University of California ANR Grain Sorghum Variety Trials

2021 Field Research on Sorghum Grain Hybrids for California

Jeff Dahlberg[1], Bob Hutmacher[2], Dan Putnam[3], Julie Pedraza[4], Nick Clark[5], Chris de Ben[6], Brian Neufeld[7]

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is the fifth most important cereal crop globally, ranking in total production behind rice, maize, wheat, and barley. The majority of US grain sorghum production is in Kansas and Texas, with only limited production in California. Sorghum is not new to California, however, having been first introduced to the state in the late 1800's as a drought tolerant forage for animal feed. Forage sorghums, which tend to use less water than other forage crops, received some renewed interest from growers within the past decade because of multiple periods of extended drought and limited irrigation water issues facing forage producters. Grain sorghum cultivars possess many of the same characteristics in terms of ability to tolerate periods of reduced water availability but still produce an economic crop, making it a viable option particularly during years when growers are trying to make difficult decisions about which crops to fully irrigate when water supplies are limited.

At one time, the primary use for grain sorghum was for animal feed, for both the dairy and beef industry, but its use has expanded into several different arenas over the years. There has been some renewed interest in grain sorghum in California related to the ethanol industry, since growers could consider sorghum as one additional potential feedstock for ethanol conversion. Grain sorghum potential as a flour substitute in gluten-free food products has been explored and there has been some progress in the marketplace; but there continues to be some consumer issues with understanding uses for sorghum and acceptance as a food crop. It is used in the pet-food industry, the pork, poultry and bird seed industry, in the renewable fuels industry, and more recently into food systems. Gluten-free beers and food have seen an increase in the last several years, while speciality "ancient grain" uses have expanded. Some grain sorghums have high anti-oxidant tannins that have become specialized ingredients in the health food market.

Sorghum has also proved to be a very useful rotation crop in some annual cropping systems, both in reducing weed populations (particularly forage sorghum) and also in reducing disease pressure. In the mid-1960's, yields in the state were approximately double the national sorghum yields at 70 bu acre^{-1}or 3920 lbs acre^{-1}. Hybrid grain sorghums had only been introduced to the United States in the late 1950's and only started to have a real impact on yields in the late 1960's. Modern grain sorghum cultivars that are well-managed under irrigated conditions have substantially higher yields, and this can be an important factor when considering if it can be economically feasible as a crop choice. Sorghum could therefore help reduce irrigation and nitrogen fertilizer use in California and be an important crop rotation cereal in many conservation tillage and farm rotational

[1] Retired Center Director, formerly with University of CA Kearney Agricultural Research and Extension Center, 9240 S. Riverbend Ave., Parlier, CA 93648, phone: 559-646-6060, Email: jadahlberg@ucanr.edu
[2] Cooperative Extension Agronomy Specialist and Center Director, University of California Westside Research and Extension Center, PO Box 158, Five Points, CA 93624, phone: 559-884-2412, Email: rbhutmacher@ucDavis.edu; rmsolorio@ucanr.edu
[3] Alfalfa & Forage Cooperative Extension Specialist, University of CA Davis, Plant Sciences Dept., Davis, CA
[4] Staff Research Associate II, University of CA Kearney Agricultural Research and Extension Center, 9240 S. Riverbend Ave, Parlier, CA
[5] Cooperative Extension Farm Advisor, University of CA Agriculture and Natural Resources, Hanford, CA
[6] Staff Research Associate III, University of California Davis, Plant Sciences Department, Davis, CA
[7] Superintendent, University of CA West Side Research and Extension Center, UC_ANR, Five Points, CA

systems whilst maintaining good marketable yields. Sorghum is an annual crop that could be both a short-term and long-term solution for California's need for a sustainable crop rotation for farms to breakup disease and nsect life-cycles, add biomass back to soils, and improve soil structure and health. It can be steam-flaked, rolled, ground into flour, and extruded into a wide range of products.

The University of California Agriculture and Natural Resources (ANR) began sorghum grain hybrid evaluation trials in 2016, and this report presents data from demonstration plots grown in three locations in 2021. The 2021 growing season was impacted by poor air quality and smoke from the various fires that impacted the state over the summer, and plant growth and yields seemed to have been affected by these poor quality air and pollution issues.

