Final Report
UC-ANR
2017 Field Research on Sorghum Forages for the California Dairy Industry

Jeff Dahlberg[1], Bob Hutmacher[2], Dan Putnam[3], Nick Clark[4], Jennifer Heguy[5], Deanne Meyer[6], Peter Robinson[7], Joy Hollingsworth[1], Julie Sievert[1], Chris de Ben[3], and Merf Solorio[2]

Introduction

The San Joaquin Valley of California is home to a multi-billion dollar dairy industry. Continuing winter droughts and poor water allocations have spurred renewed interest in forage sorghums as an option in silage pits within the dairy industry; sorghum is known for its inherent drought tolerance. It was estimated that between 70-90,000 acres of forage sorghum were planted in the state in 2016. This was the seventh year of sorghum forage and sudangrass trials planted at the Kearney Agricultural Research and Extension (KARE) Center and the Westside Research and Extension (WREC) Center to evaluate commercially available sorghum forages. This was the second year with a second planting at KARE and a site planted at the UC Davis Research Farm (UC Davis). Sugarcane Aphid (SCA) was again a problem pest after appearing in California for the first-time last year. Each of the San Joaquin Valley sites sprayed insecticides to keep it under control, but the WREC plots were too badly infested to make harvest feasible. UC ANR research in the San Joaquin Valley continues on control methods for this pest.

Methods and Materials

Six seed companies provided a total of 44 hybrids, which included traditional forage sorghums, Photoperiod sensitive (PS) forage sorghums, and brown mid-rib (BMR) derivatives of both traditional and PS sorghums. Hybrids were planted in a randomized block design in four row plots planted on 30-inch raised beds and were analyzed as a split-plot design, with the main plot being location and the sub-plot being variety. Irrigation was applied using furrow irrigation at Kearney and a combination of overhead sprinklers and flood irrigation at the Westside Center and at the Davis Farm. Fertility applications followed similar recommendation for forage sorghums for the region. The 2017 growing season was characterized by a break from the years-long drought that California has faced, which helped to restore some of the soil moisture reserves. Trials at Kearney, Westside and Davis were irrigated as needed and according to ET demands of the crop at the various locations. The first planting at KARE received a preplant irrigation of 5.3 inches on May 2, 2017 and a total of 18.61 inches of applied irrigation. The second planting at KARE received a preplant irrigation of 6.19 inches on May 24, 2017 and a total of 18.04 inches of applied irrigation. Rainfall totals from January through May 12, 2017

---

[1] Director, Kearney Agricultural Research and Extension Center, 9240 S. Riverbend Ave., Parlier, CA 93648, phone: 559-646-6060, Email: jadahlberg@ucDavis.edu; joyhollingsworth@ucanr.edu; jasievert@ucanr.edu
[2] 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 Extension Specialist, Dept. of Agronomy & Range Science, UC-Davis, 2240 PES, One Shields Ave., Davis, CA 95616, phone: 530-752-8982; Email: dhputnam@ucDavis.edu; cmdeben@ucdavis.edu
[4] Farm Advisor, UCCE Kings County, 680 Campus Drive, Suite A, Hanford, CA 93230, phone: 559-852-2788; Email: neclark@ucanr.edu
[5] Farm Advisor, UCCE San Joaquin County, 3800 Cornucopia Way, Suite A, Modesto, CA 95358, phone: 209-525-6800; Email: jmheguy@ucanr.edu
[6] Livestock Waste Management Specialist, Dept. Animal Science, One Shields Ave., UC-Davis, Davis, CA 95616, phone: 530-752-9391; Email: dmeyer@ucDavis.edu
[7] Dairy Nutrition & Management Specialist, Dept. Animal Science, One Shields Ave., UC-Davis, Davis, CA 95616, phone: 530-754-0175; Email: phrobinson@ucDavis.edu

prior to the first planting at KARE were 9.51 inches, while the second planting had a total of 9.52 inches of rain prior to planting. Rainfall totals of 0.01 and 0.14 inches were recorded throughout the growing season for the two planting dates, respectively.

Rainfall totals from January through June prior to planting at WREC were 6.1 inches, while no rainfall was recorded throughout the growing season. At WREC, there was a pre-plant irrigation of 8.2 inches on May 8 and then a total of 3.2 inches was delivered between June 16 and June 21 using sprinklers to ensure good stand establishment. An additional 19.3 was applied by furrow irrigation over the course of the season. In total, 30.7 inches of irrigation were applied in the 2017 season. Rainfall totals from January through May 26 prior to planting at UC Davis were 23.87 inches, while 0.76 inches fell throughout the growing season. The trial was irrigated to field capacity every two weeks from May 31st to August 16th. Trials were harvested approximately 100 days after planting.

