

University of California ANR Grain Sorghum Variety Trial

2022 Field Research on Sorghum Grain hybrids for California

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Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is the fifth most globally important cereal crop, ranking behind rice, maize, wheat, and barley. The majority of US grain sorghum production is in Kansas and Texas, with only limited production in California. When sorghum was first introduced to the US it was primarily used for animal feed for the dairy and beef industries, but over the years its use has expanded to the pet-food industry, the pork, poultry, and bird seed industries, in the renewable fuels industry, and more recently into food systems. Due to its gluten free characteristics, sorghum is increasingly used as food and beer in gluten-free markets. It is assumed that about 500,000 acres of irrigated cropland will be idled by 2040 under California's Sustainable Groundwater Management Act. Therefore, sorghum an annual crop could be a solution for California's need for a sustainable crop rotation for farms to reduce dust pollution, pest, and disease as a result of many croplands going into fallow. The University of California Agriculture and Natural Resources (ANR) began sorghum grain hybrid evaluation trials in 2016. This report presents data from 2022 demonstration plots grown in three locations, at the Kearney Research and Extension Center (KARE), the Westside Research and Extension Center (WSREC), and at UC Davis Research Farm (Davis). Previous reports can be found at the sorghum website, www.sorghum.ucanr.edu

Methods and Materials

Two seed companies provided 12 commercial grain sorghum hybrids for inclusion in these studies. Hybrids were planted in a replicated randomized complete block design in four 20-foot rows planted on 30-inch raised beds and were analyzed as a split-plot design, with the main plot being hybrids and the sub-plot being locations. Kearney Agricultural Research and Extension Center (KARE) received 4.84 inches of rain from January through the end of May. Rainfall during the growing season June to September was 0.26 inches. Rainfall totals from January through May prior to planting at West Side Research and Extension Center (WSREC) were 2.48 inches and total rainfall during the growing season (June-September) was 0.65 inches that were received in September. While rainfall totals from January through May prior to planting at UC Davis were 1.77 inches and growing season June through September was 3.18 inches. An additional water was applied through furrow

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irrigation once weekly throughout the growing season in the three locations. The trial was irrigated to match ET demand. Fertilizer applications followed recommendation for grain sorghums for the region.

The following is a summary of the locations where trials were located.

Trial Location: KARE Planting, Parlier, CA
Cooperator: UC-ANR
Previous Crop: Winter forage (Oats)
Soil Type: Hanford sandy loam
Plot Size: Four, 30-inch rows by 20 ft
Replications: 3
Planting Date: June 1, 2022
Planting Rate: 70,000 seed acre-1
Seed Method: Almaco 4 row plot planter
Fertilizer: 200 lbs/ac 46-0-0 pre-planting; layby application 100 lbs/ac 46-0-0; 100 lbs/ac 11-52-0; 500 lbs/ac K2O pre-plant.
Herbicide: Dual Magnum at 1 1/3 pints per ac-1 as a pre-plant; Gramoxone at 48 oz per ac-1, Maestro 4 EC at .5 pint per ac-1
Pesticide: Sivanto Prime at 14 fl oz per ac-1
Irrigation: Furrow irrigation
Grain Harvest Date: Plots harvested on September 9, 2022, with Almaco SPC 40 Plot Combine

Trial Location: WSREC, Five Points, CA
Cooperator: UC-ANR
Previous Crop: Sorghum
Soil Type: Panoche clay loam
Plot Size: Four, 30-inch rows by 20 ft
Replications: 3
Planting Date: June 6, 2022
Planting Rate: 70,000 seed acre-1
Seed Method: Almaco 4 row plot planter
Fertilizer: 250 lbs/ac 46-0-0; layby application 100 lbs/ac 46-0-0; 100 lbs/ac 11-52-0
Herbicide: Dual Magnum 24 oz/ac as pre-emergent, Clarity 8oz ac-1 as a layby 3
Pesticide: 2 applications of Sivanto Prime 14oz ac-1
Irrigation: Furrow Irrigation
Grain Harvest Date: Plots harvested with Almaco SPC 40 Plot Combine on November 15, 2022