Methods and Materials

Two seed companies provided 17 commercial grain sorghum hybrids for inclusion in these studies. Hybrids were planted in a replicated randomized 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.

The Kearney REC (KARE) location received 3.70 inches of rain from January through June 9, 2021. Irrigation totals during the growing season were 17.89 inches of irrigation applied through a linear irrigation system. The rainfall totals from January through June 7, 2021 prior to planting at the West Side REC (WREC) location were 4.90 inches. At the WREC site, within-season irrigation water applications totaled 14.5 inches applied by a combination of overhead linear move sprinkler and furrow irrigation. The rainfall total from January through May 16, 2021 prior to planting at UC Davis was 3.80 inches, 20 inches lower than the previous year. An additional 1.46 inches of rainfall fell during the remainder of the growing season at the Davis location. At all locations, irrigation amounts were estimated to meet estimated crop evapotranspiration (ETc) demand. Fertilizer applications at each site followed recommendations for grain sorghum for the region, adjusted for beginning residual soil nitrate-N levels measured in the upper 24 inches of the soil profile.

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 10, 2021
Planting Rate:	70,000 seed $acre^{-1}$
Seed Method:	Almaco 4 row plot planter
Fertilizer:	400 lbs urea ac^{-1} 46-0-0 applied pre-planting on June 7, 2021
Herbicide:	Dual Magnum at 1 1/3 pints per ac^{-1} as a pre-plant;
Pesticide:	Gramoxone at 48 oz per ac^{-1}, Maestro 4 EC at .5 pint per ac^{-1} Sivanto Prime at 14 fl oz per ac^{-1}
Irrigation:	Overhead irrigation system – see narrative for amounts
Grain Harvest Date:	Plots harvested with Almaco SPC 40 Plot Combine on November 1, 2021

Trial Location:	Westside Research and Extension Center, 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 8, 2021
Planting Rate:	70,000 seed $acre^{-1}$
Seed Method:	Almaco 4 row plot planter
Fertilizer:	Starter 100 lbs 11-52-00 pre-plant and layby of 190 lbs $acre^{-1}$
Herbicide:	Dual Magnum 24 oz/ac as pre-emergent, Clarity 8oz ac^{-1} as a layby
Pesticide:	3 applications of Sivanto Prime 14oz ac^{-1}
Irrigation:	Overhead irrigation system – see narrative for amounts
Grain Harvest Date:	Plots harvested with Almaco SPC 40 Plot Combine on November 2, 2021

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:	May 17, 2021
Planting Rate:	70,000 seed $acre^{-1}$
Seed Method:	Wintersteiger Self Propelled Drill Planter
Fertilizer:	Starter 20 lbs 8-28-6 starter fertilizer and layby of 175 lbs $acre^{-1}$ (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 30, 2021

Data Collected:

- Emergence (%) calculated by final stand counts divided by the number of seed plantedPlants per acre
- Days to Flowering (days from emergence 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 pest or disease problems were observed at any of the locations. However, sugarcane aphid populations increased to treatable levels at both KARE and WREC sites, resulting in the need for one pesticide application at KARE and two at WREC for control of sugarcane aphids. At the KARE and WREC locations, there were 17 entries included in the field trials, while at the UC Davis site there were 14 entries (Sorghum Partners varieties SPSA308, SPSC344 and SPSA411 were not included at the UC Davis site due to inadequate seed supplies at the time of planting at that site).

