Current Advances in Agricultural Sciences 6(2): 180-182 (December 2014)
Print ISSN 0975-2315
Online ISSN 2394-4471

SHORT COMMUNICATION

On-farm evaluation of advanced sorghum (*Sorghum bicolor*) hybrids in rice (*Oryza sativa*)-fallows under zero-tillage

RAJENDRAR CHAPKE[1]*, JS MISHRA[2], S BABU[3], C ARUNA[4] and JV PATIL[5]

Directorate of Sorghum Research, Rajendranagar, Hyderabad-500 030 (Telangana State), India

*Email of corresponding author: chapke@sorghum.res.in

Received: 18 May 2014; Revised accepted: 03 December 2014

ABSTRACT

Six advanced sorghum (*Sorghum bicolor* L. Moench) hybrid crosses, viz. 2295A x CB3', 456A x CB134, 3060A x B144, 3060A x CB50, 415A x CB33, 3060A x CB141 along with two popular hybrids CSH 16 and Mahalaxmi 296 were evaluated in rice-fallows under zero tillage during 2011-12 and 2012-13 at farmer's field in Guntur district of Andhra Pradesh. Grain yields of 456A x CB134 (9.05 t ha^{-1}) and CSH 16 (8.62 t ha^{-1}) were significantly higher than Mahalaxmi 296 (5.88 t ha^{-1}). The increase in grain yield was mainly due to maximum panicle weight, 100-grain weight, panicles m^{-2}, grain weight panicle^{-1} and grains panicle^{-1}. The lowest grain yield (6.06 t ha^{-1} and 5.43 t ha^{-1}) during both the years was recorded with Mahalaxmi 296, followed by 3060A x B144 (6.46 t ha^{-1}) and 3060A x CB141 (5.99 t ha^{-1}). The plant height had positive correlation with stover yields.

Key words: Advance hybrids, Rice-fallows, Sorghum, Zero-tillage

Sorghum (*Sorghum bicolor* L. Moench) is an important crop for millions of farmers in the semi-arid tropics in India. It is emerging as a potential alternative food, feed, fodder and bio-energy crop. However, part of the sorghum crop area has now been replaced by soybean, cotton and maize and also shifted to marginal lands. In rice-fallows of coastal Andhra Pradesh especially in Guntur and adjoining Krishna and Prakasam districts, sorghum cultivation is gaining popularity among farmers due to its high productivity and low water requirement (Mishra *et al*., 2011). It is now grown in more than 24,000 ha area in rice-fallows with an average productivity of 6.5 t ha^{-1}, which is the highest in the country.

Usually, farmers grow pulses (greengram and blackgram) in rice-fallows in the Krishna-Godavari zone of Andhra Pradesh as *utera* cropping (broadcasting of seeds in standing crop of rice). However, in the recent times, the area under pulses has declined due to late planting of rice and severe attack of viral diseases and parasitic weed *Cuscuta*. Farmers of the region are now growing maize (in assured irrigated areas) and sorghum (in less irrigated areas) in rice-fallows as alternate crops to pulses. Sorghum cultivation under zero- tillage has many economic and environmental benefits over conventional tillage, such as lower labour and fuel needs, reduced soil erosion, reduced runoff, increased soil organic Carbon contents, and increased soil biological activity (West and Post, 2002). Schlegel *et al*. (2007) recorded 25% higher grain yield in no tillage than reduced tillage and 98% greater than conventional tillage. Farmers of the area are however, using the fertilizers and pesticides indiscriminately (Chapke *et al*., 2011). The input use by sorghum may vary with different cultivars depending upon their growth behavior and rooting pattern. The farmers prefer to grow high yielding hybrids with medium plant height to avoid lodging. These requirements call for development of location-specific promising hybrids for this area. Therefore, the present study was conducted to evaluate the relative performance of advanced sorghum hybrids in rice-fallows under zero tillage at farmer's fields.

A field experiment was conducted at farmers' fields in Itanagar and Nandivelugu villages of Guntur district (16° 18' N, 80° 29' E, 31.5 m above mean sea level) of Andhra Pradesh, India, during the winter seasons of 2011-12 and 2012-13, respectively. The soil was clay loam (Vertisol), low in organic carbon (0.35%), medium in available phosphorus (28.4 kg ha^{-1}) and high in available potassium (392 kg ha^{-1}) with pH 7.6. Six advanced sorghum hybrids, viz. 2295A x CB35, 456A x CB134, 3060A x CB144, 3060A x CB50, 415A x CB33, 3060A x CB141 along with two popular hybrids CSH 16, and Mahalaxmi 296 were evaluated during 2011-12 and 2012-13 in a randomized block design with five replications. After the harvest of late-*kharif* transplanted rice, the sorghum cultivars were sown in December under zero tillage to utilize the residual soil moisture.