Trial Location: UC Davis Research Station, Davis, CA
Cooperator: UC-ANR
Previous Crop: Fallow
Soil Type: Yolo loam
Plot Size: Four, 30-inch rows by 20 ft
Replications: 3 Planting
Date: June 6, 2022
Planting Rate: 70,000 seed acre-1 Seed Method: Wintersteiger Self Propelled Drill Planter
Fertilizer: Starter 20 lbs 8-28-6 starter fertilizer; layby of 200 lbs/ac 46-0-0
Herbicide: Dual Magnum as a pre-emergent
Pesticide: None

Irrigation: Matched ET, Furrow Irrigation

Grain Harvest Date: Plots harvested with Almaco SPC 40 Plot Combine on November 1, 2022

Data Collected:

- Emergence (%) calculated by number of seed planted divided by stand counts
- Plants per acre
- Days to flowering
- Plant height (cm)
- Panicle length (cm)
- Panicle exertion (cm)
- Yield (bu ac⁻¹)
- Seed moisture content at harvest.
- 1000 seed weight (g)
- Data was analyzed using the SAS statistical package.

Results

No major diseases were observed in the three locations during the growing season. However, at KARE and WSREC, it was necessary to treat for sugar cane aphids twice in the season, although some varieties were also noticed to have reduced incidence of the aphids and some level of resistance to these pests.

Early Agronomic Data

Averaged across the three sites, there were no significant differences observed for exertion or panicle length amongst the 12 hybrids, although at individual sites there were some significant differences noted across hybrids at the KARE and Davis sites for panicle length and exertion, possibly due to soil and weather effects. Contrary to 2021 results, KARE had the longest days to flowering (DTF) in 2022 as compared to WSREC and Davis (Table 1). DTF reflects the various maturity periods recorded amongst the grain sorghum hybrids. And this year it ranged as early as 58 days after planting, to late flowering at 90 days for some hybrids at Davis. The plants heights were relatively shorter in 2022 with an average of 111 cm, across the three-location compared to 2021, moreover there were no significant difference for the averages across the three sites. (Table 1).

Plant and Panicle measurements and Yield Data

The continuation of table 1 shows plants per acre, yield in bu ac⁻¹ and 1,000 seed weight. There was no lodging recorded at any site this year. The average achieved plant populations per acre (plants per acre) across the three sites were 24% lower than the previous year. WSREC had much higher grain yields than KARE or Davis, however, the 1,000 seed weight was lower compared to KARE and Davis. WSREC average yield was 158.90 bu ac⁻¹, lower than what was reported in 2021 at Davis. while Davis averaged the highest 1000 seed weights. As reported in previous years, KARE with its' sandy loam soils had lower average yields than the other sites, and that was true again in these 2022 trials, with average yields at KARE of 79.85 bu ac⁻¹. The Davis site average yield was 106.59 bu ac⁻¹

When averaged across all three sites in the 2022 trials, there was no significant difference in the hybrid yields or 1,000 seed weights. However, significant differences were recorded at each site. The highest yielding hybrids recorded in 2022 were DynaGro M59GN94 and DynaGro M60GB31 with 147.27 bu ac⁻¹ and 142.86 bu ac⁻¹ respectively at the WSREC trial site (Table 4). KARE highest yielding hybrid was DynaGro M71GB91 at 103.34 bu ac⁻¹ (Table 3) while at Davis the highest yielding hybrid was S &W Seeds SP78M42 with 144.94 bu ac⁻¹.

Discussion

Plant population is very important for good yield potential, however, this year, the plant population per acre across all sites were lower compared to previous years and this might have impacted yields. Due to more serious drought conditions impacting irrigation water availability, this year apart from 3-inch irrigations applied pre-plant to encourage weed emergence there were no additional pre-irrigation treatments at KARE and WSREC sites. Under more typical conditions, we apply more irrigation water pre-plant to help establish a deeper wetted soil water profile prior to the start of the growing season. This situation might have had some negative impacts on seed emergence and root development. In addition, the total rainfall received prior to planting at the three location was quite low and if winter crops preceded the sorghum, upper zone soil profile stored water would have been largely depleted by the winter crop. There was no rainfall received at WSREC from June through August, and only 0.26 inches of rain during that period at KARE, therefore the plants were depending on furrow irrigation and several periods of more extreme high temperatures (daily peaks over 108 F at KARE and WSREC sites in Late-June, Late-July, August and early September) could have added to plant stresses and impacted grain yields. In multiple prior years, yields were higher in Davis, however this year, WSREC had the highest yields. Given the right conditions, there is potential for the KARE soils to improve and come closer to yields levels seen at WSREC and Davis sites. With this in mind, sorghum has some plant characteristics that can allow it to perform well in all soil types including locations with more marginal nutrients and water availability.