Early Agronomic Data

The time from emergence to flowering (shown in tables as "Flowering date") reflected the various maturities available in the grain sorghum hybrids being evaluated in the state. Table 1 shows averages across all 3 field sites for the parameters days to flowering, plant height, panicle exertion (distance from flag leaf to panicle base) and panicle length. Of the entries included in all three sites, average flowering dates ranged from the earliest , 60 days after emergence (Sorghum Partners PSP 68M57 and DynaGro M59GN94), to late flowering at almost 79 days after emergence (Sorghum Partners SP7715 (Table 1). Plants at the Davis site required more days to flowering than the same varieties at either WREC or KARE sites. Flowering was earlier in 2021 compared to some prior years, and this may be a reflection of several high temperature periods (peak temperatures over 105-108 F) in late June, late July and early August, combined with the poor air quality and smoke-filled skies from regional forest fires that were representative of this past summer. Average plant heights, exsertion and panicle lengths were in general in most entries longer than in most recent years. Of the entries included at all three sites, hybrids in 2021 averaged 127 cm in height (Table 1), with a range from a low of 116.7 cm (DynaGro GX20973X) to a high of 137.2 cm (Sorghum Partners SP7715). The values and statistics for these parameters at each field trial site are shown in Table 2 (Davis site), Table 3 (UC Kearney REC site), and Table 4 (UC West Side REC site).

Plant and Panicle measurements and Yield Data

The second page of Table 1 shows 3-site averages for the parameters plants per acre, yield data reported as bu ac^{-1} and 1000 seed weight. The values and statistics for these parameters at each field trial site are shown in the second page of Table 2 (Davis site), Table 3 (UC Kearney REC (KARE) site), and Table 4 (UC West Side REC (WREC) site). There was no lodging recorded at any of the sites this year (data not shown). Davis had much higher grain yields than the other sites, while KARE averaged the highest 1000 seed weights. Davis average yield was 190 bu $ac^{-}1$. In years past, KARE with its' sandy loam soils had lower average yields than the other sites, and that was true again in these 2021 trials, with average yields at KARE of 109.4 bu ac-1. The WREC site average yield was 140.2 bu ac-1. In 2021 trials, the highest yielding hybrid that was included in all three trial locations was DynaGro GX20970X with a 157.5 bu ac^{-1} yield when averaged across the 3 sites. The highest yield recorded at any test site in 2021 was DynaGro GX21965X with 202.8 bu ac-1 at the Davis trial site (Table 2).

Discussion

In the past, rainfall and irrigation timing and amounts were generally regarded as likely having the greatest impact on grain yields, particularly if crops were adequately fertilized and there were few severe high temperature periods during flowering and early seed development. This year, poor air quality and heavy smoke and several periods of more extreme high temperatures (daily peaks over 105 F at KARE and WREC sites in late June, late July and again in early August) could have added to plant stresses and impacted grain yields. As in multiple prior years, yields were higher in Davis, but there is good potential for high yielding sorghums in both the sandy-loam soils of KARE and the clay-loam soils of WREC. With so much "competition" for limited

irrigation water supplies on-farm in recent years, the lower sensitivity of most commercial grain sorghums to moderate water deficits or high temperatures when compared with corn will continue to position grain and forage sorghums as crops to insert into the overall farm plan for diversified farms in California's Central Valley.

Table 1. Various agronomic characteristics for grain sorghum hybrids averaged across 3 locations in California in 2021 KARE, WREC, 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	60.22 e	122.78 d,e	7.78 b,c	25.56 e
2	Dyna-Gro	M60GB31	63.78 d	118.89 e,f	10.00 a-c	24.78 e
3	Dyna-Gro	GX20973X	61.00 e	116.67 f	6.11 c	24.89 e
4	Dyna-Gro	M63GB78	64.44 d	131.11 b	8.89 b,c	29.00 b-d
5	Dyna-Gro	GX20998X	64.33 d	121.11 d-f	14.00 a	26.89 d,e
6	Dyna-Gro	M67GB87 ***				
7	Dyna-Gro	GX20970X	70.33 b	125.78 c,d	7.56 b,c	29.33 a-d
8	Dyna-Gro	GX21965X	64.78 d	130.89 b,c	7.11 b,c	25.67 e
9	Dyna-Gro	M71GR91	67.00 c	134.00 a,b	9.78 b,c	27.89 c-e
10	Dyna-Gro	M72GB71	65.22 c,d	129.33 b,c	8.33 b,c	29.00 b-d
11	Sorghum Partners	SP74M21	69.78 b	132.89 a,b	10.89 a,b	32.22 a
12	Sorghum Partners	SP7715	78.67 a	137.22 a	6.56 c	31.22 a,b
13	Sorghum Partners	SPSA308**				
14	Sorghum Partners	SPSC344**				
15	Sorghum Partners	SPSA411**				
16	Sorghum Partners	NK8828	70.00 b	132.89 a,b	8.67 b,c	30.11 a-c
17	Sorghum Partners	SP68M57	60.00 e	118.11 e,f	7.22 b,c	30.22 a-c
	Means		**66.12**	**127.05**	**8.68**	**28.21**
	CV		**3.18**	**4.33**	**48.81**	**11.90**
	Location					
	KARE		**62.95 c**	**105.49 c**	**7.67 b**	**25.69 b**
	UC Davis		**69.08 a**	**154.49 a**	**11.28 a**	**30.00 a**
	WREC		**66.33 b**	**121.18 b**	**7.10 b**	**28.95 a**

