALB	DKS 54-00	135	107	128	118	123	108	96	112	104	105
DEKALB	DKS 53-11	119	119	113	116	117	96	107	100	104	101
PIONEER	84G62	139	131	--	135	--	111	118	--	115	--
SORGHUM PARTNERS	NK 5418	122	115	--	119	--	98	103	--	101	--
SORGHUM PARTNERS	NK 7633	127	99	--	113	--	102	89	--	96	--
SORGHUM PARTNERS	NK 7655	120	117	--	119	--	96	105	--	101	--
(Check)	399 X 2737	125	109	102	106	112	100	98	90	94	96
Average		125	111	115	113	117					

Grain Yields were corrected to 14.0 % seed moisture content.

Limited Sprinkler Irrigated Grain Sorghum Hybrid Performance Trial at Walsh, 2005

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 3200 sorghum heat units in a Silty Loam soil.

PLOT: Four rows with 30" row spacing, at least 1000' long. SEEDING DENSITY: 58,000 Seed/A. PLANTED: June 2. HARVESTED: November 7.

EMERGENCE DATE: 9 days after planting. SOIL TEMP: 65 F.

IRRIGATION: Sprinkler irrigated with 7.5 A-in./A, applied with five rotations.

PEST CONTROL: Preemergence Herbicides: Roundup 20 Oz/A, 2,4-D 0.5 Lb/A, Atrazine 1.0 Lb/A. Post Emergence Herbicides: Banvel 4 0z/A, LoVol 5 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	1.16	677	17	2	28
July	1.01	878	26	8	59
August	1.90	763	17	3	90
September	0.24	642	15	0	120
October	1.06	276	3	0	148
Total	5.37	3236	78	13	148

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

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

COMMENTS: Planted in good soil moisture. Weed control was good. Below normal precipitation for the growing season with very warm temperatures throughout the season. Late freeze date. No greenbug infestation. None of the hybrids lodged. Grain yields were poor because irrigation caused late tillers to develop that did not produce mature seed.

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"	7.6	0.5	2.0	11	5.3	428	1.1	6.6
8"-24"				13				
Comment	Alka	VLo	Hi	Hi	Lo	VHi	Marg	Adeq

Manganese and Copper levels were adequate.

Summary: Fertilization.

Fertilizer	N	P_2O_5	Zn	Fe
	----------Lb/A----------			
Recommended	0	20	0	0
Applied	130	40	0	0

Yield Goal: 125 Bu/A.
Actual Yield: 59 Bu/A.

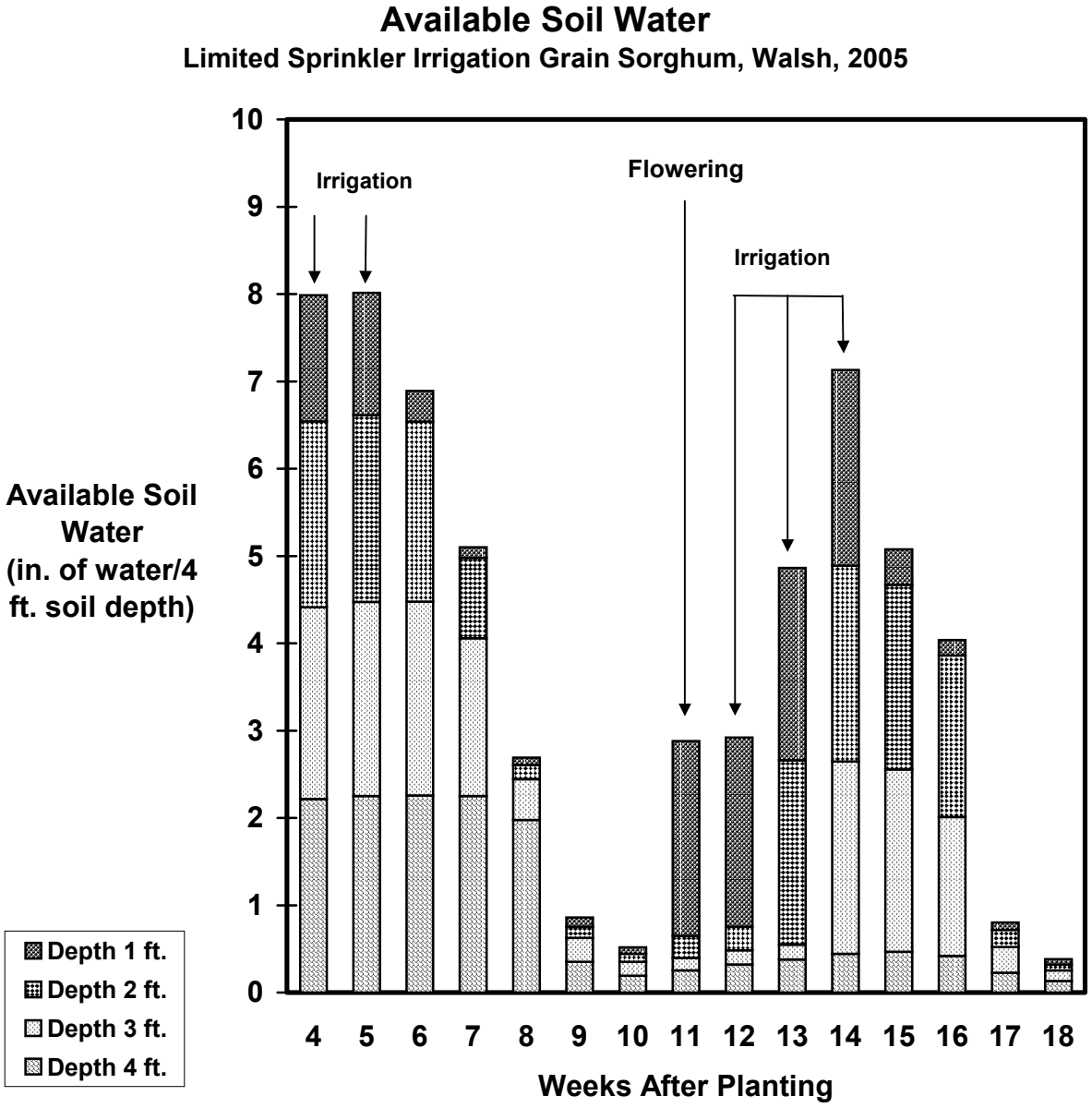

Fig. 5. Available soil water in irrigated grain sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to first freeze was 5.37 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 10.--Limited Sprinkler Irrigated Grain Sorghum Hybrid Performance Test at Walsh, 2005. \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	%
FONTANELLE	GE 3245	9	70	1861	114	E	34	36.0	0	56	62	105
TRIUMPH	TR 442	8	80	2025	126	ME	45	37.2	0	56	73	124
FONTANELLE	GE 4532	9	76	1937	121	ME	42	34.2	0	57	56	94
MYCOGEN	1482	8	73	1890	118	ME	37	38.0	0	56	53	90
MYCOGEN	M 3838	9	77	1967	124	ME	40	35.0	0	57	52	87
Average		9	75	1936	121	ME	40	36.1	0	56	59	
LSD 0.20											2.8	

\1 Planted: June 2; Harvested: November 7.