Table 1. Various agronomic characteristics for grain sorghum hybrids averaged across 3 locations in California in 2022 KARE, WSREC, and the UC Davis Research Station.

Hybrid Information			Agronomic Measurements*			
Entry	Company	Hybrid	DTF ¹	Plant Height (cm)	Exertion (cm)	Panicle Length (cm)
1	Dyna-Gro	M59GN94	61.22 e	108.67 a-d	13.16 a	28.66 a
2	Dyna-Gro	M60GB31	71.11 b	109.83 a-d	9.50 a	31.66 a
3	Dyna-Gro	M63GB78	65.67 d-e	113.33 a-c	10.33 a	28.50 a
4	Dyna-Gro	M67GB87	69.22 b-d	114.83 a-c	7.13 a	28.50 a
5	Dyna-Gro	M71GR91	68.33 b-d	114.67 a-c	8.66 a	28.00 a
6	Dyna-Gro	M72GB71	67.00 b-d	118.17 a	8.71 a	31.66 a
7	S&W Seed	SP7715	81.11 a	117.50 a-b	8.0 a	29.50 a
8	S&W Seed	SP72M42	66.56 c-d	112.33 a-c	9.50 a	31.00 a
9	S&W Seed	SP78M42	71.44 b	117.17 a-b	13.0 a	27.84 a
10	S&W Seed	NK8828	68.78 b-d	107.67 b-c	11.50 a	29.83 a
11	S&W Seed	SPSD455	66.56 c-d	100.00 d	11.33 a	28.16 a
	Means		68.95	111.78	9.90	29.47
	CV		6.97	7.66	43.01	14.17
	<i>Location</i>					
	KARE		72.65 a	117.97 a	10.22 a	28.00 b
	UC Davis		68.17 b	105.58 b	9.39 a	30.94 a
	WREC		65.89 c	*	*	*

*Means followed by the same letter do not significantly differ using LSD (P=0.05); ¹DTF=days to 50% flowering.

**These parameters were NOT collected in the trial at the WSREC site, so it is not appropriate to include in this three-site summary.

Table 1 (continued). Various agronomic and yield characteristics for grain sorghum hybrids averaged across 3 trial locations in California in 2022, KARE, WSREC, and the UC Davis Research Station.

Hybrid Information			Agronomic Measurements*		
Entry	Company	Hybrid	Average # Plants per ac	Yield bu ac ⁻¹	1000 seed Weight (g)
1	Dyna-Gro	M59GN94	42907 c-d	122.57 a	31.00 a
2	Dyna-Gro	M60GB31	52925 a	114.09 a	29.36 a
3	Dyna-Gro	M63GB78	49586 a-b	111.58 a	28.89 b
4	Dyna-Gro	M67GB87	43342 b-d	127.21 a	31.47 a
5	Dyna-Gro	M71GR91	46609 b-c	129.98 a	30.52 a
6	Dyna-Gro	M72GB71	42398 c-d	114.55 a	29.23 a
7	S&W Seed	SP7715	48497 a-c	109.83 a	29.67 a
8	S&W Seed	SP72M42	39567 d-e	99.39 a	31.14 a
9	S&W Seed	SP78M42	35647 e	126.21 a	29.89 a
10	S&W Seed	NK8828	35792 e	102.25 a	29.88 a
11	S&W Seed	SPSD455	48569 a-c	111.28 a	29.89 a
	Means		43820.15	115.11	30.10
	CV		12.31	18.49	6.23
	Location				
	KARE		44177 a	79.85 c	30.93 b
	UC Davis		**	106.59 b	32.21 a
	WREC		43463 a	158.90 a	26.89 c

*Means followed by the same letter do not significantly differ using LSD (P=0.05)

**These parameters were NOT collected in the trial at the UC Davis site, so it is not appropriate to include in this three-site summary.

Table 2. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA Davis Research Farm, Davis, California in 2022.