Other cultural practices and study information are listed below:

Trial Location:	KARE Planting 1 and 2, Parlier
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:	May 12 and June 6, 2017
Planting Rate:	100,000 seed acre^{-1}
Seed Method:	Almaco 4 row plot planter
Fertilizer:	Planting 1: 500 lbs ac^{-1} 21-7-14, Planting 2: 1000 lbs ac^{-1} 21-7-14
Herbicide:	Dual Magnum at 1.3 pints per ac^{-1} as a pre-plant
Pesticide:	Sivanto 14 fl oz ac^{-1} on both plantings on July 25 and on Planting 2 on August 9
Irrigation:	See narrative above
Silage Harvest Date:	Plots harvested with Wintersteiger Cibus S forage chopper on August 22 and September 14, 2017

Trial Location:	Westside Research and Extension Center, Five Points
Cooperator:	UC-ANR Extension
Previous Crop:	Winter forage (wheat grown for silage-not taken to grain)
Soil Type:	Panoche clay loam
Plot Size:	Four, 30 inch rows by 20 ft
Replications:	3
Planting Date:	June 15, 2017
Planting Rate:	100,000 seed acre^{-1}
Seed Method:	Almaco 4 row plot planter
Fertilizer:	200 lbs acre^{-1} N-P-K 11-52-00 on May 25 and 80 lbs acre^{-1} N-P-K 46-00-00 urea on July 6
Herbicide:	Clarity 8oz on June 30 and Prowl-H_20 at 24 oz ac^{-1} on July 11
Pesticides:	Sivanto Prime 14oz ac^{-1} on August 11 and October 14
Irrigation:	Sprinklers for pre-irrigation and stand establishment, gated pipe furrow irrigation subsequent irrigations – see narrative for amounts
Silage Harvest Date:	A heavy Sugar Cane Aphid (SCA) infestation made harvesting impossible.

Trial Location:	UC Davis Research Station, Davis
Cooperator:	UC-ANR
Previous Crop:	Small grains cover crop
Soil Type:	Reiff very fine sandy
Plot Size:	Four, 30 inch rows by 20 ft
Replications:	3
Planting Date:	May 26, 2017
Planting Rate:	100,000 seed acre^{-1}
Seed Method:	Wintersteiger Self Propelled Drill Planter
Fertilizer:	100 lbs N on June 23
Herbicide:	Dual Magnum as pre-plant
Irrigation:	See above narrative
Silage Harvest Date:	Plots harvested with Wintersteiger Cibus S forage chopper September 12, 2017

Data Collected:

1. Plant stands
2. Plant height (cm) at silage harvest
3. Lodging at silage harvest. Percent of fallen or significantly leaning plants per plot.
4. Moisture Content at Harvest.
5. Forage (silage) yield. The middle two rows of each plot were harvested with a Wintersteiger Cibus S forage chopper. Yields are reported at 65% moisture in tons/acre.
6. Nutrient analysis: Samples were collected from the forage chopper in the field, weighed and then placed in forced air Gruenberg oven (Model T35HV216, Williamsport, PA) at

50º C until dried. These sub-samples were sent to Dairyland Laboratory, Inc, Arcadia, WI for analysis.

7. Key Nutrient Analysis Definitions
    a. Crude Protein: 6.25 times % total nitrogen
    b. ADF: % Acid Detergent Fiber; constituent of the cell wall includes cellulose and lignin; inversely related to energy availability
    c. NDF: Neutral Detergent Fiber; cell wall fraction of the forage
    d. Lignin: percent estimated lignin present
    e. Starch: estimated starch content
    f. Fat: estimated fat content
    g. NDFd30: neutral detergent fiber digestibility over 30 hours
    h. NDFd240: neutral detergent fiber digestibility over 240 hours
    i. RFV: Relative Feed Value is an index for comparing forages based on digestibility and intake potential. RFV is calculated from ADF and NDF. An RFV of 100 is considered the average score and represents alfalfa hay containing 41% ADF and 53% NDF on a dry matter digestibility.
    j. RFQ: Relative Feed Quality is an index for comparing forages calculated from TDN and DMI. An RFQ of 100 is considered the average score and represents fully mature alfalfa.
    k. Milk lbs/ton: A projection of potential milk yield per ton for forage dry matter.

Data was analyzed using the SAS statistical package.

Results

A summary of yield, agronomic traits and nutritional analyses are reported by types of forage sorghums grown in the all locations in Table 1. See Tables 2 and 3 for a comparison of the different hybrids' agronomic, yield, and nutritional characteristics.

Table 1. Summary of key forage characteristics by type of forage grown at three locations, Kearney (2 planting dates), and Davis in 2017.

Sorghum Type[1]	% Lodging @ Harvest[2]	Tons/ac @65% Moist.[2]	% Crude Protein[2]	% ADF[2]	% NDF[2]	% Lignin[2]	% NDF D30[2]	% NDF D240[2]	Milk lbs/ton DM[2]	Relative Feed Quality (RFQ)[2]
BMR (24)	21.37 a	17.57 c	9.54 a	39.5 c	59.9 c	5.34 b	52.9 a	72.11 b	2351.8 a	95.18 a
NonBMR (15)	18.21 a	20.23 b	8.41 b	38.4 c	57.8 c	5.88 a	46.7 b	65.36 c	2434.2 a	91.62 ab
PSBMR (3)	22.50 a	15.99 c	10.14 a	43.6 b	65.2 b	5.27 b	55.7 a	78.36 a	2034.6 b	84.06 b
PSNonBMR (2)	8.61 a	23.86 a	7.27 c	46.3 a	69.4 a	6.27 a	45.2 b	69.09 b	1792.8 c	59.94 c
Trial Avg.	19.74	18.69	9.07	39.68	59.95	5.57	50.50	69.97	2336.6	91.64

[1]Number in parenthesis is the number of hybrids in each sorghum type. BMR = brown midrib; PS = Photoperiod sensitive.

