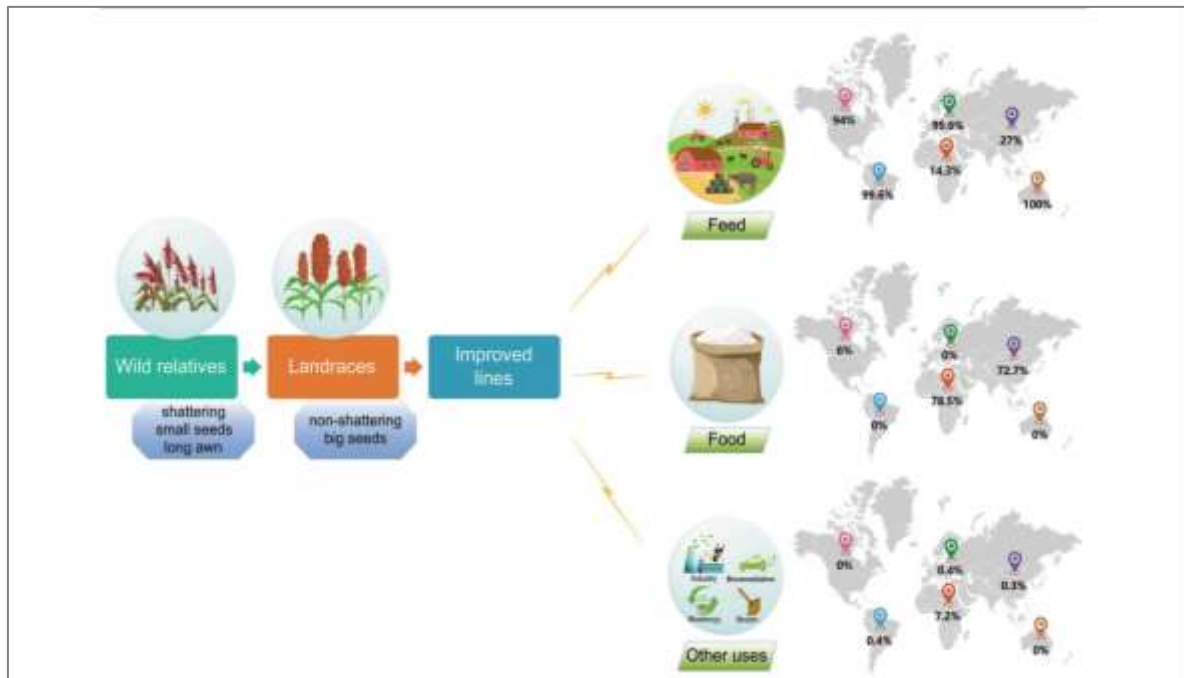


Evaluating Effects of Deficit Irrigation Strategies on Forage Sorghum Yields and Nutrient Composition Grown in the San Joaquin Valley of California

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Utilization of sorghum in different regions



- Fifth important cereal crop after rice, maize, wheat and barley
 - Drought tolerant crop for animal feed
 - Nutrient efficiency user (grown in marginal soils, salinity tolerant)
 - Soil health benefits
 - Forage sorghum available in USA since 1800's and top five producing states , 2021
1. Kansas — 3.2 million acres
 2. Texas — 2 million acres
 3. Oklahoma — 414,000 acres
 4. Colorado — 410,000 acres
 5. South Dakota — 263,000 acres

Hao *et al.*, 2021

Sustainability advantages of Sorghum

- Climate resilience-
Drought tolerant
- Diversity production
as grain, forage, cover
crop
- Improves soil health
- The whole plant can
be utilized (for grain,
forage and biofuel)





Diversity in types, amount of grain production, eventual height, photoperiod response, other characteristics



- Photoperiod sensitive types generally will not produce flowers/grain until very late in the fall.