[1]Senior Scientist (Agricultural Extension), [2]Ex-Principal Scientist, [3]Scientist, [4]Principal Scientist and [5]Director, Directorate of Sorghum Research, Rajendranagar, Hyderabad 500 030, India

The sowing was done manually in rows 40 cm x 20 cm apart at 4-6 cm depth by making a hole with wooden stick and putting 2-3 seeds in each hole (dibbling). For effective weed control, pre-emergence application of paraquat + atrazine (1.0 + 0.50 kg ha^{-1}) was done one day after sowing. Crop was irrigated twice at 30 and 60 days after sowing (DAS). The crop was fertilized with 150 kg N, 60 kg P_2O_5 and 75 kg K_2O ha^{-1}. No fertilizer was applied at sowing. Half amount of N (75 kg ha^{-1}) and full dose of P_2O_5 (60 kg ha^{-1}) were side dressed in rows at 30 DAS. Remaining amount of N (75 kg ha^{-1}) and full dose of K_2O (75 kg ha^{-1}) were applied at 60 DAS (after 2^{nd} irrigation). To reduce the incidence of shoot fly, application of cypermethrin @ 2 ml $litre^{-1}$ of water was done one week after crop emergence. Crop was harvested at 110 DAS.

Results revealed a significant variation among different hybrids for growth and yield components (Table 1). The maximum plant height was recorded with 456A x CB 134. Hybrid 3060 x B144 produced the shortest plants during both the years. Significantly longest panicles (30-35 cm) were produced by 3060A x CB50, but the branches $panicle^{-1}$ was higher with 456A x CB134. The highest 100-grain weight (3.34 and 3.12 g) was obtained by 3060A x CB50, which was on a par with 'CSH 16' (3.58 g). Maximum panicle weight (128.4 and 133.1 g) was recorded with 456A x CB134. Grain weight $panicle^{-1}$ was also found maximum with 456A x CB134 (114.59 g), followed by 3060A x CB50 and 2295A x CB35. Maximum numbers of grains $panicle^{-1}$ (3904) were recorded with 3060A x B144 which was significantly superior to Mahalaxmi 296 (1495). Among all the evaluated advance hybrids, 456A x CB134 produced the highest grain yield (9.05 and 8.31 t ha^{-1}) during both the years and was 5% higher than that of CSH 16 (8.62 t ha^{-1}) in 2011-12. The other hybrids, viz. 3060A x CB50 (6.96-7.68 t ha^{-1}), 2295A x CB35 (6.56-7.16 t ha^{-1}) and 3060A x B144 (6.46-7.23 t ha^{-1}), though yielded lower than CSH 16, but were significantly better than Mahalaxmi 296 (6.06-5.43 t ha^{-1}). The increase in grain yield was due more panicle weight, 100-grain weight, panicles m^{-2}, grain weight $panicle^{-1}$, and grains $panicle^{-1}$. Maximum fodder yield (13.4 and 14.86 t ha^{-1}) was recorded with 456A x CB134.

Correlation coefficients among plant height, yield parameters and grain yield (Table 2) indicated that panicle width had negative and highly significant correlation with plant height, while positive and significant correlation with panicle weight, panicles m^{-2}, grain weight $panicle^{-1}$ and grains $panicle^{-1}$. However, the plant height had positive and highly significant correlation with stover yields. It indicated that tall structure hybrids produced higher stover yield. The 100-grain weight