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

Lodging was significantly different among all four sites, with the lowest lodging % occurring at the first planting of the KARE trial and the highest at WREC. The first planting at KARE took place the first week of May and this may be the optimum time to plant forage sorghums to reduce lodging issues that can happen under ideal, hot growing conditions here in the valley. UC Davis produced significantly higher forage yields than either planting at KARE.

Forage yields for the trials ranged from a high of 28.6 to 12.7 tons acre^{-1} with an average of 18.7 tons acre^{-1} (see Tables 1 and 2). The non-BMR PS forages were slightly more productive than their BMR counterparts, similar to findings from previous years (Table 1). Planting at Davis consistently yielded significantly higher tons acre^{-1} in production, while the earlier planting at Kearney saw significantly less lodging than the other sites (Table 2). The increased yields at Davis could be attributed to greater soil moisture during the winter and less water stress over the growing season.

Similar to previous reports, lodging can be a major issue for forage sorghums. Lodging ranged from 0.4 to 80.5% (Table 2). There were no significant differences in lodging among any of the forage types this year.

Digestibility as measured by ADF, NDF, 30 and 240 hours NDFd, and overall forage quality as predicted by lbs of milk per dry ton and relative forage quality was significantly highest in the BMR sorghums (Table 1), though there were some excellent non-BMR forages as well (Table 3). Photoperiod sensitive forage sorghum, though high yielding, were relatively poor nutritionally. Nutritional information is important for establishing the baseline nutrition of the silage and is key to understanding the proper formulation of the feed for adequate nutrition for the dairy animal.

The top 10 hybrids were ranked in this study by taking those hybrids with the greatest yields and eliminating those hybrids that lodged by more than 10% (Table 4). Of these hybrids, yield ranged from a low of 17.1 tons acre^{-1} with Richardson RS1 to a high of 24.8 tons acre^{-1} with Scott Seed 54243X.

For many producers, yield is the greatest factor in their selection of sorghum forages. Table 5 highlights the top yielding hybrids that produced more than 20.0 tons acre^{-1} of yield. The highest yielding forage sorghum was SP 1615 from Chromatin/Sorghum Partners, LLC at 28.6 tons acre^{-1} followed by Chromatin/Sorghum Partners SS405 at 26.2 tons acre^{-1}. As in past years, lodging was associated with some of the highest yielding forage sorghums.

Discussion

This was the seventh year that a wide range of forage sorghums (44), both commercial and experimental, were evaluated for both yield and quality parameters in large replicated trials in three locations in California. Although the sites received more rainfall in 2017 than in recent years, particularly at UC Davis, it continues to be important to maximize irrigation and fertilizer efficiency. Given the limited amount of irrigation used in these studies, low inputs and high yields, the potential does exist in sorghum forages to save both water and fertilizer, both costly inputs in the production of forages in the state. Forage selection should be a combination of factors that optimize quality, yield and standability (lodging resistance) and will require additional management of feed rations to optimize the potential of these forage crops to supplement the feeding needs of dairies in the state.

Table 2. 2017 comparisons of sorghum forage hybrids and locations for agronomic characteristics and yield at KARE, WREC, and UC Davis by seed company.

Hybrid Information[1]					Agronomic Measurements[2]		
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% Lodging**	**Height (cm)**	**Ton ac-[1] 65% Moist**
AF7401	Alta Seeds	F	L	Y	0.4 s	145.2 p-r	16.4 k-s
XF7302	Alta Seeds	F	M	Y	0.4 s	150.6 o-q	14.5 p-s
XF7303	Alta Seeds	F	M	Y	0.8 r-s	132.2 q-s	13.7 r-s
XF7103	Alta Seeds	F	E	Y	1.3 r-s	163.8 n-p	15.8 l-s
AF8301	Alta Seeds	F	M	N	8.8 o-s	159.5 n-p	17.9 h-q
705F	Dyna-Gro Seed	F	E	N	25.8 j-o	158.8 n-p	16.8 j-r
F74FS23 BMR	Dyna-Gro Seed	F	M	Y	55.4 c-d	225.8 l	14.8 o-s
F73FS10	Dyna-Gro Seed	F	M	N	33.8 g-m	239.3 j-l	18.3 g-p
F76FS77 BMR	Dyna-Gro Seed	F	ML	Y	0.4 s	165.0 n-p	18.6 f-o
Fullgraze BMR	Dyna-Gro Seed	F	M	Y	34.6 f-m	255.9 e-j	19.9 d-k
Danny Boy BMR	Dyna-Gro Seed	F	PS	Y	51.6 c-f	278.8 b-d	20.1 d-k
Dual Forage SCA	Dyna-Gro Seed	F	M	N	0.8 r-s	146.4 p-q	19.2 e-m
GW 400 BMR	Gayland Ward Seed	F	ME	Y	62.5 b-c	247.6 h-k	15.4 m-s
GW 475 BMR	Gayland Ward Seed	F	ME	Y	31.3 h-m	238.0 j-l	18.7 e-o
GW 600 BMR	Gayland Ward Seed	F	M	Y	36.7 e-l	254.3 g-j	18.9 e-n
Silo Pro BMR	Gayland Ward Seed	F	M	Y	3.8 q-s	151.6 o-q	15.0 n-s
GW EXP 15F1097	Gayland Ward Seed	F	M	N	39.5 d-k	225.4 l	16.6 k-r
GW EXP 15F909	Gayland Ward Seed	F	M	N	40.4 d-j	254.2 g-j	21.7 c-h
GW EXP 15F910	Gayland Ward Seed	F	M	N	20.8 l-q	265.4 d-i	19.5 d-l
Super Sugar DM	Gayland Ward Seed	F	L	N	7.1 p-s	271.1 c-g	18.7 e-o
Sweet Forever BMR	Gayland Ward Seed	F	L	Y	47.1 c-i	267.5 c-h	23.2 b-d
Nutra King BMR	Gayland Ward Seed	F	ME	Y	80.5 a	264.9 d-i	14.1 q-s
Sweet Six BMR	Gayland Ward Seed	F	ME	Y	52.5 c-e	276.3 b-f	20.6 d-j
RX1	Richardson Seeds	F	E	N	2.1 r-s	121.3 s	17.1 i-r

