

Evaluation of sorghum (*Sorghum bicolor*) cultivars in rice (*Oryza sativa*) fallows under zero tillage*

J S MISHRA¹, B SUBBARAYUDU², R R CHAPKE³ and N SEETHARAMA⁴

Directorate of Sorghum Research, Hyderabad, Andhra Pradesh 500 030

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Sorghum (*Sorghum bicolor* L. Moench) is a staple crop for millions of farmers in the semi-arid tropics. In spite of its multiple uses as food, feed, fodder and bio-fuel, the area under grain sorghum in India has declined from 18.61 million ha in 1969–70 to 7.53 million ha in 2008–09 (ASG 2010). Part of the sorghum crop area has now been replaced by soybean, cotton and maize and also shifted to marginal lands. However, new opportunities and areas for sorghum cultivation are emerging. Sorghum in rice-fallows in Coastal Andhra Pradesh, especially in Guntur and adjoining Krishna and Prakasam districts is gaining popularity among the farmers. 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 crop to pulses. During 2005–06, sorghum in Guntur district of coastal Andhra Pradesh occupied over an area of 2000 ha in rice-fallows under zero tillage with an average productivity of 6.5 tonnes/ha (Singh 2010). Sorghum after rice gave the highest output energy of 59.1×10^3 MJ/ha as compared to rice (*Oryza sativa* L.)–pigeonpea (*Cajanus cajan* L Millsp) and rice–safflower (*Carthamus tinctorius* L) (Mahendra Kumar 1997). Zero tillage has many economic and environmental benefits over the conventional tillage, such as lower labour and fuel needs, reduced soil erosion, reduced runoff, increased soil organic C 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% higher than the conventional tillage. Umakanth *et al.* (2004) reported ‘SPV 1022’ ‘PKV 809’ and ‘CO 28’ as promising sorghum cultivars in rice-fallows. The input use by sorghum may vary with different cultivars depending upon their growth behavior and rooting pattern. The present investigation was conducted to study the relative performance of sorghum cultivars in rice-fallows under zero tillage at farmer’s fields.

A field experiment was conducted at farmer’s fields in Ananthavarm village (16° 18’ N, 80° 29’ E, 31.5 m above mean sea level), of Guntur district of Andhra Pradesh, India, during the winter (*rabi*) seasons of 2008–09. The soil was clay loam (Vertisol), low in organic carbon (0.35%), medium in available phosphorus (28.4 kg/ha) and high in available potassium (392 kg/ha) with pH 7.6. Thirteen sorghum cultivars including hybrids (‘CSH 16’, ‘C 43’, ‘MGSH 55’, ‘MRS 4094’, ‘SPH 1148’, ‘SPH 1149’, ‘MJ 4334’, ‘Sudama 333’, ‘CSH 15R’, ‘Laxmi’ (local check) and varieties (‘M 35-1’, ‘CSV 216 R’, ‘CSV 22R’) were evaluated in a randomized block design in three replications. After the harvest of late rainy (*kharif*) season transplanted rice, the sorghum cultivars were sown on 22 December 2008 under zero tillage to utilize the residual soil moisture. The sowing was done manually in rows 40 cm × 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) was done 1 day after sowing. Crop was irrigated twice at 30 and 60 days after sowing. The crop was fertilized with 150 kg N, 60 kg P₂O₅ and 75 kg K₂O/ha. No fertilizer was applied at sowing. Half amount of N (75 kg/ha) and full dose of P₂O₅ (60 kg/ha) were side dressed in rows at 30 days after sowing. Remaining amount of N (75 kg/ha) and full dose of K₂O (75 kg/ha) were applied at 60 days after sowing (after second irrigation). To reduce the incidence of shoot fly, application of endosulfan 35 EC 2 ml/litre of water was done 1 week after crop emergence. Crop was harvested at 110 days after sowing.

*Short note

¹Principal Scientist (Agronomy) (e mail: mishra@sorghum.res.in), ²Scientist Senior Scale (Entomology) (e mail: subbarayudu@sorghum.res.in), ³Senior Scientist (extension) (e mail: chapke@nrscsorghum.res.in), ⁴Former-Director (e mail: nseetharama@gmail.com)

Table 1 Plant height, yield attributes and yields of sorghum cultivars

Cultivar	Plant height at harvest (cm)	Panicles/m ²	Panicle length (cm)	Grains/panicle	Grain weight/panicle (g)	100-grain weight (g)	Grain yield (tonnes/ha)	Stover yield (tonnes/ha)
'CSH 16'	142	16.4	41.4	3087	81.6	2.67	7.80	13.17
'C 43'	122	17.2	26.5	2141	62.4	2.93	5.78	13.64
'M 35-1'	301	16.8	19.7	1605	42.0	2.43	3.56	10.24
'CSV 216 R'	320	14.6	24.4	1993	50.0	2.49	3.63	10.86
'MGSH 55'	163	16.0	37.7	3203	69.2	2.15	5.84	14.29
'MRS 4094'	154	19.8	32.3	2787	73.6	2.63	7.14	16.66
'SPH 1148'	169	13.6	31.8	1414	41.6	2.94	3.27	9.49
'SPH 1149'	286	14.4	22.9	2214	66.0	3.01	4.50	13.09
'CSV 22R'	288	16.0	23.0	2597	53.6	2.08	4.60	14.51
'MJ 4334'	157	17.4	38.4	2857	86.0	3.04	7.37	16.85
'Sudama 333'	141	18.6	38.2	3510	92.8	2.49	8.44	19.46
'CSH 15R'	191	15.4	29.4	2372	82.4	3.51	6.03	16.35
'Laxmi' (check)	143	16.8	38.0	3340	62.8	1.89	5.89	13.73
S Em±	4.14	0.55	0.36	246	7.13	0.08	0.47	1.18
CD (P=0.05)	12.10	1.56	1.04	699	20.27	0.22	1.33	3.35