Yields are corrected to 14.0% seed moisture content.

DAP: Days After Planting or maturation of seed at first freeze (24 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.

Irrigated Forage Sorghum Hybrid Performance Trial at Walsh, 2005

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

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

PLOT: Four rows with 30" row spacing, 50' long. SEEDING DENSITY: 113,250 Seed/A. PLANTED: May 26. HARVESTED: September 20.

EMERGENCE DATE: 9 days after planting. SOIL TEMP: 66 F.

IRRIGATION: Three furrow irrigations: June 28, August 3, and August 18, total applied 17 A-in./A.

PEST CONTROL: Preemergence Herbicides: Roundup 20 Oz/A, 2,4-D 0.5 Lb/A. Post Emergence Herbicides: Banvel 4 Oz/A, LoVol 5 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--------		
May	1.28	57	0	0	5
June	1.16	679	17	2	35
July	1.01	878	26	8	66
August	1.90	763	17	3	97
September	0.12	445	11	0	117
Total	5.47	2822	71	13	117

\1 Growing season from May 26 (planting) to September 20 (harvest).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

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

COMMENTS: Planted in good soil moisture. Weed control was good. The growing season was very wet and very cool. No greenbug infestation. Two hybrids had 20% or more lodging. 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"	7.7	0.5	1.9	14	6.2	490	1.0	5.8
8"-24"				16				
Comment	Alka	VLo	Hi	Hi	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	120	20	0	0

Yield Goal: 18 Ton/A.
Actual Yield: 17.5 Ton/A @ 70% MC.

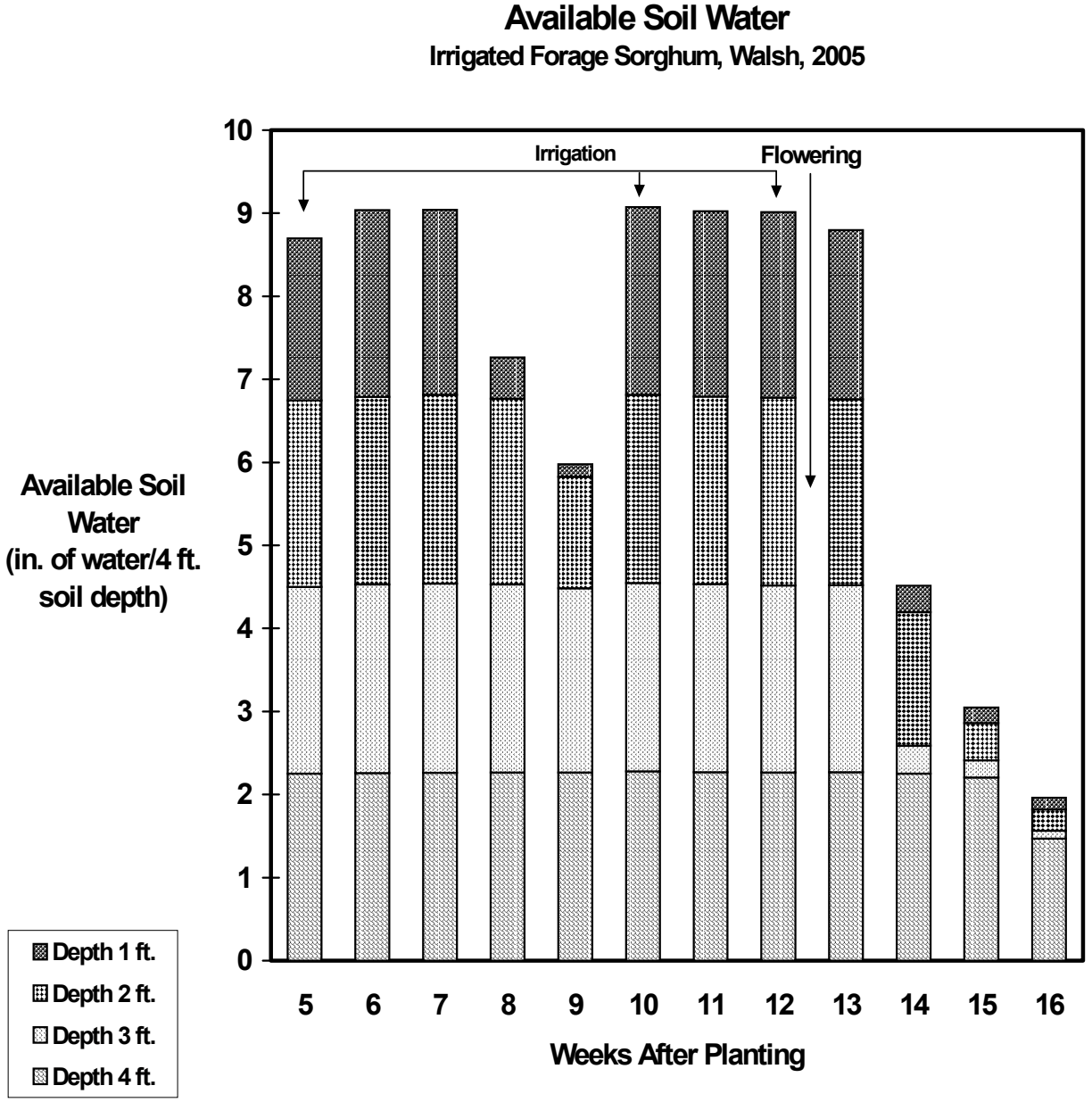

Fig. 6. Available soil water in irrigated forage sorghum at Walsh. Gypsum block measurements taken to 4 ft. with 1 ft. increments. Total rainfall at Walsh from planting to harvest was 5.47 in. Any increase in available soil water between weeks not attributed to applied irrigation is from rain.