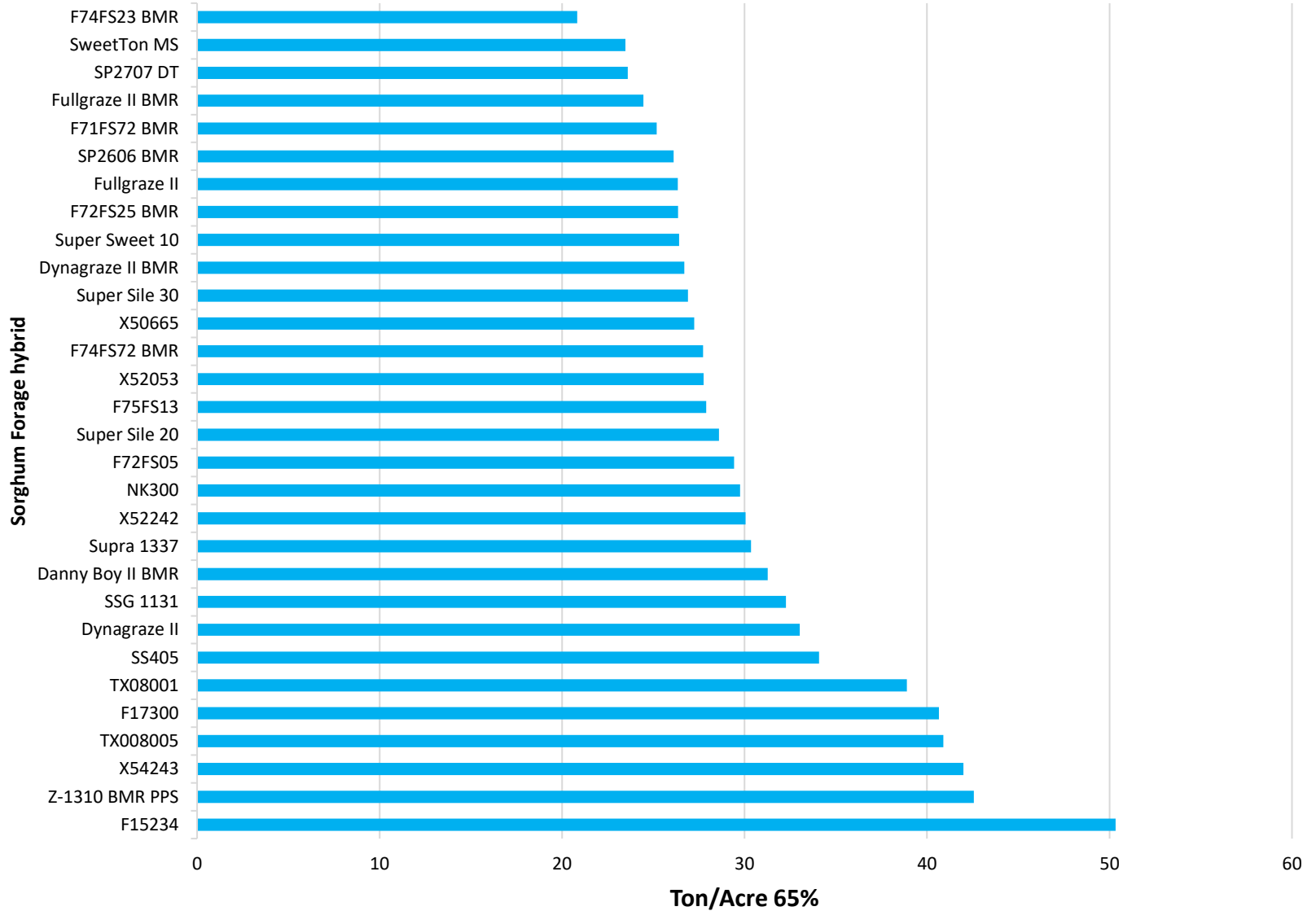
- Can result in very large plants with later harvests

- Other types, including multi-purpose cultivars typically do produce grain heads (variable amounts) in addition to forage.