The data indicated a significant variation in growth and yield components. The plant height ranged from 122 cm to 320 cm and the variation was significant among genotypes (Table 1). Maximum panicles/m² was observed in 'MRS 4094' (19.8) which was at par with 'Sudama 333' (18.6). Longest panicles were obtained with 'CSH 16' (41.4 cm), followed by 'MJ 4334' (38.4 cm), 'Sudama 333' (38.2 cm) and 'Laxmi' (38 cm). Maximum grains/panicle (3510) was recorded with 'Sudama 333' which was at par with 'Laxmi' (3340), 'MGSH 55' (3203) and 'CSH 16' (3087). Similar trend was observed with respect to grain weight/panicle. 'CSH 15R' was significantly superior to other genotypes with respect to 100-grain weight (3.51 g). The local check 'Laxmi' gave the least (1.89 g). Sorghum hybrids yielded significantly superior than varieties. Among different hybrids, 'Sudama 333' (8.44 tonnes/ha), 'CSH 16' (7.80 tonnes/ha), 'MJ 4334' (7.37 tonnes/ha) and 'MRS 4094' (7.14 tonnes/ha) registered the higher grain yield. These hybrids recorded 43, 32, 25 and 21% higher yields over the check 'Laxmi' (5.89 t/ha). The increase in grain yield was due to increased panicle length and grains/panicle. The lowest grain yield (3.27 tonnes/ha) was recorded by 'SPH 1148', followed by 'M 35-1' (3.56 tonnes/ha) and 'SPH 1149' (4.5 tonnes/ha). 'Sudama 333' (19.46 tonnes/ha) being on par with 'MJ 4334' (16.85 tonnes/ha) and 'MRS 4094' (16.66 tonnes/ha) registered the highest stover yield.

Correlation coefficients among plant height, yield parameters and grain yield (Table 2) indicated that plant height had negative and highly significant correlation with panicle length, grain weight/panicle and grain yield/ha. On the other hand, panicle length had positive and highly significant correlation with number of grains/panicle, grain weight/panicle and grain yield. Negative association of plant

Table 2 Correlation co-efficient among various characters in sorghum

Parameter	X ₁	X ₂	X ₃	X ₄	X ₅
Plant height (cm) X ₁	1.000				
Panicle length (cm) X ₂	-0.803**	1.000			
Grains /panicle X ₃	-0.525	0.745**	1.000		
Grain weight/panicle (g) X ₄	-0.570*	0.662*	0.754**	1.000	
Grain yield (tonnes/ha) X ₅	-0.709**	0.756**	0.825**	0.929**	1.000

r = 0.5525 (P=0.05) and 0.6835 (P=0.01)

height with grain yield indicated that hybrid sorghum cultivars with medium tall stature are more suitable than tall cultivars in zero till rice-fallow situations where the grain is the main marketable product.

SUMMARY

Thirteen sorghum cultivars including hybrids ('CSH 16', 'C 43', 'MGSH 55', 'MRS 4094', 'SPH 1148', 'SPH 1149', 'MJ 4334', 'Sudama 333', 'CSH 15R', 'Laxmi' (local check) and varieties ('M35-1', 'CSV 216 R', 'CSV 22R') were evaluated in rice-fallows under zero tillage during winter (*rabi*) 2008–09 at farmer's field in Guntur district of Andhra Pradesh. Sorghum hybrids yielded significantly superior than the varieties. Among different hybrids, 'Sudama 333' (8.44 tonnes/ha) being at par with 'CSH 16' (7.80 tonnes/ha), 'MJ 4334' (7.37 tonnes/ha) and 'MRS 4094' (7.14 tonnes/ha) registered the highest grain yield. These hybrids recorded 43,

32, 25 and 21% higher yields over local check 'Laxmi' (5.89 tonnes/ha). The increase in grain yield was mainly due to increased panicle length and grains/panicle. The lowest grain yield (3.27 tonnes/ha) was recorded with 'SPH 1148' followed by 'M 35-1' (3.56 tonnes/ha) and 'SPH 1149' (4.5 tonnes/ha). Plant height showed negative correlation with grain yield, indicating the need for medium tall hybrids for rice-fallow situations.

REFERENCES

- ASG 2010. *Agricultural Statistics at a Glance*. Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India.
- Mahendra Kumar R, Murthy G R K and Subbaiah S V. 1997. Energy dynamics of rice-based cropping systems under different methods of rice cultivation. *Journal of Agricultural Engineering* **34** (2): 17–25.
- 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*, held during 21 July 2007 at Florida, USA.
- Singh J P. 2010. *Status paper on millets*. Directorate of Millets Development, Ministry of Agriculture, Department of Agriculture and Cooperation, Jaipur.
- Umakanth A V, Seetharama N, Mahendra Kumar R and Kiran Kumari V S S. 2004. Evaluation of sorghum genotypes for their suitability in rice fallows in vertisols. (in) *Extended Summaries, International Symposium on Rice*, pp 317–8, held during 4–6 October 2004 at New Delhi.
- West T O and Post W M. 2002. Soil organic carbon sequestration rates by tillage and crop rotation: A global data analysis. *Soil Science Society of America Journal* **66**:1930–46.