

## University of California-ANR

### 2024 Field Research on Sorghum Grain hybrids for California

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#### Introduction

Grain sorghum (*Sorghum bicolor* (L.) Moench) is a versatile and drought-tolerant cereal crop widely grown for food, feed, and industrial uses. It thrives in diverse environments, particularly in regions with limited rainfall, making it a valuable staple in many parts of the world. Sorghum is rich in carbohydrates, fiber, and essential nutrients, contributing to food security and livestock nutrition. Its adaptability, efficient water use, and resistance to heat stress make it a sustainable option for grain production. Additionally, grain sorghum plays a role in biofuel production and gluten-free food products, further enhancing its economic and agricultural significance. California's Sustainable Groundwater Management Act projects that approximately 500,000 acres of irrigated cropland will be idled by 2040. As an annual crop, sorghum presents a potential solution, providing a sustainable rotation option to help farms address drought and water limitations while also reducing dust pollution, pests, and diseases associated with fallow croplands. The University of California Agriculture and Natural Resources (ANR) initiated sorghum grain hybrid evaluation trials in 2016. This report presents data from 2024 demonstration plots cultivated across two locations: the Kearney Agricultural Research and Extension Center (KARE) and the Westside Research and Extension Center (WSREC). Previous reports can be found at the sorghum website, <https://sorghum.ucdavis.edu/>

#### Methods and Materials

Three seed companies provided 10 commercial grain sorghum hybrids for inclusion in these studies. The hybrids were planted in a replicated randomized complete block design, with four 20-foot rows on 30-inch raised beds. The analysis followed a split-plot design, with hybrids as the main plot and locations as the sub-plot. Bird damage was significant at the KARE location. Final grain means were extrapolated from estimating the grain loss, and plants were covered with white bee netting to protect them from further damage. The Kearney Agricultural Research and Extension Center (KARE) received 7.84 inches of rain from January through the end of May. During the growing season from June to September, rainfall amounted to 0.07 inches. Prior to planting at the West Side Research and Extension Center (WSREC), rainfall from January through May totaled 6.93 inches, with total rainfall during the growing season (June-September) at 0.11 inches. Sprinkler irrigation was used to establish the stand, then followed by furrow irrigations through the remainder of the growing season at both locations. Furrow irrigation frequency differed between sites based on the differences in soil water holding capacity and infiltration rates. The sandy loam soil at the KARE location was furrow irrigated at approximately 7–10-day intervals during the primary growing season, while the interval between irrigations in the clay loam soil at the WSREC site was approximately 14 to 21 days. The trial was irrigated to match the evapotranspiration (ET) demand, and fertilizer applications followed recommendations for grain sorghums in the region, with amounts shown in the following summary.

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

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**Trial Location:** KARE Planting, Parlier, CA  
**Cooperator:** UC-ANR  
**Previous Crop:** Winter forage (Oats, barley, wheat)  
**Soil Type:** Hanford sandy loam  
**Plot Size:** Four, 30 inch rows by 20 ft  
**Replications:** 3  
**Planting Date:** June 6, 2024  
**Planting Rate:** 70,000 seed acre<sup>-1</sup>  
**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<sup>-1</sup>, Maestro 4 EC at .5 pint per ac<sup>-1</sup>  
**Pesticide:** two applications of Sivanto Prime 14oz ac-1  
**Irrigation Methods:** Sprinkler irrigation for stand establishment, followed by Furrow irrigation  
**Irrigation Amounts:** total (sprinkler plus furrow irrigation) = 26.5 inches  
**Grain Harvest Date:** Plots hand harvested on September 25, 2024

**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:** May 30, 2024  
**Planting Rate:** 70,000 seed acre-1  
**Seed Method:** Almaco 4 row plot planter  
**Fertilizer:** 250 lbs/ac46-0-0; 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  
**Pesticide:** two applications of Sivanto Prime 14oz ac-1  
**Irrigation Method:** Sprinkler irrigation for stand establishment, followed by Furrow Irrigation  
**Irrigation Amounts:** total (sprinkler plus furrow irrigation) = 24.1 inches  
**Grain Harvest Date:** Plots harvested with Almaco SPC 40 Plot Combine on September 27, 2024.

