Madras Agric. J., 100 (4-6): 387-389, June 2013
https://doi.org/10.29321/MAJ.10.001316

Response of Sweet Sorghum [*Sorghum bicolor* (L.) Moench] to Tillage and Spentwash on Growth and Yield

M.T. Malagi[1*], S.S. Angadi[1], N.D. Yogendra[2], A.C. Mahendra[2], S.P. Dineshkumar[1] and Y.H. Sujay[3]
[1]Department of Agronomy, U.A.S, Dharwad -580 005
[2]Department of Soil Science and Agricultural Chemistry, U.A.S, G.K.V.K, Bengaluru
[3]Department of Entomology, U.A.S, Raichur

A field experiment was conducted at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad to study the effect of spentwash and tillage on growth and yield of sweet sorghum under rainfed condition. Results revealed that deep tillage recorded significantly higher grain yield (18.0 q/ha) and green biomass yield (35.5 t/ha) of sweet sorghum as compared to shallow tillage (13.7 q/ha and 28.6 t/ha, grain yield and green biomass yield). Among the spentwash levels, application of 150 kg N per ha through spentwash recorded significantly higher grain yield (18.0 q/ha) and green biomass yield (34.7 t/ha) as compared to 75 kg N per ha through spentwash and control, but was on par with 100 kg N per ha through spentwash, RDF and 125 kg N per ha through spentwash. The growth parameters and yield components followed similar trend as that of yield. Treatment combination of deep tillage with 100 kg N per ha through spentwash was suitable. Spent wash application was an effective nutrient supplement which could be a potential resource for sweet sorghum cultivation at low cost.

Key words: Distillery effluent, Spentwash, Sweet sorghum, Tillage

*[1]Corresponding author email: mallikarjunagro@gmail.com

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the five major cereals of world, being grown in tropical and subtropical environments. In India, sorghum ranks fourth in area and production after rice, wheat and maize and is cultivated on an area of 8.78 million ha with a production of 7.63 million tonnes and the productivity of 869 kg per ha. However, area under sorghum is declining every year (from 18 million ha in 1960 to 8.75 million ha in 2005-06) in all parts of India (Anonymous, 2006). This decline in area is mainly due to competing crops. In this context, sweet sorghum is similar to common grain sorghum with sugar rich stalk. Apart from grain and fodder, several alternate products can be prepared by sweet sorghum including bioethanol. Sweet sorghum has been investigated for its wider adaptability, drought resistance and tolerance to water logging and relatively low water and fertilizer requirements.

In order to meet out the food, fodder and fuel requirement of growing population of human and livestock, the greatest challenge is to establish a balance between environment and resource base. The crop growth and development is mainly controlled by climatic, genetic and management factors. Keeping genetic factor constant, management of soil conditions and its nutrient status according to favourable climate is as important as any other production practice (Tandon, 2007). So, tillage and spentwash are such an efforts made in the present study for better growth and yield of sweet sorghum.

Materials and Methods

A field experiment was conducted at the Main Agricultural Research Station, University of Agricultural Sciences, Dharwad. The experiment was laid out in split plot design with three replications on medium deep black soil with pH of 7.70 and EC of 0.21ds/m and values for N,P_2O_5 and K_2O was 205.60,27.30 and 443.70 kg/ha. Experiment involves two main plots *viz*., M_1: Deep tillage (45 cm) and M_2: Shallow tillage (15 cm) and six sub plots *viz*., S_1: 75 kg N/ha through spentwash; S_2 : 100 kg N/ha through spentwash; S_3 : 125 kg N/ha through spentwash; S_4:150 kg N/ha through spentwash; S_5 : Recommended dose of fertilizer (RDF) (100:75:37.5 kg N, P_2O_5, K_2O kg/ha) and S_6: Control. Spentwash was analyzed for its physical and chemical properties, which indicated the presence of the essential plant nutrients including both major and micro-nutrients (Table 1). In the present investigation, crop nutrition was on the basis of nitrogen content of spentwash. Sweet sorghum received varied levels of N (i.e., 75,100,125 and 150 kg N/ha) and constant level of P_2O_5 and K_2O (*i.e.*, 75 and 37.5 kg/ha) were supplied through spentwash and fertilizers. For all sub-plot treatments except S_5

and S_6 full dose of N and K_2O and partial dose of P_2O_5 were supplied through different quantities of spentwash in splits at different periods of crop growth (Table 2). Phosphorus supply through spentwash was lower than the recommended which was supplemented through single superphosphate (SSP).