Table 11.--Irrigated Forage Sorghum Hybrid Performance Test at Walsh, 2005. \1

Brand	Hybrid	Forage Type \2	Days to Emerge	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	%
DEKALB	FS-25E	FS	9	109	38.3	104	PM	7	0	22.0	125
DEKALB	FS-5	FS	9	96	38.3	102	LM	7	0	21.5	123
RICHARDSON SEEDS	Dairy Master BMR	FS	10	96	44.9	100	MM	9	35	17.9	102
DEKALB	DKS 59-09	FS	9	84	32.2	77	SD	4	1	17.8	102
RICHARDSON SEEDS	Bundle King BMR	FS	10	113	40.7	100	FL	8	20	16.4	93
(Check)	NB 305F	FS	11	95	34.1	106	MM	14	0	15.9	91
RICHARDSON SEEDS	Pacesetter BMR	FS	11	Veg	35.6	93	Veg	6	0	15.3	87
RICHARDSON SEEDS	Sweeter 'N Honey II	SS	8	107	50.3	112	PM	9	0	18.3	104
CAL/WEST SEEDS	CW 4-67-6	SS	9	80	43.4	91	HD	5	2	17.5	100
RICHARDSON SEEDS	Honey Graze BMR	SS	9	84	44.5	105	ED	9	0	17.4	99
CAL/WEST SEEDS	CW 2-62-6	SS	9	79	45.7	93	HD	6	2	16.2	92
RICHARDSON SEEDS	Sweeter 'N Honey BMR	SS	9	92	37.2	97	LM	7	4	16.0	91
CAL/WEST SEEDS	CW 2-61-6	SS	9	79	43.0	86	HD	7	2	15.8	90
CAL/WEST SEEDS	CW 2-63-6	SS	10	78	43.8	87	MT	7	0	13.0	74
MYCOGEN	2T801 (Bt/RR)	Corn	7	75	31.0	78	SD	4	0	21.9	125
Sorghum Average		FS	9	86	40.2	95	LM	7	4	17.5	
LSD 0.20										2.12	

\1 Planted: May 26; Harvested: September 20.

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

\3 Seed Maturation: PM, premilk; EM, early milk; MM, midmilk; LM, late milk; ED, early dough; SD, soft dough; HD, hard dough; MT, mature.

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

Table 12.--Summary: Irrigated Forage Sorghum Hybrid Performance Tests at Walsh, 2003-2005.

		Forage Yield					Yield as % of Test Average				
Brand	Hybrid	2003	2004	2005	2-Year Avg	3-Year Avg	2003	2004	2005	2-Year Avg	3-Year Avg
		----------Tons/A----------									
AERC	AERC SSH 35	19.8	7.3	--	13.6	--	102	48	--	75	--
BUFFALO BRAND	Canex	19.8	16.4	--	18.1	--	102	107	--	105	--
BUFFALO BRAND	Canex BMR 208	16.6	15.3	--	16.0	--	86	100	--	93	--
BUFFALO BRAND	Canex BMR 310	18.0	14.2	--	16.1	--	93	93	--	93	--
BUFFALO BRAND	Canex BMR 248	19.6	14.4	--	17.0	--	101	94	--	98	--
BUFFALO BRAND	Grazex BMR 727	20.8	13.4	--	17.1	--	107	88	--	98	--
DEKALB	FS-5	24.0	21.0	21.5	21.3	22.2	124	137	123	130	128
DEKALB	FS-25E	23.6	13.3	22.0	17.7	19.6	122	87	125	106	111
DEKALB	DKS 59-09	17.4	20.7	17.8	19.3	18.6	90	136	102	119	109
DRUSSEL SEED	DSS Dividend BMR	24.1	17.8	--	21.0	--	124	116	--	120	--
SORGHUM PARTNERS	NK 300	21.9	16.2	--	19.1	--	113	106	--	110	--
SORGHUM PARTNERS	SS 405	20.6	13.1	--	16.9	--	106	86	--	96	--
SORGHUM PARTNERS	Sordan Headless	19.9	19.7	--	19.8	--	103	129	--	116	--
(Check)	NB 305F	20.0	17.2	15.9	21.8	17.7	113	112	91	102	105
(Check)	Corn	19.3	18.7	21.9	20.3	20.0	99	122	125	124	115
Average		19.4	15.3	17.5	16.4	17.4					

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

Table 13.--Irrigated Forage Sorghum Hybrid Dry Matter Analysis at Walsh, 2005.

Brand	Hybrid	Forage Type \1	Days to Boot	Plant Height at Boot	CP	ADF	NDF	IVTD	TDN	RFQ	Net Energy Main.	Net Energy Gain	Net Energy Lact.
				In	----------%----------						-----MCal/lb-----		
DEKALB	DKS 59-09	FS	77	53	10.7	36.8	57.4	83.0	65.0	147	0.60	0.34	0.67
DEKALB	FS-25E	FS	100	95	10.1	37.2	58.8	80.0	62.6	134	0.60	0.34	0.64
RICHARDSON SEEDS	Pacesetter BMR	FS	Veg	96	9.3	38.3	60.3	80.7	62.1	132	0.58	0.32	0.64
(Check)	NB 305F	FS	87	80	9.4	38.4	60.6	79.2	62.6	130	0.58	0.32	0.64
RICHARDSON SEEDS	Dairy Master BMR	FS	88	84	5.6	40.4	64.1	79.0	63.1	128	0.54	0.29	0.65
RICHARDSON SEEDS	Bundle King BMR	FS	103	92	6.8	38.9	62.8	78.0	62.3	125	0.57	0.31	0.64
DEKALB	FS-5	FS	88	80	6.2	43.2	65.5	76.3	59.6	114	0.49	0.24	0.61
RICHARDSON SEEDS	Honey Graze BMR	SS	77	66	10.4	37.7	57.2	82.9	64.6	147	0.59	0.33	0.66
CAL/WEST SEEDS	CW 2-61-6	SS	72	53	9.6	35.7	58.2	81.1	64.1	140	0.62	0.36	0.66
CAL/WEST SEEDS	CW 2-63-6	SS	71	58	8.2	37.1	60.4	80.4	64.7	137	0.60	0.34	0.67
CAL/WEST SEEDS	CW 4-67-6	SS	73	53	8.2	37.7	60.4	80.3	64.6	137	0.59	0.33	0.66
RICHARDSON SEEDS	Sweeter 'N Honey BMR	SS	85	65	9.9	38.7	60.7	81.3	62.7	135	0.57	0.31	0.64
CAL/WEST SEEDS	CW 2-62-6	SS	71	59	7.8	38.1	60.9	79.8	63.4	133	0.58	0.32	0.65
RICHARDSON SEEDS	Sweeter 'N Honey II	SS	97	89	10.2	40.7	59.4	79.0	61.3	128	0.54	0.28	0.63
MYCOGEN	2T801 (Bt/RR)	Corn	71	68	10.4	36.2	59.3	77.3	61.5	124	0.61	0.35	0.63
Sorghum Average		FS	83	73	8.9	38.3	60.4	79.9	62.9	133	0.58	0.32	0.65

\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; IVTD, In Vitro True Digestibility; RFQ, Relative Forage Quality; Net Energy: Maintenance, Gain, Lactation..