**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<sup>-1</sup>) at 13%
- 1000 seed weight (g)
- Data was analyzed using the R statistical package.

## **Results**

### *Sugarcane Aphid Incidence*

Major sugarcane aphid infestations were observed at both the KARE and WSREC sites close to the timing of flag leaf initiation, but populations were kept under control with two Sivanto applications. There were some observations of reduced aphid incidence and potential resistance in some hybrids at flag leaf initiation timing, but less clear differences apparent at the timing of the second Sivanto application.

### *Early Agronomic Data*

In 2024, WSREC recorded a higher average number of days to flowering (DTF) compared to KARE, reflecting differences in hybrid maturity periods. DTF varied significantly among the 10 hybrids. Flowering dates ranged from 66 days after planting for the earliest hybrid (Dyna-Gro M67GB87) to 85 days for the latest-flowering variety (S&W Seeds SP7715-SI) (Table 1). At KARE, significant differences were also observed among hybrids, with flowering times ranging from 57 to 81 days after planting (Table 2). In 3 of the varieties grown at the WSREC site, there were significant plant-to-plant differences in timing of flowering, with delays in flowering of 5-7 days in some plants that were related to slow initial plant growth due to areas with rough seed beds.

Plant heights in 2024 were notably taller, averaging 140.9 cm across both locations, compared to previous years (2022 and 2023). Hybrids at WSREC grew significantly taller than those at KARE (Table 1).

### *Plant and Yield Data*

No lodging was recorded at either site in 2024. At both KARE and WSREC sites, average plant populations per acre were lower levels achieved in 2023 field trials and were more variable across replications within varieties. Average seed weight varied between locations and across varieties. The average 1000-seed weight at WSREC was 32.9 g, significantly higher than the 28 g recorded at KARE. Across both locations, hybrid seed weights ranged from 27.9 g to 33.3 g (Table 1).

Yield performance also differed between sites. The average yield at WSREC was 88.3 bu ac<sup>-1</sup>, considerably higher than the 73.1 bu/ac recorded at KARE. At KARE, bird damage impacted yields, with losses ranging from 0% to 27%. Dyna-Gro Seed M62GB36 experienced the highest incidence of bird damage. To mitigate grain loss to the birds at KARE, white bee netting with PVC supports were used to protect the plots.

Due to differences in harvest conditions and bird damage, average yields were not combined across locations. At KARE, significant yield differences were observed among hybrids, ranging from 42.6 to 101.7 bu/ac. In contrast, no significant yield differences were found among hybrids at WSREC. The highest yielding hybrids recorded at WSREC and KARE in 2024 were Dyna-Gro Seed M71GR91 at 103.1 bu ac<sup>-1</sup> and Dyna-Gro Seed M62GB36 at 101.68 bu ac<sup>-1</sup>, respectively (Table 3 and 5).

## **Discussion**

In 2024, the grain sorghum performance trial was evaluated at two sites, KARE and WSREC which differed in soil type (sandy loam at KARE, clay loam soil at WSREC). Particularly at the WSREC site, some rows in plots had lower-than-desired plant populations due to rough, cloddy seed beds in some rows. Extra sprinkler irrigations were required to break down the cloddy beds and provide adequate moisture for germination and seedling establishment, and in those affected rows there were 5-to-7-day delays in seedling emergence or even failure of establishment in parts of some plot rows. Fortunately, since all plots were four rows wide, rows were still available with acceptable plant populations for harvest measurements in all plots.

Despite the generally good plant populations at the KARE site, we had to use alternative harvest measurements to estimate grain yields to significant initial bird damage. We were able to reduce any continuing impact of the birds by covering the plots with bee netting. Grain yields were estimated by hand harvest of plot rows combined with estimated grain losses on measured panicles. There is a need to identify sustainable solutions. Birds primarily feed on the grain during the milk and soft dough stages, with certain varieties being more highly preferred than others, resulting in reduced yields.