Results and Discussion

Deep tillage recorded (Table 5) significantly higher grain (18.0 q/ha) and green biomass yield (35.5 t/ha) of sweet sorghum compared to shallow tillage (13.7 q/ha and 28.6 t/ha respectively,). The increase in grain yield and green biomass yield in deep tillage was to an extent of 32.84 and 24.53 per cent respectively, as compared to shallow tillage.

Table 1. Physical and chemical properties of secondary treated spentwash

Characteristics	Values
Colour	Dark brown
Odour	Bad
pH	8.59
EC (dS/m)	19.90
BOD (mg/L)	5400.00
COD (mg/L)	14000.00
Total N (mg/L)	1000.00
Total P_2O_5 (mg/L)	200.00
Total K_2O (mg/L)	11500.00
Total Mg (mg/L)	790.00
Total Ca (mg/L)	2160.00
Total Fe (mg/L)	75.20
Total Zn (mg/L)	10.50
Total Cu (mg/L)	4.15
Total Mn (mg/L)	9.60
Total Na (mg/L)	130.00
Total SO_4^{2-} (mg/L)	1500.00

These results are in conformity with the findings of Singh *et al.* (2007) and Dev Narayan and Lal (2009). Higher yields may be due to yield and growth attributes (Table 5). The improvement in yield and growth attributes in sweet sorghum may be due to higher soil moisture content at all the stages of crop growth and nutrient availability (Table 3). Similar trend of results were followed in case of growth and yield attributes. The combined effect contributed for higher yield. Besides, the higher rate of photosynthesis coupled with efficient translocation of photosynthates into different plant parts *viz.*, leaf, stem in initial stages (vegetative) and translocation to ear during later stage (reproductive) resulted in higher total dry matter production per plant and its accumulation in ear. Higher total dry matter production per plant (Table 4) in deep tillage was attributed to production of taller and thicker plants with more number of leaves and increased size of ear as evidenced by increased length of ear (Table 5). Similarly, Sarma (2007) recorded increased dry matter production per plant with increase in depth of tillage.

In the present investigation, significantly higher grain yield (18.0 q/ha) and green biomass yield (34.7 t/ha) were recorded with application of 150 kg N per ha through spentwash (Table 5), but was on par with 100 kg N per ha through spentwash, RDF and 125 kg N per ha through spentwash. Significantly lower grain yield and green biomass yield was recorded with 75 kg N per ha through spentwash (14.4 q/ha and 29.8 t/ha respectively,) and control (10.9 q/ha and 25.7 t/ha respectively,). Similarly, Anandakrishnan *et al.* (2008), Suganya and Rajannan (2009) and Bhukia *et al.* (2009) recorded increased grain yield and green biomass yield due to higher doses or concentration of spentwash applied. Spentwash might have undergone mineralization rapidly resulting in supply of all essential plant nutrients apart from supplying nitrogen. Whereas, RDF supplied only recommended N, P and K. Increased supply of nitrogen and other essential nutrients through spentwash and RDF might have increased the rate of photosynthesis coupled with efficient translocation of photosynthates to different plant parts *viz.*, leaf,

Table 2. Nitrogen supplied through spentwash in sub plots

Sub plot treatments	Spentwash applied (litre/ha)	Number of splits and time of application
S_1 : 75 kg N per ha through spentwash	75,000	One time application (15 DBS)
S_2 : 100 kg N per ha through spentwash	1,00,000	Two equal splits (15 DBS and 30 DAS)
S_3 : 125 kg N per ha through spentwash	1,25,000	Three equal splits (15 DBS, 30 DAS and 60 DAS)
S_4 : 150 kg N per ha through spentwash	1,50,000	Three equal splits (15 DBS, 30 DAS and 60 DAS)

DBS: days before sowing DAS: days after sowing

Table 3. Soil moisture and available nutrients as influenced by tillage and spentwash