Irrigated Forage Sorghum Hybrid Performance Trial at Rocky Ford, 2005

COOPERATOR: Abdel Berrada, Research Scientist Arkansas Valley Research Center, Rocky Ford, Colorado.

PURPOSE: To identify high yielding hybrids under irrigated conditions in a Silty Clay Loam soil.

PLOT: Two rows with 30" row spacing, 32' long. SEEDING DENSITY: 99,700 Seed/A. PLANTED: June 8. HARVESTED: September 20.

IRRIGATION: Six furrow irrigations: June 9, June 29, July 15, July 25, August 3, and August 25.

PEST CONTROL: Preemergence Herbicides: Clarity 7 oz/A, Dual II Magnum 2.0 pts/A. Postemergence Herbicide: None Insecticide: Fanfare 6.4 oz/A, Dimethoate 14.5 oz/A, MSO/Suceed 8.0 oz/A, LI 700 1.6 oz/A.

Summary: Growing Season Precipitation and Temperature \1
Arkansas Valley Research Center, Rocky Ford, Otero County.

Month	Rainfall	GDD \2	>90 F	>100 F	DAP \3
	In		--------No. of Days--------		
June	0.91	549	15	2	22
July	0.45	878	26	8	53
August	2.17	763	17	3	84
September	1.23	445	11	0	104
Total	4.76	2635	69	13	104

\1 Growing season from June 8 (planting) to September 20 (harvest).
\2 GDD: Growing Degree Days for sorghum.
\3 DAP: Days After Planting.

SOIL: Silty Clay Loam, 1 - 1.5 % O.M., pH-ca. 7.8. FERTILIZER: 148 lbs. N/A applied in irrigation water.

COMMENTS: Planted in good soil moisture. Weed control was good. The growing season was nearly normal, except July was hot and August was wetter than average. There was only minor nonconsistent lodging. The forage crop was not stressed because of abundant irrigation water. Forage yields were excellent.

Table 14.--Irrigated Forage Sorghum Hybrid Performance Test at Rocky Ford, 2005. \1

Brand	Hybrid	Forage Type \2	Days to 50% Bloom	Plant Ht.	Stage \3 at Harvest	Stem Sugar	Dry Matter	Forage Yield	Yield % of Test Avg.
				In.		%	%	Tons/A	%
CAL/WEST SEEDS	CW 2-61-1	SS	69	90	ED	10	28	52.6	111
CAL/WEST SEEDS	CW 2-62-6	SS	69	96	LM	10	28	51.3	108
BUFFALO BRAND	Grazex BMR 719	SS	71	101	MM	14	26	48.3	102
CAL/WEST SEEDS	CW 4-67-6	SS	70	88	MM	13	27	46.3	98
BUFFALO BRAND	Grazex BMR 718	SS	74	103	EM	12	25	46.3	98
CAL/WEST SEEDS	CW 2-63-6	SS	70	88	EM	14	26	45.7	97
(Check)	NB 305F	FS	84	105	EM	14	22	48.5	103
BUFFALO BRAND	Canex BMR 208	FS	73	101	MM	11	26	46.6	99
BUFFALO BRAND	Silex BMR 501	FS	99	97	PM	13	20	39.9	84
Sorghum Average		FS	75	97	LM	12	25.5	47.3	
LSD 0.05							1.7	6.0	
CV (%)							3.8	9.5	

\1 Planted: June 8; Harvested: September 20.

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

\3 Seed Maturation: 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.

Zn Fertilization of Irrigated Grain Sorghum in Southeastern Colorado

Kevin Larson, Dennis Thompson, and Bill Brooks

Soil test recommendations for Southeastern Colorado typically recommend banding 2 Lb Zn/A to both dryland and irrigated grain sorghum. From our previous studies, we reported yield increases with Zn fertilization for dryland corn, but only once did dryland grain sorghum respond positively to applied Zn (Larson, Schweissing, Thompson, 2001). The one time dryland grain sorghum yields did increase with Zn fertilization was an exceptionally high rainfall, high yielding year. Since Zn increased yields under a high production environment, we decided to study the effects of Zn under irrigation. This is the fourth year of our continuing study to determine the optimum Zn rate for irrigated grain sorghum under high yielding conditions.

Materials and Methods

This year we tested six seedrow Zn rates: 0, 0.2, 0.4, 0.6, 0.8, and 1.0 Lb Zn/A as Zn chelate with three replications. We mixed the Zn with 5 Gal 10-34-0/A prior to application. The Zn soil test for this study was 1.1 ppm (low to marginal). The site was subsurface drip irrigated with 11.8 A-in./A. We planted Mycogen 1482 on June 15 at 87,100 Seeds/A. We applied 140 Lb N/A and 20 Lb P_2O_5/A to the site. For weed control, we sprayed Roundup 20 Oz/A, 2,4-D 0.5 Lb/A and Atrazine 1.0 Lb/A pre-emergence, and Banvel 4 Oz/A and LoVol 5 Oz/A post-emergence. We cultivated one time. The 10 ft. X 650 ft. plots were harvested with a self-propelled combine and weighed in a digital weigh cart. For each plot at harvest, we took a sample for moisture and test weight.