*Means followed by the same letter do not significantly differ using LSD (P=0.001); ; [1]DTF=days to 50% flowering.
**These entries were NOT included in the trial at the UC Davis site, so it is not appropriate to include in this three-site summary.
*** Rep missing for UC Davis site.

Table 1 (continued).Various agronomic and yield characteristics for grain sorghum hybrids averaged across 3 trial locations in California in 2021, KARE, WREC, 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	58032 a,b	135.52 d	33.02 b-d
2	Dyna-Gro	M60GB31	55302 b	136.73 d	29.55 g,h
3	Dyna-Gro	GX20973X	55999 b	136.56 d	30.94 e-g
4	Dyna-Gro	M63GB78	58487 a,b	152.89 a-c	31.40 d-f
5	Dyna-Gro	GX20998X	59000 a,b	147.10 a-d	31.11 e-g
6	Dyna-Gro	M67GB87 ***			
7	Dyna-Gro	GX20970X	55883 b	157.47 a	31.57 d-f
8	Dyna-Gro	GX21965X	60684 a,b	153.32 a,b	29.16 h
9	Dyna-Gro	M71GR91	59406 a,b	150.90 a-c	33.35 b,c
10	Dyna-Gro	M72GB71	61691 a	149.95 a-c	32.75 b-d
11	Sorghum Partners	SP74M21	55641 b	146.32 a-d	36.67 a
12	Sorghum Partners	SP7715	59551 a,b	154.88 a,b	32.23 c-e
13	Sorghum Partners	SPSA308**			
14	Sorghum Partners	SPSC344**			
15	Sorghum Partners	SPSA411**			
16	Sorghum Partners	NK8828	56057 b	140.27 c,d	30.18 f-h
17	Sorghum Partners	SP68M57	55312 b	143.13 b-d	33.87 b
	Means		**57772.47**	**146.54**	**31.99**
	CV		**9.85**	**9.30**	**5.34**
	Location				
	KARE		**60140 b**	**109.38 c**	**37.62 a**
	UC Davis		**69428 a**	**190.02 a**	**29.91 b**
	WREC		**43750 c**	**140.23 b**	**28.43 c**

*Means followed by the same letter do not significantly differ using LSD (P=0.001)