Table 2. continued.

Hybrid Information[1]					Agronomic Measurements[2]		
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% Lodging**	**Height (cm)**	**Ton ac-1 65% Moist**
RX2	Richardson Seeds	F	E	N	7.9 p-s	148.8 o-q	18.4 f-o
SPX56216 BD	Sorghum Partners	F	ML	Y	48.3 c-h	227.3 k-l	16.4 k-s
NK300	Sorghum Partners	F	E	N	3.8 q-s	163.0 n-p	22.2 c-f
SS405	Sorghum Partners	F	L	N	51.0 c-f	293.7 b	26.2 a-b
SP1615	Sorghum Partners	F	PS	N	31.7 h-m	288.9 b-c	28.6 a
SP2774	Sorghum Partners	F	M	Y	22.9 k-p	276.2 b-f	21.9 c-g
SP2876	Sorghum Partners	F	M	Y	30.3 i-n	255.4 f-j	20.7 d-i
SP3903 BD	Sorghum Partners	F	ML	Y	6.3p-s	158.5 n-p	18.6 f-o
SP4555	Sorghum Partners	F	M	Y	72.9 a-b	245.6 i-l	15.1 n-s
SP1880	Sorghum Partners	F	L	N	47.9 c-h	318.8 a	23.2 b-d
506/10	Scott Seed Co.	F	L	Y	0.8 r-s	147.9 p-q	15.9 l-s
514/10	Scott Seed Co.	F	L	Y	3.8 q-s	170.1 m-o	17.0 i-r
512/09	Scott Seed Co.	F	PS	N	11.3 o-s	247.6 h-k	19.1 e-m
503/15	Scott Seed Co.	F	ML	N	1.7 r-s	144.7 p-r	18.2 g-p
506/32	Scott Seed Co.	F	M	Y	13.3 n-s	124.0 r-s	14.1 q-s
50644X	Scott Seed Co.	F	PS	Y	23.3 j-p	188.9 m	12.7 s
54243X	Scott Seed Co.	F	L	Y	9.6 o-s	275.3 b-g	24.8 a-c
50643X	Scott Seed Co.	F	L	N	49.6 c-g	277.3 b-e	22.5 b-e
50652X	Scott Seed Co.	F	PS	Y	3.6 q-s	165.4 n-p	15.2 n-s
50651X	Scott Seed Co.	F	ME	Y	17.9 m-r	177.2 m-n	17.4 i-r
Means **CV**					**25.6** **84.1**	**214.6** **12.7**	**18.7** **22.3**
Location							
KARE1					**10.0 d**	**167.5 d**	**15.3 b**
KARE2					**28.5 b**	**194.4 c**	**15.3 b**
WREC					**43.1 a**	**238.6 b**	**na**
UC Davis					**20.7 c**	**258.0 a**	**25.6 a**

[1]Hybrid information provided by seed companies. F=Forage sorghum, E=Early, ME=Medium Early, M=Medium, ML=Medium Late, L=Late, PS=Photoperiod Sensitive.
[2]Means followed by the same letter do not significantly differ using LSD (P=0.05)

Table 3. 2017 comparisons of sorghum forage hybrids and locations for nutrient composition and calculations at KARE, WREC, and UC Davis by seed company.