Results and Discussion

This year there was no yield response to seedrow Zn with a low to marginal Zn soil test of 1.1 ppm (Fig. 7). The near zero linear response indicates there were no yield or test weight trends with increasing Zn rates. The lack of yield and test weight response to increasing Zn rates under these high yielding irrigated production conditions suggests that there was sufficient time for the crop to mature. The test weight results from this year ranged from 57.3 to 58.2 Lb/Bu confirming that the seed fully matured. Results from our Vilas study two years ago (Larson, Schweissing, and Thompson, 2004) suggested that Zn was not needed if the growing season was long enough for full seed maturation even with a low Zn soil test of 0.6 ppm. The results from this year confirm our explanation of the role of Zn in seed maturation. Last year with a low Zn soil test of 0.8 ppm seedrow Zn increased both grain yield and test weight with a maximum rate of 0.8 Lb/A for grain yield and 0.6 Lb/A for test weight (Larson, Berrada, and Thompson, 2005). Last year we expected a yield response to Zn because of the late planting date (July 2) and the suggested Zn role of maturity acceleration observed two years ago. In 2003, we observed maturity acceleration with increasing Zn rate; however, there was no yield response to applied Zn on irrigated grain sorghum at either of the Zn sites (the Zn soil test was 0.6 ppm for the Vilas site and 1.0 ppm for the Walsh site) (Larson, Schweissing, and Thompson, 2004). For the last three years of this study, we had late freeze dates (October 26, 25, and 24, respectively); however, the yield response to Zn rates varied. Planting date was the determinate factor to the

response to applied Zn and seed maturation. In the years when we had a typical planting date (late May to mid June), there was no response to applied Zn. Last year when we had a late planting date (July 2) grain yields and test weights were optimized at 0.6 to 0.8 Lb Zn/A. In 2003, with typical planting dates (late May to mid June), we observed that the late freeze date (October 26, 22 F) allowed all Zn rates to mature. Last year, we again had a late freeze date (October 25, 29 F), but because of our late planting date (July 2), the maturity acceleration gained with applied Zn increased both yield and test weight. The low test weights we recorded indicate that none of the Zn rates fully matured, but test weight increased with Zn rate from 51.5 Lb/Bu for the 0 lb/A Zn rate to 53.5 Lb/Bu for the 0.6 Lb/A rate. At Walsh in 2004, the optimum seedrow Zn rate of 0.8 Lb/A with a yield of 83 Bu/A was similar to the Zn response we recorded from the 2002 Vilas site with an optimum rate around 0.6 Lb Zn/A and a yield of 98 Bu/A (Larson, Schweissing, Thompson, 2003). These positive yield responses to Zn were from low Zn soil tests of 0.6 ppm at Vilas in 2002 and 0.8 ppm at Walsh in 2004.

This is the fourth year of our multi-year irrigated grain sorghum Zn study. The lack of Zn response we obtained this year suggests that Zn fertilizer may not be needed for high grain sorghum production with a low to marginal Zn soil test, 1.1 ppm, when planted as late as mid June with a late first freeze date. If the growing season is long enough for full seed maturation, Zn fertilization may not be necessary under high yielding irrigated conditions with low to marginal Zn soil tests ranging from 0.6 ppm to 1.1 ppm. We observed that when Zn soil test were low, 0.6 ppm to 0.8 ppm, and the growing season was not long enough for full maturation, seedrow Zn increased both grain yield and test weight. In the years that we observed Zn responses with low Zn soil tests, applying seedrow Zn to irrigated, high production grain sorghum produced a optimum response from 0.5 Lb/A with a typical planting date and an early first freeze date, and 0.6 to 0.8 Lb/A of Zn with a late planting date and a late first freeze date.

In summary for the past four years of this irrigated grain sorghum study, the only instances that we obtained yield increases with seedrow-applied Zn were with low Zn soil tests, 0.6 ppm to 0.8 ppm; however, low to marginal Zn soil tests, 0.6 ppm to 1.1 pmm, did not consistently produce yield increases with seedrow Zn. With low to marginal Zn soil tests, yield responses to seedrow Zn were more closely associated with grain sorghum maturation than with low Zn soil tests. When there was sufficient time for the grain sorghum crop to fully mature, we observed no yield increase with seedrow Zn even with our lowest recorded Zn soil test of 0.6 ppm. However, we observed grain yield responses to seedrow Zn with low Zn soil tests, 0.6 ppm to 0.8 ppm, when there was inadequate time for the grain sorghum crop to fully mature.

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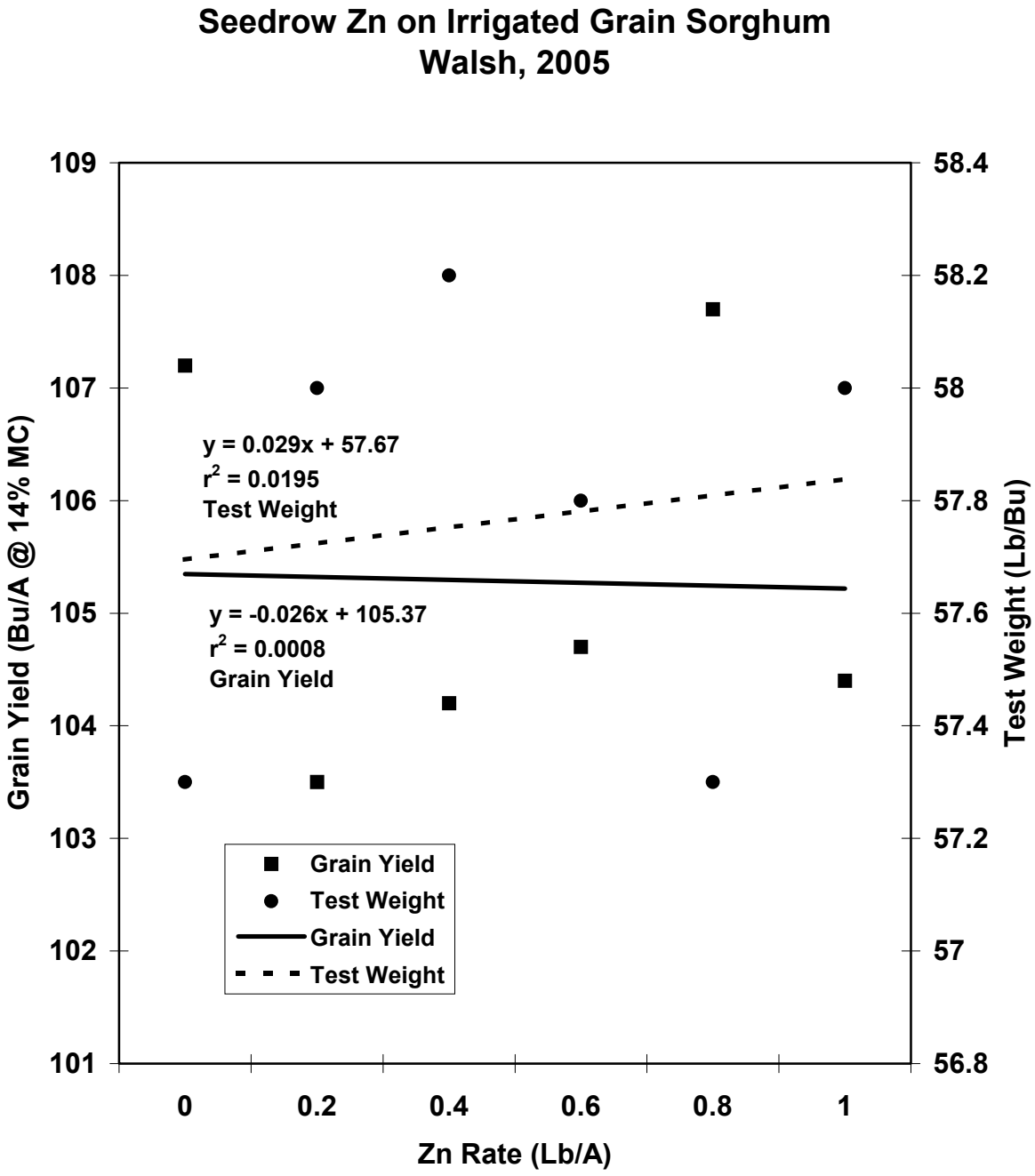