Hybrid Information			Agronomic Measurements*			
Entry	Company	Hybrid	DTF ¹	Plant Height (cm)	Exertion (cm)	Panicle Length (cm)
1	Dyna-Gro	M59GN94	58.00 d	104.66 ac	12.33 a-b	30.00 a-b
2	Dyna-Gro	M60GB31	82.33 a-b	100.66 c	5.66 b	30.00 a-b
3	Dyna-Gro	M63GB78	62.00 c-d	104.33 a-c	11.33 a-b	29.33 a-b
4	Dyna-Gro	M67GB87	72.00 b-c	108.33 a-b	9.33 a-b	27.33 b
5	Dyna-Gro	M71GR91	66.00 c-d	116.66 a	7.33 a-b	32.66 a-b
6	Dyna-Gro	M72GB71	63.67 c-d	109.66 a-b	7.33 a-b	33.00 a-b
7	S&W Seed	SP7715	90.33 a	105.00 a-c	5.00 b	31.66 a-b
8	S&W Seed	SP72M42	61.00 c-d	105.00 a-b	11.66 a-b	32.33 a-b
9	S&W Seed	SP78M42	71.00 b-c	114.66 a-b	8.66 a-b	29.00 a-b
10	S&W Seed	NK8828	64.00 c-d	101.66 b-c	14.33 a	30.66 a-b
11	S&W Seed	SPSD455	65.00 c-d	93.33 c	12.66 a-b	33.33 a
	Means		68.17	105.60	9.36	30.96
	CV		10.42	6.96	4.2	10.99

*Means followed by same letter do not significantly differ using LSD (alpha=0.05); ¹DTF=days to 50% flowering

Table 2 (continued). Various agronomic characteristics for grain sorghum hybrids grown at the University of CA Davis Research Farm, Davis, California in 2022.

Hybrid Information			Agronomic Measurements*	
Entry	Company	Hybrid	Yield bu ac ⁻¹	1000 seed Weight (g)
1	Dyna-Gro	M59GN94	137.94 a	30.00 a
2	Dyna-Gro	M60GB31	115.64 a-b	30.12 a
3	Dyna-Gro	M63GB78	104.23 a-b	29.33 a
4	Dyna-Gro	M67GB87	99.82 a-b	27.33 a
5	Dyna-Gro	M71GR91	109.41 a-b	32.66 a
6	Dyna-Gro	M72GB71	117.19 a-b	33.00 a
7	S&W Seed	SP7715	109.41 a-b	31.67 a
8	S&W Seed	SP72M42	82.97 b	32.33 a
9	S&W Seed	SP78M42	144.94 a	29.00a
10	S&W Seed	NK8828	102.67 a-b	30.67 a
11	S&W Seed	SPSD455	119.79 a-b	33.33 a
	Means		114.21	32.21
	CV		22.42	8.23

*Means followed by the same letter do not significantly differ using LSD (alpha=0.05).

Table 3. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA ANR Kearney Agricultural Research and Extension Center, Parlier, California in 2022.

Hybrid Information			Agronomic Measurements*			
Entry	Company	Hybrid	DTF ¹	Plant Height (cm)	Exertion (cm)	Panicle Length (cm)
1	Dyna-Gro	M59GN94	63.67 d	112.66 a-c	14.00 a	27.33 a-b
2	Dyna-Gro	M60GB31	71.00 c	119.00 a-c	13.3 a	33.34 a
3	Dyna-Gro	M63GB78	70.00 c	122.33 a-c	9.33 a	27.20 a-b
4	Dyna-Gro	M67GB87	70.33 c	121.33 a-c	7.33 a	29.17 a-b
5	Dyna-Gro	M71GR91	71.33 c	112.66 a-b	7.00 b	23.70 b
6	Dyna-Gro	M72GB71	71.67 c	126.66 a-c	10.00 a	30.30 a
7	S&W Seed	SP7715	85.67 a	130.00 a	8.66 a	27.10 a-b
8	S&W Seed	SP72M42	71.67 c	119.0 b-c	7.33 b	29.41 a-b
9	S&W Seed	SP78M42	75.67 b	119.10 b-c	17.33 a	26.80 a-b
10	S&W Seed	NK8828	75.33 b	113.70 a-c	8.66 a	29.00 a-b
11	S&W Seed	SPSD455	70.67 c	106.10 c	10.00 a	23.50 b
	Means		72.81	117.84	10.22	26.16
	CV		1.54	7.71	74.12	17.5

*Means followed by the same letter do not significantly differ using LSD (alpha=0.05); ¹DTF=days to 50% flowering

Table 3 (continued). Various agronomic characteristics for grain sorghum hybrids grown at the University of CA ANR Kearney Agricultural Research and Extension Center, Parlier, California in 2022.