Hybrid Information[1]					Nutrient Composition & Calculations[2]					
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% Crude Protein**	**% ADF**	**% NDF**	**% Lignin**	**% Starch**	**% Fat**
AF7401	Alta Seeds	F	L	Y	11.27 a-c	40.2 e-j	60.5 e-h	5.13 i-n	6.6 g-m	2.2 a-e
XF7302	Alta Seeds	F	M	Y	12.23 a	40.4 e-j	60.6 e-h	5.49 f-m	5.1 i-p	2.0 d-i
XF7303	Alta Seeds	F	M	Y	11.85 a-b	39.6 h-l	58.8 g-j	5.53 e-k	6.7 g-m	1.9 e-k
XF7103	Alta Seeds	F	E	Y	10.83 a-d	32.6 q	50.46 p	5.15 i-n	18.0 b	2.2 a-c
AF8301	Alta Seeds	F	M	N	9.47 d-l	38.6 i-n	57.6 h-l	6.25 b-f	11.2 d-e	1.6 l-p
705F	Dyna-Gro Seed	F	E	N	8.90 g-p	38.3 j-o	58.4 g-k	5.80 c-i	10.2 d-g	1.7 h-o
F74FS23 BMR	Dyna-Gro Seed	F	M	Y	10.31 b-h	41.0 d-i	61.7 d-g	5.57 e-k	5.3 h-o	1.8 g-n
F73FS10	Dyna-Gro Seed	F	M	N	8.71 i-p	39.3 h-m	59.3 g-i	6.28 b-e	8.4 e-i	1.7 l-p
F76FS77 BMR	Dyna-Gro Seed	F	ML	Y	10.40 b-g	39.7 g-l	60.5 e-h	5.45 g-n	7.7 e-k	1.9 e-k
Fullgraze BMR	Dyna-Gro Seed	F	M	Y	8.32 k-s	42.2 c-g	63.8 b-e	5.80 c-i	3.7 l-r	1.6 m-p
Danny Boy BMR	Dyna-Gro Seed	F	PS	Y	8.95 g-o	42.9 b-d	65.4 b-c	5.51 f-l	2.6 n-r	1.7 k-p
Dual Forage SCA	Dyna-Gro Seed	F	M	N	10.18 c-i	36.6 n-p	53.4 n-p	5.94 c-h	17.3 b	1.7 i-o
GW 400 BMR	Gayland Ward Seed	F	ME	Y	9.47 d-l	39.2 h-m	59.6 g-i	4.74 m-n	5.9 h-n	2.0 d-i
GW 475 BMR	Gayland Ward Seed	F	ME	Y	8.35 k-r	40.1 f-k	61.2 e-g	5.10 i-n	4.6 j-q	2.0 d-i
GW 600 BMR	Gayland Ward Seed	F	M	Y	8.09 l-t	39.1 h-m	58.7 g-k	5.47 g-m	8.9 e-h	1.9 e-k
Silo Pro BMR	Gayland Ward Seed	F	M	Y	10.72 a-e	38.9 h-n	60.0 f-h	4.76 l-n	6.5 h-m	2.0 c-h
GW EXP 15F1097	Gayland Ward Seed	F	M	N	8.44 j-q	36.6 n-p	56.7 i-n	4.69 n	7.1 f-l	2.2 a-d
GW EXP 15F909	Gayland Ward Seed	F	M	N	6.88 r-t	37.5 l-o	57.1 h-m	5.76 c-i	13.1 c-d	1.8 f-n
GW EXP 15F910	Gayland Ward Seed	F	M	N	8.19 l-t	38.3 j-o	56.6 i-n	5.92 c-h	13.1 c-d	1.7 k-p
Super Sugar DM	Gayland Ward Seed	F	L	N	7.98 l-t	42.5 b-f	63.8 b-e	6.46 b-c	4.8 i-q	1.6 n-p
Sweet Forever BMR	Gayland Ward Seed	F	L	Y	6.66 t	42.6 b-e	66.3 b-c	5.54 e-k	2.5 n-r	1.7 k-p
Nutra King BMR	Gayland Ward Seed	F	ME	Y	9.24 e-m	36.1 o-p	54.6 l-o	5.13 i-n	13.2 c-d	2.2 a-e
Sweet Six BMR	Gayland Ward Seed	F	ME	Y	8.46 j-q	36.0 o-p	54.7 l-o	5.10 i-n	13.4 c-d	2.3 a-b

Table 3. continued.