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

*** Rep missing for UC Davis site.

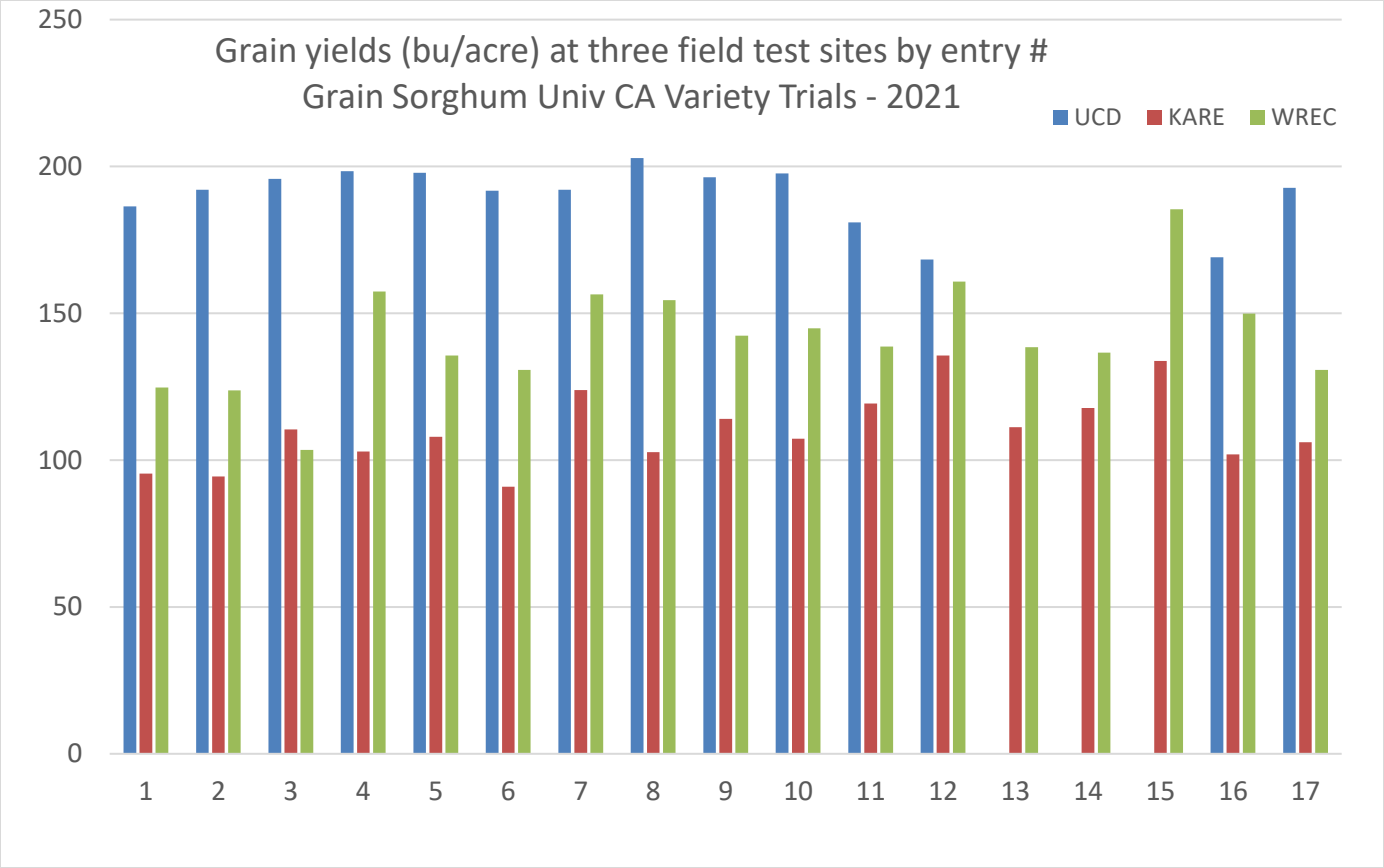

Figure 1. Grain yields (bu ac-1) averages for each of the three field test sites (Univ, CA Davis (UCD), Kearney REC (KARE), and West Side REC (WREC) in University of California Grain Sorghum Variety trials in 2021.

Growers interested in relative yield performance of specific varieties can look at yield averages shown in Table 1 to assist in making selections to grow based on yield performance, or may want to review information such as that shown in Figure 1, where they can compare varieties for yield performance for consistency across multiple trial locations.

Table 2. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA Davis Research Farm, Davis, California in 2021.