Generally, the results from the two sites confirm that, given the right conditions, sorghum has the potential to perform well in different soils and across multiple years in California.

Table 1. Various agronomic and yield characteristics for grain sorghum hybrids averaged across 2 trial locations in California in 2024, University of CA ANR Kearney Agricultural Research and Extension Center, Parlier, and West Side Research and Extension Center, Five Points

Hybrid Information		Agronomic Measurements *			
Company	Hybrid	DTF <sup>1</sup>	Plants per ac	Height (cm)	1000 seed Weight (g)
Scott Seed Co	X50415	81 ab	<b>Plants/acre</b>	143.3 bc	27.6 c
Scott Seed Co	X50615	77 bc	39064.4 e	163.3 a	30.8 a-c
Dyna-Gro Seed	M67GB87	66 f	41367.8 de	137.9 c-e	33.3 a
Dyna-Gro Seed	M60GB31	70 de	42614.53 c-e	140.0 b-e	28.7 bc
Dyna-Gro Seed	M71GR91	73 cd	52449.53 ab	135.5 c-e	29.0 bc
Dyna-Gro Seed	M72GB71	70 de	48477.97 a-d	140.6 b-d	30.8 a-c
Dyna-Gro Seed	M70GR37	71 de	48512.27 a-d	130.4 e	33.2 a
Dyna-Gro Seed	M62GB36	67 ef	45750.27 b-e	138.0 c-e	31.4 ab
S&W Seeds	SP66M16-SI	76 c	51454.6 a-c	130.9 de	30.9 a-c
S&W Seeds	SP7715-SI	85 a	56172.27 a	149.2 b	28.5 bc
<b>Mean</b>		<b>73.51</b>	<b>47874.59</b>	<b>140.9</b>	<b>30.4</b>
<b>CV (coefficients of variation-%)</b>		<b>5.07</b>	<b>16.62</b>	<b>6.1</b>	<b>10.1</b>
<b>Location Means</b>					
<b>KARE</b>		<b>66.14 b</b>	<b>52221.18a</b>	<b>136.3 b</b>	<b>27.95 b</b>
<b>WREC</b>		<b>80.63 a</b>	<b>43528b</b>	<b>145.19 a</b>	<b>32.86 a</b>

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

Table 2. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA ANR Kearney Agricultural Research and Extension Center, Parlier, California in 2024.

Hybrid Information		Agronomic Measurements *			
Company	Hybrid	DTF <sup>1</sup>	Height (cm)	Exertion (cm)	Panicle Length (cm)
Scott Seed Co	X50415	75 ab	144 b	9.3 a	23.3 c
Scott Seed Co	X50615	70bc	161 a	11.3 a	25.0 bc
Dyna-Gro Seed	M67GB87	57 f	137 b-d	10.7 a	25.0 bc
Dyna-Gro Seed	M60GB31	65 c-e	136 b-d	7.3 a	26.0 bc
Dyna-Gro Seed	M71GR91	67 c-e	130 cd	9.7 a	28.0 ab
Dyna-Gro Seed	M72GB71	63 d-f	137 b-d	15 a	25.7 bc
Dyna-Gro Seed	M70GR37	59 ef	127 d	10.7 a	25.3 bc
Dyna-Gro Seed	M62GB36	57 f	129 d	15.7 a	24.7 bc
S&W Seeds	SP66M16-SI	67 cd	123 d	13.7 a	27.3 ab
S&W Seeds	SP7715-SI	81 a	144 bc	10.3 a	30 a
<b>Mean</b>		<b>66.14</b>	<b>137</b>	<b>11.4</b>	<b>26.0</b>
<b>CV</b>		<b>6.24</b>	<b>6.3</b>	<b>46.9</b>	<b>9.0</b>

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

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 2024.