Forage variety evaluation sites



2023 Combined Forage Yields from KREC, WREC, UC Davis



Nutritional composition for the different sorghum types (2023)

Sorghum Type	% Lodge @ Harvest ²	Silage Yield (T/A) @ 65% Moisture ²	% CP	% ADF ²	% aNDF ²	% Lignin ²	% NDFD30 ²	Milk lbs/ton DM ²	RFQ
PS (4)	6.67 b	42.69 a	5.99 c	39.91 a	62.88 a	4.7 b	50.28 b	2625.33 b	91.22 d
PSBMR (2)	21.39 ab	36.92 b	7.23 b	38.65 a	58.02 b	5.71 a	52.98 a	2739 b	107.01 c
FNON (15)	25.45 a	29.5 c	7.45 b	32.2 b	48.6 c	4.02 c	48.55 c	3083.25 a	128.82 b
FBMR (9)	20.21 ab	25.58 d	7.77 a	31.07 b	46.81 c	4.49 b	53.14 a	3162.03 a	144.03 a
Mean	21.28	30.71	7.33	33.36	50.65	4.35	50.3	3020.25	126.41
CV	132.82	26.4	13.97	13.17	14.03	19.8	8.81	10.17	21.5

Location Means	LODGE	TONacre65	CP	ADF	aNDF	STARCH	MILK	RFQ
KARE	11.83 c	25.84 b	6.05 c	32.10 b	49.97 b	19.65 a	3068.77 a	123.17 b
WREC	29.89 a	27.95 b	7.54 b	34.41 a	53.28 a	15.60 b	2929.09 b	119.07 b
DAVIS	22.11 b	38.34 a	8.39 a	35.57 a	48.71 b	20.05 a	3062.9 a	136.99 a



Scan for Annual forage yield and nutritional data.

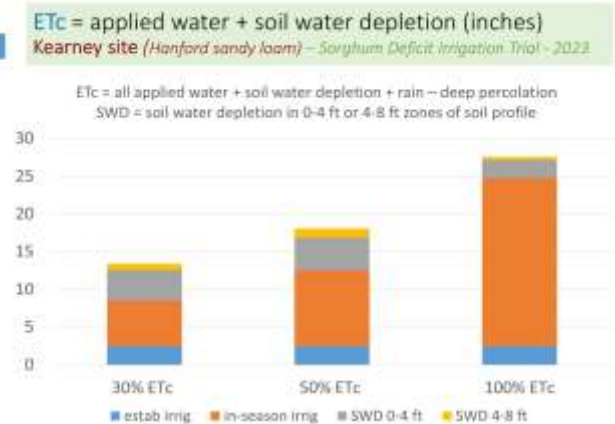
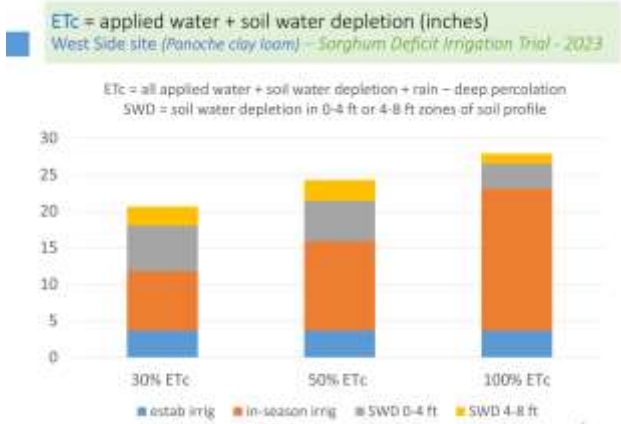
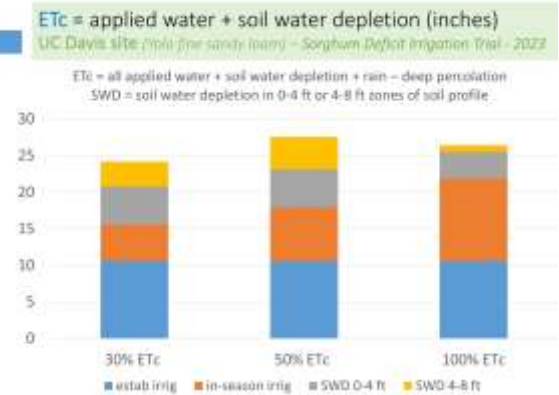
Forage sorghum deficit irrigation