Fig. 7. Seedrow Zn rate on subsurface drip irrigated grain sorghum at Walsh. The Zn rates were 0, 0.2, 0.4, 0.6, 0.8 and 1.0 Lb Zn/A as Zn chelate. The grain sorghum hybrid was Mycogen 1482 planted at 87,100 Seeds/A on June 15.

Sandbur Control, Grain Yield and Net Return of Microencapsulated Herbicides in Dryland Grain Sorghum

Kevin Larson and Dennis Thompson

Weed control is an essential component of grain sorghum production. In order to evaluate economic return of herbicide applications, it is important to consider chemical costs and grain yields. We tested three microencapsulated grass herbicides with Atrazine. Microencapsulated herbicides are advertised as providing slow release of herbicide that prolongs herbicide activity. We tested three microencapsulated grass herbicides and Atrazine on sandbur, the most prevalent grassy weed in grain sorghum in Southeastern Colorado.

Materials and Methods

We applied four pre-emergence herbicide treatments: Bicep Lite II Magnum 1.5 Qt/A, G-Max Lite 1.5 Qt/A, Micro-Tech 2.5 Qt/A with Atrazine 1.0 Lb/A, and Atrazine 1.0 Lb/A with three replications on Richfield Silty Loam soil. All herbicide treatments had 1.0 Lb/A of Atrazine and all were applied on June 8 at 10 Gal/A with 110^{o} flat fan nozzles spaced 18 in. apart. We had planned to incorporate the herbicide with sprinkler irrigation immediately after spraying, but the sprinkler was down and the herbicides were not incorporated until three days later with 0.70 inches of rain. The 20 ft. by 1250 ft. plots were planted June 2 with Mycogen M3838 at 58,000 Seeds/A. To control broadleaf weeds, we sprayed Banvel 4 Oz/A and LoVol 5 Oz/A and cultivated once.

Results and Discussion

All three microencapsulated herbicide treatments had significantly higher sandbur control than the Atrazine check (Table 15). Bicep Lite II Magnum was the only treatment that produced significantly higher yields than the Atrazine check (4 Bu/A more). The Atrazine check generated the highest variable net income producing at least $9.21 more than any of the microencapsulated herbicide treatments. The microencapsulated herbicide treatments cost $13.76/A to $17.68/A more than the Atrazine only treatment. The meager yield increase of the microencapsulated herbicide treatments did not justify the higher cost of these treatments compared to Atrazine alone. Since all of microencapsulated herbicide treatments produced better sandbur control than the Atrazine check, it demonstrates that not all of the herbicide was lost to the three-day incorporation delay. Herbicide efficacy would have been higher if we were able to incorporate with sprinkler irrigation immediately after herbicide application, as the Bicep II Magnum label states, “If irrigation is not possible and rain does not occur within 2 days after planting and application, weed control may be decreased.” Waiting three days after herbicide application for rain to incorporate the treatments allowed volatilization to occur and some weed control was lost. Last year when we were able to rotary-hoe incorporate after herbicide application, we produced significantly higher yields and variable net incomes than the Atrazine check (Larson, Berrada, Thompson, 2005).

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Larson, K.J., A. Berrada, D.L. Thompson. 2005. Sorghum hybrid performance trials in Colorado, 2004. Technical Report TR05-03. AES, Dept. of Soil and Crop Sciences, CSU, 49p.

Table 15.-Sandbur Control in Dryland Grain Sorghum at Walsh, 2005.

Herbicide Treatment	Rate	Sandbur Control	Test Weight	Grain Yield	Chem. Cost	Var. Net Income
	*/A	%	Lb/Bu	Bu/A	$/A	$/A
Atrazine	1.0 lb	53	57	59	2.38	109.65
Bicep Lite II Magnum (rate applied 1.0 lb atrazine)	1.5 qt	75	56	63	20.06	100.44
Micro Tech & Atrazine	2.5 qt 1.0 lb	82	56	60	16.14	98.85
G-Max Lite (rate applied 1.0 lb atrazine)	1.5 qt	72	57	61	19.85	97.11
Average		71	57	61	14.61	101.51
LSD 0.20		18.0		3.3		

Planted: June 2, Mycogen M 3838 at 58,000 Seeds/A; Harvested: November 7.
Herbicide Treatments applied June 8.
Variable Net Income: Treatment Yield x $1.97/Bu - Chemical Cost - Application Cost ($4/A). All treatments were cultivated.

Strip-Till N and P and Surface N and Planter P Comparison for Sprinkler Irrigated Grain Sorghum and Corn Production

Kevin Larson and Dennis Thompson

Strip-till is a tillage system being newly adopted by many row crop producers in Southeastern Colorado. It is a modified no-till system with one tillage operation used for fertilizer placement. The crop is planted into the same rows where tillage occurred and where the fertilizer was placed. In this study we compared strip-till placement of anhydrous N and liquid P to surface applied liquid N and planter P for both sprinkler irrigated grain sorghum and corn production.