Hybrid Information[1]					Nutrient Composition & Calculations[2]					
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% Crude Protein**	**% ADF**	**% NDF**	**% Lignin**	**% Starch**	**% Fat**
RX1	Richardson Seeds	F	E	N	8.80 h-p	29.5 r	44.7 q	4.85 k-n	26.2 a	2.3 a
RX2	Richardson Seeds	F	E	N	8.70 i-p	36.0 o-p	53.9 m-o	5.37 g-n	15.2 b-c	2.0 d-i
SPX56216 BD	Sorghum Partners	F	ML	Y	9.42 d-l	43.2 b-d	65.1 b-d	5.67 d-j	2.7 n-r	1.9 f-l
NK300	Sorghum Partners	F	E	N	8.13 l-t	36.4 n-p	55.2 k-n	5.74 c-i	15.1 b-c	1.9 f-m
SS405	Sorghum Partners	F	L	N	6.97 q-t	40.4 e-j	61.3 e-g	6.37 b-d	8.3 e-j	1.6 m-p
SP1615	Sorghum Partners	F	PS	N	6.78 s-t	47.6 a	72.3 a	6.07 b-g	0.6 r	1.4 p-q
SP2774	Sorghum Partners	F	M	Y	7.61 n-t	40.9 d-i	61.8 d-g	5.59 e-k	8.1 e-k	1.8 g-o
SP2876	Sorghum Partners	F	M	Y	7.41 o-t	37.7 k-o	58.6 g-k	5.46 g-m	10.6 d-f	2.0 d-i
SP3903 BD	Sorghum Partners	F	ML	Y	9.76 c-k	39.2 h-m	61.2 e-g	4.91 j-n	7.1 f-m	2.1 a-f
SP4555	Sorghum Partners	F	M	Y	9.13 f-n	34.8 p-q	51.3 o-p	5.50 f-m	16.2 b-c	2.1 b-f
SP1880	Sorghum Partners	F	L	N	7.40 p-t	44.5 b-c	67.2b	6.76 a-b	3.5 l-r	1.6 n-p
506/10	Scott Seed Co.	F	L	Y	9.79 c-k	41.3 d-h	63.3 c-f	4.92 j-n	4.4 k-q	2.0 c-g
514/10	Scott Seed Co.	F	L	Y	10.90 a-d	39.5 h-m	60.5 e-h	5.04 i-n	6.8 g-m	2.0 d-i
512/09	Scott Seed Co.	F	PS	N	7.76 m-t	45.0 b	66.6 b-c	6.47 b-c	3.4 m-r	1.5 o-p
503/15	Scott Seed Co.	F	ML	N	9.94 c-j	36.6 n-p	54.7 l-o	5.54 e-k	15.3 b-c	1.9 e-k
506/32	Scott Seed Co.	F	M	Y	10.65 b-f	37.1 m-p	55.6 j-n	4.90 k-n	12.8 c-d	1.9 e-j
50644X	Scott Seed Co.	F	PS	Y	10.71 a-e	43.9 b-c	65.0 b-d	5.18 h-n	1.2 q-r	2.0 d-h
54243X	Scott Seed Co.	F	L	Y	7.58 o-t	47.9 a	70.8 a	7.42 a	1.6 o-r	1.2 q
50643X	Scott Seed Co.	F	L	N	8.86 h-p	42.6 b-e	63.6 c-e	5.95 c-g	4.4 k-q	1.7 j-o

Table 3. continued.

Hybrid	Company	Type	Maturity	BMR	% Crude Protein	% ADF	% NDF	% Lignin	% Starch	% Fat
50652X	Scott Seed Co.	F	PS	Y	10.85 a-d	43.9 b-c	65.1 b-d	5.11 i-n	1.6 p-r	1.9 f-l
50651X	Scott Seed Co.	F	ME	Y	10.51 b-f	39.3 h-m	59.2 g-i	4.93 j-n	8.0 e-k	2.0 d-i
Means **CV**					**9.07** **18.30**	**39.68** **6.68**	**59.95** **6.29**	**5.57** **14.80**	**8.38** **48.89**	**1.85** **14.93**
Location										
KARE1					**9.86 b**	**40.11 a**	**61.63 a**	**5.79 a**	**5.26 c**	**1.64 c**
KARE2					**10.45 a**	**40.02 a**	**61.02 a**	**5.61 a**	**6.61 b**	**1.84 b**
UC Davis					**6.91 c**	**38.91 b**	**57.18 b**	**5.32 b**	**13.30 a**	**2.07 a**
WREC					**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Table 3. continued.