Treatment	Soil moisture content (%)									Available nutrients at harvest								
	At 60 DAS			At 50 per cent flowering			At harvesting			Available N (kg/ha)			Available P_2O_5 (kg/ha)			Available K_2O (kg/ha)		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1	18.50	16.60	17.55	17.88	16.25	17.07	13.19	11.76	12.48	54.27	44.87	49.57	1095	1091	1093	1095	1091	1093
S_2	17.89	16.16	17.03	17.34	15.78	16.56	12.79	11.33	12.06	52.10	42.80	47.45	1138	1117	1127.5	1138	1117	1127.5
S_3	17.84	16.11	16.98	17.28	15.76	16.52	12.75	11.28	12.02	50.70	41.53	46.12	1158	1126	1142	1158	1126	1142
S_4	17.80	16.09	16.95	17.24	15.72	16.48	12.71	11.20	11.96	48.59	42.19	45.39	1176	1134	1155	1176	1134	1155
S_5	17.88	17.12	17.00	17.30	15.77	16.54	12.76	11.29	12.03	51.96	42.83	47.40	507	503	505	507	503	505
S_6	19.07	17.10	18.09	18.40	16.70	17.55	13.74	11.16	12.95	24.40	20.60	22.50	436	428	432	436	428	432
Mean	18.16	16.36	17.26	17.57	16.00	16.79	12.99	11.50	12.25	47.00	39.14	43.07	918.33	899.83	909.08	918.33	899.83	909.08

For comparing means of	SEm±	CD (0.05)	SEm±	CD (0.05)	SEm±	CD (0.05)	SEm±	CD (0.05)	SEm±	CD (0.05)	SEm±	CD (0.05)
M	0.02	0.06	0.04	0.13	0.04	0.12	0.47	1.50	2.83	9.05	2.83	9.05
S	0.03	0.10	0.03	0.10	0.04	0.11	0.70	2.08	4.87	14.35	4.87	14.35
SXM	0.05	NS	0.05	NS	0.05	NS	1.00	NS	6.88	NS	6.88	NS
MXS	0.05	NS	0.06	NS	0.06	NS	1.02	NS	6.89	NS	6.89	NS

M_1: Deep tillage (45 cm); M2: Shallow tillage (15 cm); S_1:75 kg N/ha through spentwash; S_2 : 100 kg N/ha through spentwash; S_3 : 125 kg N/ha through spentwash; S_4:150 kg N/ha through spentwash; S_5 : RDF (100:75:37.5 kg N, P_2O_5, K_2O kg/ha) ; S_6: Control NS: Non-significant; DAS: Days after sowing

Table 4. Plant height, shoot thickness, number of leaves and total dry matter production of sweet sorghum at harvest as influenced by tillage and spentwash

Treatment	Plant height (cm)			Shoot thickness (cm)			No. of green leaves (per plant)			Total dry matter production (g/plant)		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1	276.25	240.42	258.33	1.90	1.50	1.70	6.33	5.53	5.93	146.28	113.56	129.92
S_2	304.80	268.66	286.73	2.19	1.77	1.98	6.60	5.73	6.17	166.08	134.77	150.43
S_3	318.80	277.47	298.13	2.28	1.86	2.07	6.67	5.93	6.30	170.11	140.42	155.27
S_4	322.72	281.00	301.86	2.32	1.90	2.11	6.73	6.07	6.40	173.74	142.92	158.33
S_5	310.25	272.85	291.55	2.23	1.80	2.02	6.60	5.80	6.20	167.86	136.12	151.99
S_6	250.31	214.70	232.51	1.50	1.15	1.33	6.00	5.27	5.63	126.33	95.80	111.07
Mean	297.19	259.18	278.19	2.07	1.66	1.87	6.49	5.72	6.11	158.40	127.27	142.83
For comparing means of	SEm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)	
M	5.75	17.30		0.03	0.09		0.08	0.25		2.40	7.68	
S	5.96	17.62		0.05	0.16		0.06	0.18		2.76	8.14	
SXM	8.43	NS		0.08	NS		0.09	NS		3.90	NS	
MXS	9.61	NS		0.08	NS		0.11	NS		4.29	NS	

M_1: Deep tillage (45 cm); M2: Shallow tillage (15 cm); S_1:75 kg N/ha through spentwash; S_2 : 100 kg N/ha through spentwash; S_3 : 125 kg N/ha through spentwash; S_4:150 kg N/ha through spentwash; S_5 : RDF (100:75:37.5 kg N, P_2O_5, K_2O kg/ha) ; S_6: Control ; NS: Non-significant; DAS: Days after sowing

stem in initial stages (vegetative) and translocation to ear during later stage (reproductive) might have resulted in higher total dry matter accumulation per plant and increased size of ear as evidenced by increased ear length (Table 5). Similarly, Deora *et al.* (2008) and Suganya and Rajannan (2009) recorded increased dry matter production per plant with increased doses or concentration of spentwash applied. Higher total dry matter production per plant (Table 4) with graded levels of spentwash application was attributed to production of taller and thicker plants with more number of leaves and

Table 5. Yield and yield components of sweet sorghum as influenced by tillage and spentwash