Materials and Methods

The previous crop at this site was corn. The AB-DTPA soil test for P was 5.3 ppm (with a pH of 7.6 and an organic matter level of 2.0%). We applied N at 130 Lb/A and P at 40 Lb P2O5/A to the grain sorghum, and 160 Lb N/A and 60 Lb P2O5/A to the corn for both the Strip-till N and P and Surface N and Planter P treatments. The N for the strip-till treatment was anhydrous, and for the surface-applied treatment we used liquid 32-0-0. The P treatment was applied 6 inches deep with the strip-till implement and 3 inches deep with a planter before planting. We strip-tilled the N and P for the Strip-till N and P treatment on March 4. For the Surface N and Planter P treatment, we surface applied N on March 18 in 18-inch spaced streams, and on March 30 we applied the P with a planter into the untilled strips. We planted two corn hybrids, Pioneer 33B54 and Mycogen 2T801, at 29,000 Seeds/A on May 5, and we planted two grain sorghum hybrids, Mycogen M3838 and Triumph TR 442, at 58,000 Seeds/A on June 2. For weed control, we sprayed preplant Balance 2.0 Oz/A and Atrazine 1.0 Lb/A to the corn site, and preplant Atrazine 1.0 Lb/A and post emergence Banvel 4 Oz/A and LoVol 5 Oz/A to the grain sorghum site. The site was sprinkler irrigated with the corn receiving 18.0 in./A of water and the grain sorghum receiving 7.5 in./A of water. We harvested the grain sorghum on November 8 and the corn on October 17 with a self-propelled combine and weighed them in a digital scale cart. Grain yields were adjusted to 14% seed moisture for grain sorghum and 15.5% seed moisture for corn.

Results

For both grain sorghum and corn, Strip-till N and P produced significantly more yield than Surface N and Planter P ($P > 0.20$) (Table 16 and Table18). There was a significant yield difference between the grain sorghum hybrids (Table 17), and the corn hybrids (Table 19). There was no interaction between the hybrids and the N and P placement treatments: both the hybrids for the corn and grain sorghum responded similarly to Strip-till N and P and Surface N and Planter P treatments. Plant densities were similar between hybrids and between N and P fertilizer placements.

Discussion

The advantages of strip-till compared to no-till are the use of anhydrous N fertilizer (the least expensive form of N fertilizer), deeper and more readily available placement of immobile nutrients, potential compaction alleviation, and early planting from enhanced soil warming (Jasa, 2003). The disadvantages of strip-till compared to

no-till are the horsepower and fuel use requirements for injecting fertilizers with knives or subsoiler shanks and the potential of drying the soil when planting and the strip-till operations are temporally close.

This is the second year of our study on strip-till. This year we applied both N and P with a strip-till implement and compared it to surface applied N and planter applied P. Last year we investigated N only and compared strip-till placement of N to surface-applied N. Last year the strip-till N produced the same yield as surface N for grain sorghum, while corn produced more yield with surface N than with strip-till N. This year the strip-till placement of both N and P produced significantly higher yield than surface N and planter P placement for both corn and grain sorghum. Last year with a very low P soil test of 2.1 ppm and seedrow placement of P for both strip-till N and surface N treatments, we observed no grain sorghum yield difference between strip-till N and surface N. This year with a low soil P test of 5.3 ppm there was a significant yield increase with strip-till when both N and P were applied together compared to surface N and planter P, this suggests that the deep placement of P obtained with strip-till may be responsible for the yield increase.

Last year we believed that one of the disadvantages of strip-till, drying of the soil, caused the corn yield reduction of strip-till N compared to surface applied N. There was only about 18 in. of moisture in the soil profile at corn planting and the extra soil moisture loss from strip-tilling may have lowered corn yield. The short time interval between the strip-till application and the corn planting date (three weeks) did not allow sufficient time for moisture to be replenished. A report comparing spring strip-till N, performed in April, to no-till N found no significant difference between corn yields; however, there was a significant yield difference between winter strip-till N, performed in January, to no-till N (Olsen, 2004). Last year we expected that corn and grain sorghum yields would be unaffected by N placement since N is a mobile nutrient. Therefore, it was no surprise that grain sorghum yields were identical for both strip-till N and surface applied N. The lack of yield response of grain sorghum to strip-till N and surface applied N was also reported for dryland grain sorghum in Northwest Kansas (Olsen, 2004).

The yield advantage obtained this year with deep placement of N and P using strip-till compared to surface N and planter P placement (shallow P placement) suggests that P availability may be increased with deep placement of P. With shallow P placement, such as seedrow placement, P fertilizer may only be available when the surface is wet, such as after a rain or irrigation. With deep placement of P fertilizer, available moisture and thus P availability may increase compared to shallow placed P. For both years of our study, we tested the same N placement treatments, strip-till N and surface applied N, but different P placements, seedrow P (shallow P placement) for both treatments the first year, and strip-till P (deep P placement) and planter P (shallow P placement) the second year. The lack of yield response for the first year of our study with a very low soil P test and with shallow P placement compared to the higher yield obtained for the second year of our study with a low soil P test and with strip-till P placement suggests that deep placement of N may not be as important as deep placement of P for high yields. This is only the second year of our study and for future studies we will continue testing strip-till placement of N and P to determine if deep

placement of P with strip-till will continue to produce higher yields than shallow placement of P.

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Table 16. -Sprinkler Irrigated Grain Sorghum, Strip-Till vs. Surface N and Planter P, 2005.

N and P Placement	50% Flowering Date	Plant Density	Test Weight	Grain Yield
		Plants/A X 1000	Lb/Bu	Bu/A
Strip-Till (knifed N and P)	19-Aug	34.7	57	65
Surface N and Planter P	19-Aug	37.5	56	60
Average	19-Aug	36.1	56.5	63
LSD 0.20				2.2

Strip-Till N (130 Lb/A) and P (40 Lb P2O5/A) applied March 4.
Surface N (130 Lb/A) applied March 18; Planter P (40 Lb P2O5/A) applied March 30.
Planted: June 2 at 58,000 Seeds/A; Harvested: November 8.
Total applied sprinkler irrigation: 7.5 in./A.

Table 17.-Sprinkler Irrigated Grain Sorghum Response to Fertilizer Placement, 2005.

Hybrid	50% Flowering Date	Plant Density	Test Weight	Grain Yield
		Plants/A X 1000	Lb/Bu	Bu/A
TRIUMPH TR 442	21-Aug	37.2	57	74
MYCOGEN M 3838	18-Aug	35.0	56	52
Average	19-Aug	36.1	56.5	63
LSD 0.20				1.1

N at 130 Lb/A applied strip-till and surface streamed.
P at 40 Lb P2O5/A applied strip-till and planter.
Planted: June 2 at 58,000 Seeds/A; Harvested: November 8.
Total applied sprinkler irrigation: 7.5 in./A.

Table 18.-Sprinkler Irrigated Corn, Strip-Till vs. Surface N and Planter P, 2005.