Hybrid Information[1]				Nutrient Composition & Calculations[2]					
Hybrid	Company	Type	Maturity	BMR	% K	% S	Milk Lbs ton-1	Rel. Feed Value	Rel. Forage Quality
AF7401	Alta Seeds	F	L	Y	2.73 b-c	0.168 a-b	2275.8 f-l	89.47 h-l	96.44 f-m
XF7302	Alta Seeds	F	M	Y	2.79 b	0.174 a	2131.3 j-n	88.58 i-m	88.44 i-p
XF7303	Alta Seeds	F	M	Y	2.64 b-d	0.171 a-b	2124.4 j-n	92.72 g-j	86.16 k-q
XF7103	Alta Seeds	F	E	Y	1.86 l-p	0.134 d-k	2811.2 b	120.05 b	122.81 b
AF8301	Alta Seeds	F	M	N	1.97 j-p	0.130 e-l	2364.8 e-j	98.85 d-h	89.01 h-p
705F	Dyna-Gro Seed	F	E	N	1.98 j-p	0.122 i-o	2453.2 d-h	96.03 e-i	93.311
F74FS23 BMR	Dyna-Gro Seed	F	M	Y	2.41 d-h	0.149 b-g	2129.8 j-n	86.81 i-n	83.19 l-r
F73FS10	Dyna-Gro Seed	F	M	N	1.73 p-v	0.117 j-p	2329.1 e-k	92.89 g-j	82.22 m-r
F76FS77 BMR	Dyna-Gro Seed	F	ML	Y	2.43 c-g	0.149 b-g	2255.8 f-m	91.45 g-k	92.18 g-n
Fullgraze BMR	Dyna-Gro Seed	F	M	Y	2.37 d-i	0.123 i-o	2283.1 f-l	82.34 k-o	90.03 g-p
Danny Boy BMR	Dyna-Gro Seed	F	PS	Y	2.34 d-i	0.132 d-k	2161.2 i-n	79.12 m-o	86.64 k-q
Dual Forage SCA	Dyna-Gro Seed	F	M	N	1.91 k-p	0.136 d-k	2458.6 c-g	107.30 c-d	92.44 f-n
GW 400 BMR	Gayland Ward Seed	F	ME	Y	1.78 n-s	0.138 d-j	2269.0 f-l	92.25 g-j	95.89 f-m
GW 475 BMR	Gayland Ward Seed	F	ME	Y	1.70 p-v	0.130 e-l	2358.6 e-j	87.82 i-n	97.70 e-l
GW 600 BMR	Gayland Ward Seed	F	M	Y	1.75 o-t	0.124 h-n	2482.6 c-g	93.53 g-i	101.64 c-j
Silo Pro BMR	Gayland Ward Seed	F	M	Y	2.20 f-k	0.156 a-d	2271.1 f-l	92.31 g-j	94.73 f-m
GW EXP 15F1097	Gayland Ward Seed	F	M	N	1.83 l-q	0.124 h-n	2660.9 b-d	99.70 d-g	113.35 b-d
GW EXP 15F909	Gayland Ward Seed	F	M	N	1.42 u-v	0.085 q	2596.5 b-e	99.04 d-h	96.01 f-m
GW EXP 15F910	Gayland Ward Seed	F	M	N	1.49 r-v	0.104 n-q	2256.6 f-m	99.05 d-h	79.57 n-s
Super Sugar DM	Gayland Ward Seed	F	L	N	1.99 j-p	0.129 f-m	2104.4 j-n	81.45 l-o	71.65 q-s
Sweet Forever BMR	Gayland Ward Seed	F	L	Y	1.85 l-p	0.096 p-q	2485.1 c-g	78.21 n-o	97.43 e-l
Nutra King BMR	Gayland Ward Seed	F	ME	Y	1.71 p-v	0.132 d-k	2607.7 b-e	104.56 c-e	103.69 c-h
Sweet Six BMR	Gayland Ward Seed	F	ME	Y	1.44 t-v	0.120 i-o	2719.1 b-d	104.02 c-e	107.46 c-f

Table 3. continued.

Hybrid Information[1]				**Nutrient Composition & Calculations[2]**					
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% K**	**% S**	**Milk Lbs ton-1**	**Rel. Feed Value**	**Rel. Forage Quality**
RX1	Richardson Seeds	F	E	N	1.41 v	0.120 i-o	3181.9 a	146.83 a	150.18 a
RX2	Richardson Seeds	F	E	N	1.83 l-q	0.126 g-n	2714.0 b-d	107.97 c-d	111.90 b-e
SPX56216 BD	Sorghum Partners	F	ML	Y	2.48 b-f	0.153 a-e	2043.4 k-o	79.32 m-o	76.67 p-s
NK300	Sorghum Partners	F	E	N	1.69 p-v	0.107 l-q	2595.6 b-e	104.36 c-e	98.77 d-k
SS405	Sorghum Partners	F	L	N	1.52 q-v	0.101 o-q	2328.5 e-k	87.76 i-n	77.63 o-s
SP1615	Sorghum Partners	F	PS	N	2.10 h-m	0.104 o-q	1651.7 p	67.16 p	53.95 t-u
SP2774	Sorghum Partners	F	M	Y	2.06 i-o	0.108 l-q	2504.3 c-f	86.28 i-n	100.10 d-k
SP2876	Sorghum Partners	F	M	Y	1.81 m-r	0.106 m-q	2747.1 b-c	95.43 e-i	115.61 b-c
SP3903 BD	Sorghum Partners	F	ML	Y	2.26 e-j	0.138 d-j	2437.4 d-i	89.85 h-l	102.01 c-i
SP4555	Sorghum Partners	F	M	Y	1.46 s-v	0.128 f-n	2665.9 b-d	113.14 b-c	104.58 c-g
SP1880	Sorghum Partners	F	L	N	1.79 m-r	0.112 k-p	2098.8 j-n	75.37 o-p	68.05 r-t
506/10	Scott Seed Co.	F	L	Y	2.56 b-e	0.148 b-h	2210.4 g-n	83.70 j-o	90.55 g-p
514/10	Scott Seed Co.	F	L	Y	2.48 b-f	0.163 a-c	2165.6 h-n	90.40 g-l	89.97 g-p
512/09	Scott Seed Co.	F	PS	N	2.32 d-i	0.119 j-p	1933.9 n-p	75.88 o-p	65.93 s-u
503/15	Scott Seed Co.	F	ML	N	1.83 l-q	0.130 e-l	2493.3 c-g	103.38 c-f	93.32 f-n
506/32	Scott Seed Co.	F	M	Y	2.14 g-l	0.151 a-f	2438.3 d-i	103.37 c-f	103.25 c-i
50644X	Scott Seed Co.	F	PS	Y	3.31 a	0.174 a	1966.8 m-o	78.39 n-o	83.33 l-q
54243X	Scott Seed Co.	F	L	Y	1.73 p-u	0.116 k-p	1768.1 o-p	67.94 p	50.96 u
50643X	Scott Seed Co.	F	L	N	2.08 i-n	0.143 c-i	2011.9 l-o	81.58 l-o	72.86 q-s

Table 3. continued.