Hybrid Information			Agronomic Measurements*			
Entry	**Company**	**Hybrid**	**DTF[1]**	**Plant Height (cm)**	**Exertion (cm)**	**Panicle Length (cm)**
1	Dyna-Gro	M59GN94	63.67 g,h	163.33 a,b	16.67 a,b	26.67 b,c
2	Dyna-Gro	M60GB31	68.00 d,e	143.33 e,f	8.33 c,d	26.67 b,c
3	Dyna-Gro	GX20973X	63.00 h	156.67 b-d	15.00 a-c	28.33 b,c
4	Dyna-Gro	M63GB78***	65.33 f,g	161.67 a,b	11.67 a-d	30.00 b,c
5	Dyna-Gro	GX20998X	68.33 c-e	160.00 a-c	18.33 a	30.00 b,c
6	Dyna-Gro	M67GB87	66.00 f	170.00 a	7.50 d	40.00 a
7	Dyna-Gro	GX20970X	71.67 b	153.33 b-e	11.67 a-d	30.00 b,c
8	Dyna-Gro	GX21965X	67.67 e	150.00 c-f	6.67 d	25.00 c
9	Dyna-Gro	M71GR91	69.33 c-e	163.33 a,b	10.00 b-d	30.00 b,c
10	Dyna-Gro	M72GB71	70.00 c	161.67 a,b	10.00 b-d	28.33 b,c
11	Sorghum Partners	SP74M21	69.67 c,d	146.67 d-f	6.67 d	36.67 a,b
12	Sorghum Partners	SP7715	88.67 a	155.00 b-d	10.00 b-d	33.33 a-c
13	Sorghum Partners	SPSA308				
14	Sorghum Partners	SPSC344				
15	Sorghum Partners	SPSA411				
16	Sorghum Partners	NK8828	69.00 c-e	153.33 b-e	10.00 b-d	31.67 a-c
17	Sorghum Partners	SP68M57	63.67 g,h	140.00 f	11.67 a-d	33.33 a-c
	Means		**68.93**	**155.24**	**11.10**	**30.49**
	CV		**0.96**	**5.56**	**3.61**	**16.50**

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

**These entries were not planted at UCDavis station.

*** Rep missing for UC Davis site.

Table 2 (continued). Various agronomic characteristics for grain sorghum hybrids grown at the University of CA Davis Research Farm, Davis, California in 2021.

Hybrid Information			Agronomic Measurements*		
Entry	**Company**	**Hybrid**	**Plant per ac**	**Yield bu ac^{-1}**	**1000 seed Weight (g)**
1	Dyna-Gro	M59GN94	71961 a,b	186.43 a,b	30.83 b,c
2	Dyna-Gro	M60GB31	68302 a-c	192.13 a,b	28.33 d
3	Dyna-Gro	GX20973X	68302 a-c	195.76 a	29.93 b,c
4	Dyna-Gro	M63GB78	70741 a,b	198.35 a	28.25 d
5	Dyna-Gro	GX20998X	73181 a	197.84 a	30.27 b,c
6	Dyna-Gro	M67GB87***	69522 a-c	191.74 a,b	34.46 a
7	Dyna-Gro	GX20970X	67082 b,c	192.13 a,b	30.10 b,c
8	Dyna-Gro	GX21965X	73181 a	202.76 a	26.50 a
9	Dyna-Gro	M71GR91	69522 a-c	196.28 a	31.33 b,c
10	Dyna-Gro	M72GB71	70741 a,b	197.58 a	29.83 e
11	Sorghum Partners	SP74M21	69522 a-c	180.98 a,b	35.67 b
12	Sorghum Partners	SP7715	67082 b,c	168.28 b	30.15 b,c
13	Sorghum Partners	SPSA308**			
14	Sorghum Partners	SPSC344**			
15	Sorghum Partners	SPSA411**			
16	Sorghum Partners	NK8828	68302 a-c	169.05 b	27.90 d
17	Sorghum Partners	SP68M57	64643 c	192.65 a,b	29.72 c
	Means		**69432.52**	**190.10**	**30.13**
	CV		**4.06**	**7.12**	**2.58**

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

**These entries were not planted at UCDavis station.

*** Rep missing for UC Davis site.

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 2021.