Treatment	Ear length (cm)			1000-grain weight (g)			Green biomass yield (t/ha)			Grain yield (q/ha)		
	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean	M_1	M_2	Mean
S_1	20.19	17.30	18.75	24.40	21.32	22.86	32.8	26.8	29.8	16.3	12.4	14.4
S_2	22.35	18.82	20.59	26.70	23.87	25.29	37.6	30.5	34.1	19.4	14.9	17.2
S_3	22.41	18.90	20.66	26.81	24.20	25.51	37.9	30.5	34.2	19.9	15.3	17.6
S_4	22.53	19.05	20.79	27.00	24.33	25.67	38.4	31.0	34.7	20.3	15.6	18.0
S_5	22.38	18.86	20.62	26.75	23.94	25.35	37.1	30.1	33.6	19.6	15.0	17.3
S_6	18.21	15.55	16.88	21.86	18.65	20.26	28.9	22.5	25.7	12.6	9.2	10.9
Mean	21.35	18.08	19.71	25.59	22.72	24.15	35.5	28.6	32.1	18.0	13.7	15.9
For comparing means of	SEm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)		SEm±	CD (0.05)	
M	0.24	0.71		0.47	1.39		0.52	1.61		0.21	0.62	
S	0.62	1.83		0.56	1.64		0.71	2.09		0.54	1.59	
SXM	0.88	NS		0.79	NS		1.00	NS		0.76	NS	
MXS	0.84	NS		0.86	NS		1.05	NS		0.73	NS	

M_1: Deep tillage (45 cm); M2: Shallow tillage (15 cm); S_1:75 kg N/ha through spentwash; S_2 : 100 kg N/ha through spentwash; S_3 : 125 kg N/ha through spentwash; S_4:150 kg N/ha through spentwash; S_5 : RDF (100:75:37.5 kg N, P_2O_5, K_2O kg/ha) ; S_6: Control ; NS: Non-significant; DAS: Days after sowing

increased size of ear as evidenced by increased length of ear (Table 5).Similarly, Bhukia *et al.* (2009) and Suganya and Rajannan (2009) recorded increased growth attributes due to increased doses or concentration of spentwash application. Further, nitrogen applied through spentwash above 100 kg N per ha i.e., 125 kg N (S_3) and 150 kg N (S_4) per ha was not able to bring any significant difference in growth and yield parameters. The interaction effects between tillage and nitrogen levels through spentwash and RDF were non-significant for growth and yield of sweet sorghum.

Conclusion

The results of the present study indicated that application of secondary aerated spentwash **(**100 kg N/ha) with deep tillage influenced growth and yield of sweet sorghum which may be adopted safely for higher sweet sorghum yield.

References

Anandakrishnan, B., Dawood, M.S., Soundarrajan, M., Jebaraj, S. and Murugesan, M. 2008. Conjunctive use of post methanated distillery effluent and inorganic fertilizers for sustainable sugarcane cultivation. *Crop Res.,* **9**: 311-316.

Anonymous, 2006, Scenario and SWOT analysis, Directorate of Sorghum Research Prospective Plan – Vision 2025, **1**: 33-60.

Bhukia, T. D., Patil, S.G. and Angadi, S.S. 2009. Crop nutrition through distillery spentwash in maize (*Zea mays* L.). *J. Environ. Sci. Engg.,* **51**: 87-92.

Deora, A., Kukreja, K. and Suneja, S. 2008. Effect of digested distillery effluent on seed germination and plant growth of wheat. *Crop Res.,* **9**: 110-115.

Dev Narayan and Lal, B., 2009, Rainwater conservation and yield of sorghum (*Sorghum bicolor*) as influenced by tillage and cover management practices in red soils. *Indian J. Agron.,* **54**: 438-443.

Sarma, C.K. 2007. Growth and development studies in maize (*Zea mays* L.) as influenced by tillage, seed rate and weed control method. *Crop Res.,* **34**: 53-56.

Singh, R., Sharma, A.R. and Behera, U.K. 2007. Tillage crop establishment practices for improving productivity of maize (*Zea mays*) under different weed control methods. *Indian J. Agric. Sci.,* **77**: 731-737.

Suganya, K. and Rajannan, G. 2009. Effect of one time post-sown and pre-sown applications of distillery spentwash on the growth and yield of maize crop. *Botany Res. Int.*, **2**: 288-294.

Tandon, H. L. S. 2007. Soil nutrient balance sheets in India: importance, status, issues and concerns. *Better Crops*, **1**: 15-19.

Received: April 16, 2012; Accepted: September 4, 2012