N and P Placement	50% Silking Date	Plant Density	Test Weight	Grain Yield
		Plants/A X 1000	Lb/Bu	Bu/A
Strip-Till (knived N and P)	24-Jul	26.0	59	125
Surface N and Planter P	24-Jul	27.4	59	117
Average	24-Jul	26.7	59	121
LSD 0.20				8.3

Strip-Till N (160 Lb N/A) and P (60 Lb P2O5/A) applied March 4.
Surlace N (160 Lb N/A) applied March 18; Planter P (60 Lb P2O5/A) applied March 30.
Planted: May 5 at 29,000 Plants/A; Harvested: October 17.
Total applied sprinkler irrigation: 18.0 in./A.

Table 19.-Sprinkler Irrigated Corn, Hybrid Response to N and P Placement, 2005.

Hybrid	50% Silking Date	Plant Density	Test Weight	Grain Yield
		Plants/A X 1000	Lb/Bu	Bu/A
PIONEER 33B54	24-Jul	26.4	60	129
MYCOGEN 2T801	24-Jul	27.0	58	113
Average	24-Jul	26.7	59	121
LSD 0.20				3.8

N at 160 Lb/A applied strip-till and surface streamed.
P at 60 Lb P2O5/A applied strip-till and planter.
Planted: May 5 at 29,000 Plants/A; Harvested: October 17.
Total applied sprinkler irrigation: 18.0 in./A.

Skip-Row Planting for Dryland Grain Sorghum and Corn Production

Kevin Larson and Dennis Thompson

Skip-row planting is an old idea that is being revitalized for dryland row crop production in the drier areas of the High Plains. The two main advantages of skip-row planting compared to solid planting are reported to be late-season water availability from water stored in the skip-row (Klein, et al., 2005) and less input costs because fewer rows are planted (Jost and Brown, 2001). The crop emphasis for skip-row has shifted from cotton and grain sorghum to glyphosate-resistant corn and soybean crops, because the glyphosate-resistant crops provide simple weed management and moisture conservation in the skip-row area.

Materials and Methods

The site used for this study was previously in a wheat-grain sorghum-fallow rotation. Our three skip-row treatments were: 1) all rows planted (sorghum, 35,000 Seeds/A; corn, 16,000 Seeds/A), 2) skip row/plant row (sorghum, 17,500 Seeds/A; corn, 8,000 Seeds/A), and 3) skip row/plant two rows (sorghum, 21,900 Seeds/A; corn, 10,000 Seeds/A). We planted the corn hybrid, Mycogen 2K541, on May 17 and the grain sorghum hybrid, Mycogen M3838, on June 17. We applied N at 70 Lb/A and we seedrow applied P at 20 Lb P_2O_5/A to the grain sorghum and corn studies. For preplant weed control, we sprayed Roundup Ultra at 24 Oz/A and Atrazine 1.0 Lb/A to both the corn and grain sorghum sites, and for post emergence control we applied Roundup Ultra at 24 Oz/A to the corn site and Banvel 4 Oz/A and LoVol 5 Oz/A to the grain sorghum site. We harvested the grain sorghum on November 16 and the corn on September 27 with a self-propelled combine and weighed them in a digital scale cart. Grain yields were adjusted to 14% seed moisture for grain sorghum and 15.5% seed moisture for corn.

Results and Discussion

For sorghum, the skip row/plant two rows treatment produced 3 Bu/A more than planting all rows (Table 20). The corn crop was a failure. For corn, it did not matter which skip row treatment was employed because all treatments failed. The highest skip row treatment, skipping alternative rows, produced only 3.2 Bu/A. This is contrary to the results from a dryland skip-row corn study conducted in Western Nebraska were they reported a 13 Bu/A increase with the skip two/plant two treatment compared to the all rows planted check (Klein, et al., 2005).

The corn crop failed because there was insufficient moisture in July to mid August to produce a profitable grain harvest even with the additional moisture stored in the skip row. This suggests than dryland corn is dependent on July to mid August rainfall. A study conducted at the ARS research center at Akron, Colorado concluded that dryland corn yields could not be predicted by the amount of stored soil moisture at planting (Nielson, Vigil, and Benjamin, 2005). If July to mid August rains are inadequate, then corn production suffers regardless of stored moisture at planting. There was approximately 9 to 11 inches of water available for corn growth from stored moisture and rainfall from planting through July (flowering). Apparently, corn uses approximately 9 to 11 inches of rain to reach its vegetative threshold since the corn crop

had just enough moisture to begin grain production (11.3" if all rainfall and stored moisture is available and 9.04" if 80% of the moisture is available: May 2.22", June 1.16", July 1.01"; and stored estimated at 6.9"). The 20 Bu/A yield average for the grain sorghum demonstrates that grain sorghum has a lower water requirement for its vegetative threshold than corn. The moisture stored with skip-row contributed to higher grain sorghum yields: the skip row/plant two rows treatment produced 3 Bu/A more than planting all rows. Seeding density was also decrease with skip-row compared to planting all rows, 21,900 Seeds/A for skip row/plant two rows compared to 35,000 Seeds/A for all rows planted. Some of the yield increase with skip-row may be attributed to adjusting population density to moisture conditions. Seeding density manipulation may be as important as skip-row patterns for sustaining yields during dry weather. Next year we will lower the seeding densities of solid planting to the seeding densities obtained with skip-row.

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

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Table 20.-Dryland Grain Sorghum Skip-Row Study, Walsh 2005.

Skip Row Treatment	No. of Rows Harvested	Seeding Density	Seed Moisture	Test Weight	Grain Yield
		Seeds/A (1000 X)	%	Lb/Bu	Bu/A
Plant all rows	8	35.0	10.6	57.0	18
Skip row, plant two rows	5	21.9	12.2	59.5	21
Skip row, plant row	4	17.5	12.5	60.0	20
Average		24.8	11.8	58.8	20
LSD 0.20					2.1

Planted: June 17 with Mycogen M 3838; Harvested: November 16.

Table 21.-Dryland Corn Skip-Row Study, Walsh 2005.

Skip Row Treatment	No. of Rows Harvested	Seeding Density	Seed Moisture	Test Weight	Grain Yield
		Seeds/A (1000 X)	%	Lb/Bu	Bu/A
Plant all rows	8	16.0	15.1	51.0	0.4
Skip row, plant two rows	5	10.0	16.1	52.2	0.6
Skip row, plant row	4	8.0	16.8	52.0	3.2
Average		11.3	16.0	51.7	1.4
LSD 0.20					0.22

Planted: May 17 with Mycogen 2K541; Harvested: September 27.