Hybrid Information[1]				Nutrient Composition & Calculations[2]					
Hybrid	**Company**	**Type**	**Maturity**	**BMR**	**% K**	**% S**	**Milk Lbs ton-1**	**Rel. Feed Value**	**Rel. Forage Quality**
50652X	Scott Seed Co.	F	PS	Y	3.38 a	0.174 a	1959.1 n-o	78.54 n-o	81.68 m-r
50651X	Scott Seed Co.	F	ME	Y	2.43 c-g	0.156 a-d	2257.9 f-l	93.83 f-i	92.95 f-n
Means **CV**					**2.05** **16.66**	**0.131** **19.40**	**2336.6** **13.36**	**92.36** **11.45**	**91.64** **17.79**
Location									
KARE1					**2.23 a**	**0.140 a**	**2130.1 c**	**87.77 a**	**83.38 c**
KARE2					**2.10 b**	**0.145 a**	**2339.1 b**	**91.41 b**	**93.19 b**
UC Davis					**1.83 c**	**0.110 b**	**2540.5 a**	**97.93 a**	**98.35 a**
WREC					**NA**	**NA**	**NA**	**NA**	**NA**

[1]Hybrid information provided by seed companies. F=Forage sorghum, E=Early, ME=Medium Early, M=Medium, ML=Medium Late, L=Late, PS=Photoperiod Sensitive.
[2]Means followed by the same letter do not significantly differ using LSD (P=0.05)

Table 4. Top hybrids in the 2017 UC Sorghum Forage Trials based on yield and lodging[1].

Hybrid	Company	Type	Maturity	BMR	% Lodging	Ton ac^{-1} 65% Moist	% Crude Protein	240 hr NDFd	Milk Lbs ton^{-1}	Rel. Forage Quality
54243X	Scott Seed Co.	F	L	Y	9.6	24.8	7.58	60.8	1768.1	50.96
NK300	Sorghum Partners	F	E	N	3.8	22.2	8.13	65.1	2595.6	98.77
Dual Forage SCA	Dyna-Gro Seed	F	M	N	0.8	19.2	10.18	60.3	2458.6	92.44
Super Sugar DM	Gayland Ward Seed	F	L	N	7.1	18.7	7.98	67.7	2104.4	71.65
F76FS77 BMR	Dyna-Gro Seed	F	ML	Y	0.4	18.6	10.40	73.3	2255.8	92.18
SP3903 BD	Sorghum Partners	F	ML	Y	6.3	18.6	9.76	76.7	2437.4	102.01
RX2	Richardson Seeds	F	E	N	7.9	18.4	8.70	67.2	2714	111.9
503/15	Scott Seed Co.	F	ML	N	1.7	18.2	9.94	66.1	2493.3	93.32
AF8301	Alta Seeds	F	M	N	8.8	17.9	9.47	63.3	2364.8	89.01
RX1	Richardson Seeds	F	E	N	2.1	17.1	8.80	62.5	3181.9	150.18

[1]The top hybrid list was derived by taking those hybrids with the highest yields and eliminating those hybrids that lodged by more than 10%.

Table 5. Top yielding hybrids that yielded over 20.0 tons acre^{-1} averaged over the UC Forage Trials in 2017.

Hybrid	Company	Type	Maturity	BMR	% Lodging	Ton ac-[1] 65% Moist	240 hr NDFd	Milk Lbs ton^{-1}	Rel. Forage Quality
SP1615	Sorghum Partners	F	PS	N	31.7	28.6	70.2	1651.7	53.95
SS405	Sorghum Partners	F	L	N	51	26.2	63.5	2328.5	77.63
54243X	Scott Seed Co.	F	L	Y	9.6	24.8	60.8	1768.1	50.96
Sweet Forever BMR	Gayland Ward Seed	F	L	Y	47.1	23.2	75.8	2485.1	97.43
SP1880	Sorghum Partners	F	L	N	47.9	23.2	66.6	2098.8	68.05
50643X	Scott Seed Co.	F	L	N	49.6	22.5	68.7	2011.9	72.86
NK300	Sorghum Partners	F	E	N	3.8	22.2	65.1	2595.6	98.77
SP2774	Sorghum Partners	F	M	Y	22.9	21.9	73.8	2504.3	100.1
GW EXP 15F909	Gayland Ward Seed	F	M	N	40.4	21.7	65.4	2596.5	96.01
SP2876	Sorghum Partners	F	M	Y	30.3	20.7	73.4	2747.1	115.61
Sweet Six BMR	Gayland Ward Seed	F	ME	Y	52.5	20.6	66.5	2719.1	107.46
Danny Boy BMR	Dyna-Gro Seed	F	PS	Y	51.6	20.1	77.5	2161.2	86.64

[1]Hybrid information provided by seed companies. F=Forage sorghum, ME=Medium Early, M=Medium, L=Late, E=Early, PS=Photoperiod Sensitive.