Hybrid Information			Agronomic Measurements*			
Entry	**Company**	**Hybrid**	**DTF[1]**	**Plant Height (cm)**	**Exertion (cm)**	**Panicle Length (cm)**
1	Dyna-Gro	M59GN94	53.67 i	92.33 e	5.33 a,b	21.67 e
2	Dyna-Gro	M60GB31	57.33 h,i	95.00 d,e	10.67 a,b	21.00 e
3	Dyna-Gro	GX20973X	57.33 h,i	92.33 e	2.33 b	22.00 d,e
4	Dyna-Gro	M63GB78	60.67 f-h	101.33 c-e	7.33 a,b	27.33 a-c
5	Dyna-Gro	GX20998X	59.67 g,h	93.67 e	12.00 a	24.67 b-e
6	Dyna-Gro	M67GB87	55.33 h,i	95.33 d,e	5.00 a,b	23.33 c-e
7	Dyna-Gro	GX20970X	71.67 a-c	106.33 b-d	4.33 a,b	26.00 a-e
8	Dyna-Gro	GX21965X	60.67 f-h	112.33 a-c	6.33 a,b	25.00 b-e
9	Dyna-Gro	M71GR91	64.00 e-g	108.33 b-d	10.00 a,b	27.00 a-d
10	Dyna-Gro	M72GB71	60.33 f-h	109.00 a-d	5.00 a,b	29.33 a,b
11	Sorghum Partners	SP74M21	70.33 b-d	118.67 a,b	11.33 a	28.00 a-c
12	Sorghum Partners	SP7715	76.33 a	123.00 a	5.33 a,b	29.67 a,b
13	Sorghum Partners	SPSA308	65.33 d-f	118.00 a,b	10.33 a,b	31.00 a
14	Sorghum Partners	SPSC344	67.33 c-e	113.00 a-c	7.67 a,b	28.67 a,b
15	Sorghum Partners	SPSA411	74.50 a,b	119.50 a,b	8.00 a,b	28.50 a,b
16	Sorghum Partners	NK8828	72.33 a-c	116.67 a,b	10.00 a,b	27.00 a-d
17	Sorghum Partners	SP68M57	54.00 i	102.33 c-e	9.67 a,b	25.33 b-e
	Means		**63.36**	**106.64**	**7.68**	**26.16**
	CV		**4.70**	**6.86**	**58.02**	**2.60**

*Means followed by the same letter do not significantly differ using LSD Duncan (alpha=0.05);; [1]DTF=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 2021.

Hybrid Information			Agronomic Measurements*		
Entry	**Company**	**Hybrid**	**Plant per ac**	**Yield bu ac^{-1}**	**1000 seed Weight (g)**
1	Dyna-Gro	M59GN94	62204 a,b	95.42 d-f	40.34 a-c
2	Dyna-Gro	M60GB31	58545 b	94.38 e,f	34.35 f,e
3	Dyna-Gro	GX20973X	59764 a,b	110.46 b-f	37.02 b-e
4	Dyna-Gro	M63GB78	58545 b	102.94 c-f	36.65 c-e
5	Dyna-Gro	GX20998X	60984 a,b	107.86 c-f	36.62 c-e
6	Dyna-Gro	M67GB87	62204 a,b	91.01 e,f	35.30 d-f
7	Dyna-Gro	GX20970X	59764 a,b	123.94 a-c	36.03 d-f
8	Dyna-Gro	GX21965X	63423 a,b	102.68 c-f	35.72 d-f
9	Dyna-Gro	M71GR91	59764 a,b	114.09 a-f	38.29 b-d
10	Dyna-Gro	M72GB71	62204 a,b	107.34 c-f	40.50 a,b
11	Sorghum Partners	SP74M21	57325 b	119.27 a-d	38.88 a-d
12	Sorghum Partners	SP7715	62204 a,b	135.61 a	37.21 b-e
13	Sorghum Partners	SPSA308	62204 a,b	111.23 b-f	36.56 d,e
14	Sorghum Partners	SPSC344	67082 a	117.72 a-e	32.49 f
15	Sorghum Partners	SPSA411	64033 a,b	133.79 a,b	36.64 c-e
16	Sorghum Partners	NK8828	57325 b	101.9 c-f	35.56 d-f
17	Sorghum Partners	SP68M57	59764 a,b	106.05 c-f	41.93 a
	Means		**60959.61**	**109.87**	**37.07**
	CV		**6.90**	**11.20**	**5.19**

*Means followed by the same letter do not significantly differ using LSD Duncan (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 2021.