Hybrid Information			Agronomic Measurements*		
Entry	Company	Hybrid	Plant per ac	Yield bu ac ⁻¹	1000 seed Weight (g)
1	Dyna-Gro	M59GN94	45012 a-c	78.51 a-c	34.77 a
2	Dyna-Gro	M60GB31	54305 a	75.22 a-c	29.87 d-f
3	Dyna-Gro	M63GB78	53579 a	84.49 a-b	27.87 f
4	Dyna-Gro	M67GB87	42253 b-d	98.63 a	30.54 c-e
5	Dyna-Gro	M71GR91	49804 a-b	103.34 a	30.60 c-e
6	Dyna-Gro	M72GB71	48642 a-b	81.36 a-c	31.50 b-d
7	S&W Seed	SP7715	47771 a-b	53.82 c	28.80 e-f
8	S&W Seed	SP72M42	33541 d-e	79.42 a-c	33.00 a-b
9	S&W Seed	SP78M42	35574 c-e	89.10 a-b	32.73 a-c
10	S&W Seed	NK8828	29476 e	68.87 b-c	30.47 c-e
11	S&W Seed	SPSD455	49949 a-b	75.98 a-c	30.43 c-e
	Means		40428.49	79.85	30.93
	CV		12.23	18.85	4.10

*Means followed by the same letter do not significantly differ using LSD (alpha=0.05)

Table 4. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA ANR West Side Research and Extension Center, Five Points, California in 2022.

Hybrid Information			Agronomic Measurements*		
Entry	Company	Hybrid	DTF ¹	Plant Height (cm)	Exertion (cm)
1	Dyna-Gro	M59GN94	62.00 b	**	**
2	Dyna-Gro	M60GB31	60.00 b	**	**
3	Dyna-Gro	M63GB78	65.00 a-b	**	**
4	Dyna-Gro	M67GB87	65.00 a-b	**	**
5	Dyna-Gro	M71GR91	67.00 a-b	**	**
6	Dyna-Gro	M72GB71	65.00 a-b	**	**
7	S&W Seed	SP7715	67.00 a-b	**	**
8	S&W Seed	SP72M42	67.33 a-b	**	**
9	S&W Seed	SP78M42	67.66 a-b	**	**
10	S&W Seed	NK8828	67.00 a-b	**	**
11	S&W Seed	SPSD455	64.00 a	**	**
	Means		65.75	**	**
	CV		6.32		

¹Means followed by the same letter do not significantly differ using LSD (alpha=0.05), ¹DTF=days to 50% flowering.

**These parameters were NOT collected in the trial at the WSREC site

Table 4 (continued). Various agronomic characteristics for grain sorghum hybrids grown at the University of CA-ANR West Side Research and Extension Center, Five Points, California in 2022.

Hybrid Information			Agronomic Measurements*		
Entry	Company	Hybrid	Plant per ac	Yield bu ac ⁻¹	1000 seed Weight (g)
1	Dyna-Gro	M59GN94	40801 a-c	147.27 a-b	27.33 a-c
2	Dyna-Gro	M60GB31	51546 a	142.86 a-b	24.37 d
3	Dyna-Gro	M63GB78	45593 a-c	133.79 b	26.60 b-d
4	Dyna-Gro	M67GB87	44431 a-c	162.05 a-b	29.97 a
5	Dyna-Gro	M71GR91	43415 a-c	161.53 a-b	28.57 ab
6	Dyna-Gro	M72GB71	36155 c	134.05 b	26.93 b-d
7	S&W Seed	SP7715	49223 a-b	174.49 a	26.43 b-d
8	S&W Seed	SP72M42	45593 a-c	127.56 b	26.87 b-d
9	S&W Seed	SP78M42	35719 c	145.20 a-b	26.80 b-d
10	S&W Seed	NK8828	42108 a-c	123.93 b	26.53 b-d
11	S&W Seed	SPSD455	47190 a-b	140.27 a-b	25.23 c-d
	Means		43463.20	143.51	26.89
	CV		12.82	14.54	5.57

*Means followed by the same letter do not significantly differ using LSD (alpha=0.05).