Westside forage deficit irrigation
forage deficit

Kearney

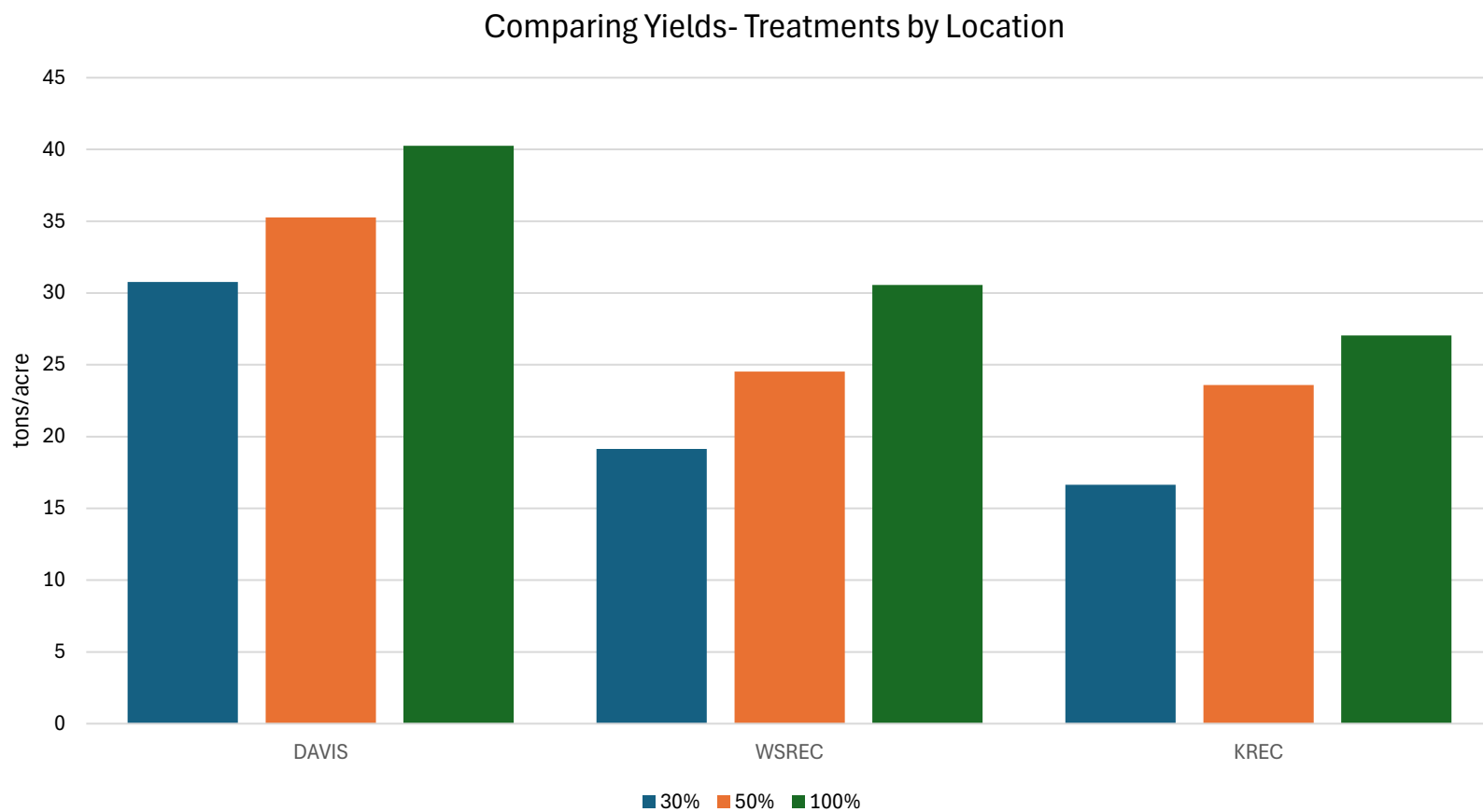


Water Use in the 2023 Forage Deficit trial



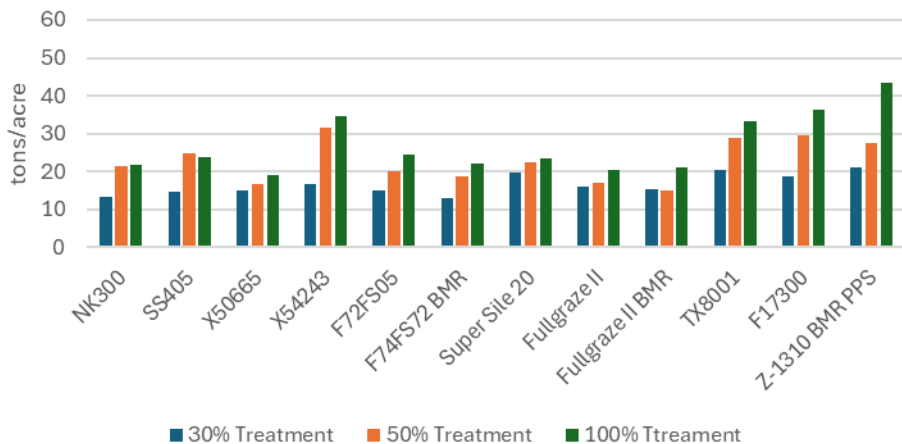
1. Differences in calculated ETc across treatments (much more spread in ETc across trts at KARE than at UCD or WSREC, with WSREC intermediate between KARE and UCD in terms of trt impacts on Etc)
2. Soil-related differences in amounts of water extracted in the upper profile (0-4 ft) versus lower profile (4-8 ft), ie. there is less water per unit soil water volume (less plant available water) to extract in soil at KARE than other sites.
3. There were large differences across sites in the amount of water applied for establishment.