Table 1. Yield and yield attributes of sorghum hybrids in rice-fallows system

Hybrids	Plant height at harvest (cm)		Panicles m^{-2}		Panicle length (cm)		Branches $panicle^{-1}$	Panicle weight (g)		Grains $panicle^{-1}$	Grain weight $panicle^{-1}$ (g)		100-grain weight (g)		Grain yield (t ha^{-1})			Stover yield (t ha^{-1})		
	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	2011-12	2011-12	2012-13	2011-12	2011-12	2012-13	2011-12	2012-13	2011-12	2012-13	mean	2011-12	2012-13	mean
456A x CB134	227	210	9.0	7.6	27.2	23.4	73.4	128.4	133.1	2611	107.6	114.6	3.20	2.74	9.78	8.31	9.05	13.40	14.86	14.13
3660A x CB50	191	174	8.4	8.6	35.0	30.0	65.4	92.4	120.2	3237	83.0	104.8	3.34	3.12	6.96	7.68	7.32	12.50	12.15	12.33
2295A x CB35	203	189	8.4	8.0	25.2	28.1	62.8	100.0	115.2	2865	78.0	98.1	2.27	2.80	6.56	7.16	6.86	10.00	12.17	11.09
3060A x B144	164	152	8.6	9.0	32.0	28.4	68.8	85.6	107.2	3904	73.8	86.4	2.06	2.94	6.46	7.23	6.85	8.30	10.34	9.32
415A x CB33##		182		6.6		29.7			96.7	1685		75.4		2.62		6.04	6.04		11.25	11.25
3060A x CB141##		209		6.0		28.6			93.9	1490		71.9		2.68		5.99	5.99		9.92	9.92
CSH 16#	216		8.4		32.0	-	65.8	108.6			102.4		3.58		8.62		8.62	12.50		12.5
Mahalaxmi 296	191	187	7.6	5.6	26.5	25.9	74.0	91.4	92.8	1495	78.8	73.4	3.09	2.64	6.06	5.43	5.75	7.90	10.44	9.17
LSD (P=0.05)	14.7	26.	1.1	1.4	1.7	4.2	9.0	13.9	22.4	547	8.0	20.4	0.31	0.49	1.05	1.33	1.19	2.79	3.44	3.12

#Evaluated during 2011-12; ##Evaluated during 2012-13

Table 2. Correlation co-efficient among various traits of sorghum hybrids

Parameters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}
Panicle length (cm)-X_1	1.00									
Panicle width (cm)-X_2	-0.058	1.00								
Plant height at harvest (cm)-X_3	0.019	-0.57**	1.00							
100-grain weight (g)-X_4	0.230	0.11	0.23	1.00						
Panicle weight after harvest (g)-X_5	0.024	0.33**	-0.056	0.219	1.00					
Panicles m^{-2} (g)-X_6	0.215	0.284*	-0.045	0.063	0.417**	1.00				
Grain weight $panicle^{-1}$ (g)-X_7	0.160	0.330**	-0.058	0.380**	0.873**	0.577**	1.00			
Grains $panicle^{-1}$-X_8	0.013	0.334**	-0.235	-0.072	0.484**	0.720**	0.550**	1.00		
Grain yield (t ha^{-1})-X_9	0.114	0.116	0.341**	0.389**	0.393**	0.606**	0.590**	0.514**	1.00	
Stover yield (t ha^{-1})-X_{10}	0.299*	-0.066	0.442**	0.360**	0.163	0.619**	0.345**	0.428**	0.757**	1.00

r=0.245 (at P=0.05) and 0.317 (at P=0.01) had positive correlation with grain weight panicle^{-1}, grain and stover yields. The panicle weight had highly significant correlation with number of panicles m^{-2}, grain weight panicle^{-1}, grains panicle^{-1} and grain yield. In addition, panicles m^{-2}, grain weight panicle^{-1}, grains panicle^{-1} had highly positive correlation with grain and stover yields. It indicated that higher grain yield of sorghum hybrids depends on panicle weight, 100-grain weight, number of panicles m^{-2}, grain weight panicle^{-1} and grains panicle^{-1} in zero till rice-fallow situations where the grain is the main marketable product. These yield attributes need to be kept in mind while developing sorghum hybrids for rice-fallow situations.

REFERENCES

Chapke RR, Mondal B and Mishra JS, 2011. Resource-use efficiency of sorghum (*Sorghum bicolor*) production in rice (*Oryza sativa*)-fallows in Andhra Pradesh, India. Journal of Human Ecology 34: 87-90.

Mishra JS, Subbarayudu B, Chapke RR and Seetharama N, 2011. Evaluation of sorghum (*Sorghum bicolor*) cultivars in rice (*Oryza sativa*)-fallows under zero-tillage. Indian Journal of Agricultural Sciences 81: 277-279.

Schlegel Alan, Stone Loyd, Dumler Troy and Thompson Curtis, 2007. Long-term no-till improves soil properties and increases grain yield. Paper presented during Annual Meeting of the Soil and Water Conservation Society, Saddlebrook Resort, Tampa, Florida, July 21, 2007.

West TO and Post WM, 2002. Soil organic carbon sequestration rates by tillage and crop rotation: A global data analysis. Soil Science Society of America Journal 66: 1930–1946.