Hybrid Information			Agronomic Measurements*			
Entry	**Company**	**Hybrid**	**DTF**[1]	**Plant Height (cm)**	**Exertion (cm)**	**Panicle Length (cm)**
1	Dyna-Gro	M59GN94	63.33 f-g	112.67 e,f	1.33 d,e	28.33 a-d
2	Dyna-Gro	M60GB31	66.00 c-f	118.33 c-f	11.00 a,b	26.67 a-d
3	Dyna-Gro	GX20973X	62.67 g,h	101.00 g	1.00 d,e	24.33 c,d
4	Dyna-Gro	M63GB78	67.33 b-d	130.33 a,b	7.67 a-e	29.67 a,b
5	Dyna-Gro	GX20998X	65.00 d-g	109.67 f,g	11.67 a,b	26.00 b-d
6	Dyna-Gro	M67GB87	64.00 e-g	120.67 b-e	8.00 a-e	24.00 d
7	Dyna-Gro	GX20970X	67.67 b-d	117.67 d-f	6.67 b-e	32.00 a
8	Dyna-Gro	GX21965X	66.00 c-f	130.33 a,b	8.33a-d	27.00 a-d
9	Dyna-Gro	M71GR91	67.67 b-d	130.33 a,b	9.33 a-c	26.67 a-d
10	Dyna-Gro	M72GB71	65.33 d-g	117.33 d-f	10.00 a-c	29.33 a-c
11	Sorghum Partners	SP74M21	69.33 a,b	133.33 a	14.67 a	32.00 a
12	Sorghum Partners	SP7715	71.00 a	133.67 a	4.33 b-e	30.67 a,b
13	Sorghum Partners	SPSA308	65.67 d-f	127.67 a-d	7.33 a-e	30.67 a,b
14	Sorghum Partners	SPSC344	66.33 c-e	122.00 b-e	5.00 b-e	31.67 a
15	Sorghum Partners	SPSA411	69.67 a,b	129.67 a,b	3.00 c-e	32.00 a
16	Sorghum Partners	NK8828	68.67 a-c	128.67 a-c	6.00 b-e	31.67 a
17	Sorghum Partners	SP68M57	62.33 h	112.00 e,f	0.33 e	32.00 a
	Means		**66.35**	**122.08**	**6.80**	**29.10**
	CV		**2.34**	**4.68**	**59.74**	**9.40**

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

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 2021.

Hybrid Information			Agronomic Measurements*		
Entry	**Company**	**Hybrid**	**Plant per ac**	**Yield bu ac^{-1}**	**1000 seed Weight (g)**
1	Dyna-Gro	M59GN94	39930 c,d	124.72 c-e	27.89 c-f
2	Dyna-Gro	M60GB31	39059 c,d	123.68 d,e	25.98 e,f
3	Dyna-Gro	GX20973X	39930 c,d	103.46 e	25.88 e,f
4	Dyna-Gro	M63GB78	46174 a-d	157.39 b	29.31 b-d
5	Dyna-Gro	GX20998X	42834 a-d	135.61 b-d	26.44 e,f
6	Dyna-Gro	M67GB87	34267 d	130.68 b-e	29.61 b-d
7	Dyna-Gro	GX20970X	40801 b-d	156.35 b	28.58 b-e
8	Dyna-Gro	GX21965X	45448 a-d	154.53 b,c	25.28 f
9	Dyna-Gro	M71GR91	48932 a-c	142.35 b-d	30.41 b,c
10	Dyna-Gro	M72GB71	52127 a-c	144.94 b-d	27.91 c-f
11	Sorghum Partners	SP74M21	40075 c,d	138.72 b-d	35.47 a
12	Sorghum Partners	SP7715	49368 a-c	160.76 a,b	29.33 b-d
13	Sorghum Partners	SPSA308	54595 a	138.46 b-d	29.73 b-d
14	Sorghum Partners	SPSC344	54014 a,b	136.64 b-d	29.48 b-d
15	Sorghum Partners	SPSA411	48061 a-c	185.39 a	30.86 b
16	Sorghum Partners	NK8828	42544 a-d	149.87 b-d	27.08 d-f
17	Sorghum Partners	SP68M57	41527 a-d	130.68 b-e	29.98 b,c
	Means		**44687.44**	**142.01**	**28.78**
	CV		**15.55**	**10.83**	**5.14**

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