Yield performance across sites

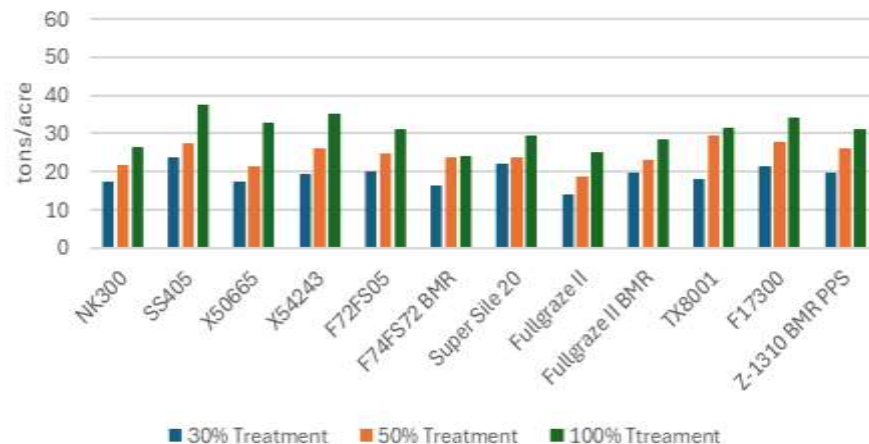


Yield comparison in different sites/soil types

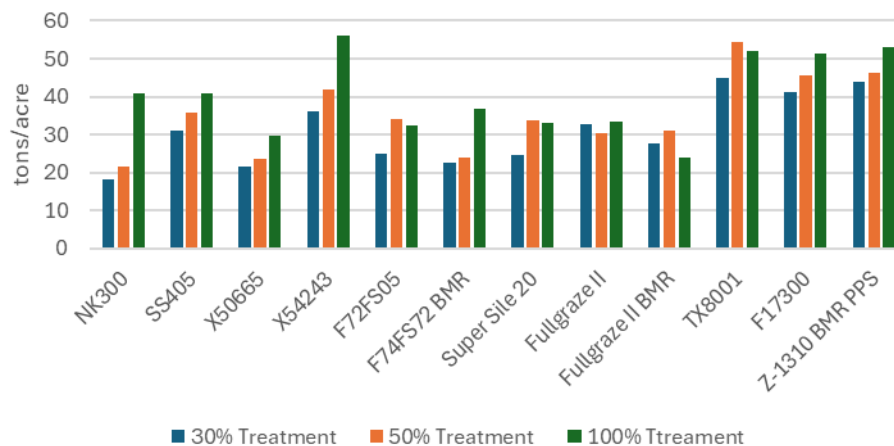
Comparing Irrigation Treatments at KREC



Comparing Irrigation Treatments at WSREC



Comparing Irrigation Treatments at UCD



Nutritional performance- Combined location deficit treatment

ENTRY	CP			ADF			aNDF			LIGNIN		
	30%	50%	100%	30%	50%	100%	30%	50%	100%	30%	50%	100%
1	8.3 ab	8.8 ab	7.3 cd	31.7 cde	28.8 d	29.3 ef	49.7 bc	43.4 e	43.9 efg	3.5 cde	4 bcd	4.3 c
2	7.9 abc	7.4 d	6.8 def	32.6 cd	32.9 b	34.6 bc	52.1 b	51.1 b	52.9 cd	3.4 cde	4 bcd	4.1 cd
3	8.5 a	9.2 a	8.4 a	30.4 de	29.4 d	27.7 f	47.2 c	44.6 de	41.4 g	2.9 e	3.2 e	3.5 d
4	6.6 d	6.5 e	6.8 def	36.3 ab	37.4 a	38.9 a	59.4 a	60.7 a	61 ab	3.5 cde	4 bcd	5 b
5	7.5 bc	8.2 bc	7.6 bc	31.8 cde	27.7 d	30.6 def	50.3 bc	42.7 e	46.9 ef	3.5 cde	3.2 e	4 cd
6	8.5 a	8.3 bc	8.1 ab	29.8 e	29.8 cd	28 f	46.9 c	45.4 cde	42.2 fg	3.8 bc	3.7 d	4.4 bc
7	7.3 cd	8 cd	7.1 cde	32 cde	32 bc	32.8 cde	49.6 bc	47.8 bcd	48.4 de	3.6 cd	3.9 bcd	4.1 cd
8	7.3 cd	8.2 bc	7.7 abc	34.1 bc	32.8 b	33.7 bcd	52.5 b	48.8 bc	49.1 de	4.3 ab	4.4 b	4.5 bc
9	7.7 bc	8 cd	6.8 def	32.7 cd	32.1 b	34.4 bc	51.6 b	49.5 b	52.8 cd	3.9 bc	4.4 b	5 b
10	7.3 cd	6.6 e	6.3 f	35.5 ab	37.8 a	38.3 a	56.9 a	60.2 a	60.8 ab	3.7 bcd	4.3 bc	4.5 bc
11	7.2 cd	6.3 e	6.4 ef	35.4 ab	37.8 a	39.6 a	56.7 a	60.6 a	62.6 a	3.2 de	3.8 cd	4.6 bc
12	7.4 c	6.7 e	7.1 cde	36.7 a	37.5 a	37.1 ab	57.5 a	58.5 a	55.9 bc	4.8 a	5.4 a	5.9 a

Conclusion

- Improved varieties has higher fiber and digestive (BMR) increasing energy availability.
- Forage sorghum can be used in dairy diets
- Its important to harvest forage at the proper stage of maturity to optimize nutrient quality
- Taking nutrient analyses often before including it in the ration
- Our study show reduction of water reduces % lodging

Thank you

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