Hybrid Information		Agronomic Measurements *		
Company	Hybrid	Plants per ac	Yield bu/ ac <sup>-1</sup>	1000 Seed Weight (g)
Scott Seed Co	X50415	39059 e	42.6 d	25.9 c
Scott Seed Co	X50615	40366 de	61.0 b-d	26.7 c
Dyna-Gro Seed	M67GB87	41672 c-e	86.0 ab	31.6 ab
Dyna-Gro Seed	M60GB31	56192 ab	83.7 ab	27.2 bc
Dyna-Gro Seed	M71GR91	58153 ab	59.2 b-d	25.6 c
Dyna-Gro Seed	M72GB71	51691 b-d	77.1 a-c	28.0 a-c
Dyna-Gro Seed	M70GR37	52417 bc	96.4 a	32.1 a
Dyna-Gro Seed	M62GB36	53869 b	101.7 a	29.5 a-c
S&W Seeds	SP66M16-SI	66211 a	75.1 a-c	27.8 a-c
S&W Seeds	SP7715-SI	62581 ab	48.2 cd	25.2 c
<b>Mean</b>		<b>52221.18</b>	<b>73.1</b>	<b>28.0</b>
<b>CV</b>		<b>13.29</b>	<b>25.6</b>	<b>9.9</b>

\*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 2024.

Hybrid Information		Agronomic Measurements *			
Company	Hybrid	DTF <sup>1</sup>	Height (cm)	Exertion (cm)	Panicle Length (cm)
Scott Seed Co	X50415	87 ab	142.2 bc	**	**
Scott Seed Co	X50615	84 ab	165.6 a	**	**
Dyna-Gro Seed	M67GB87	74 d	139.2 c	**	**
Dyna-Gro Seed	M60GB31	75 d	144.3 bc	**	**
Dyna-Gro Seed	M71GR91	77 cd	141.2 bc	**	**
Dyna-Gro Seed	M72GB71	77 cd	144.3 bc	**	**
Dyna-Gro Seed	M70GR37	82 bc	134.1 c	**	**
Dyna-Gro Seed	M62GB36	77 cd	147.3 bc	**	**
S&W Seeds	SP66M16-SI	85 ab	139.1 c	**	**
S&W Seeds	SP7715-SI	89 a	154.4 ab	**	**
<b>Mean</b>		<b>80.63</b>	<b>145.2</b>	<b>**</b>	<b>**</b>
<b>CV</b>		<b>4.29</b>	<b>5.5</b>	<b>**</b>	<b>**</b>

\*Means followed by the same letter do not significantly differ using LSD (alpha=0.05); <sup>1</sup>DTF = days to 50% flowering; \*\*These parameters were NOT collected in the trial at the WSREC site

Table 5. Various agronomic characteristics for grain sorghum hybrids grown at the University of CA-ANR West Side Research and Extension Center, Five Points, California in 2024.

Hybrid Information		Agronomic Measurements *		
Company	Hybrid	Plants per acre	Yield bu/ac <sup>-1</sup> @ 13% moist	1000 Seed Weight (g)
Scott Seed Co	X50415	39070 ab	89.1 ab	29.2 b
Scott Seed Co	X50615	42370 ab	80.8 ab	34.9 ab
Dyna-Gro Seed	M67GB87	43556.67 ab	91.8 ab	30.0 a
Dyna-Gro Seed	M60GB31	48706.67 ab	95.5 a	30.1 ab
Dyna-Gro Seed	M71GR91	38803.33 b	103.1 a	32.4 ab
Dyna-Gro Seed	M72GB71	45333.33 ab	81.4 ab	33.6 ab
Dyna-Gro Seed	M70GR37	39083.33 ab	67.8 b	34.2 ab
Dyna-Gro Seed	M62GB36	49040 a	97.5 a	33.3 ab
S&W Seeds	SP66M16-SI	46133.33 ab	86.6 ab	34.0 ab
S&W Seeds	SP7715-SI	43183.33 ab	89.2 ab	31.9 ab
<b>Mean</b>		<b>43528</b>	<b>88.3</b>	<b>32.9</b>
<b>CV</b>		<b>13.49</b>	<b>16.6</b>	<b>10.1</b>

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