Karnataka J. Agric. Sci., 5 (2) : (114-120) 1992

The Quality Characters of Sweet Sorghum (*Sorghum bicolor* (L.) Moench) Genotypes as influenced by Different Nutrient levels*

M. B. AGNAL, M. D. KACHAPUR and M. B. CHETTI
University of Agricultural Sciences, Dharwad-580 005

(Received November, 1990)

Abstract : A field experiment was conducted at the Agricultural College Farm, Dharwad during Kharif 19889-89 with a view to understand the effect on quality characters in four sweet sorghum genotypes. Genotypes Rio was found to be superior followed by SSV-119 in grain yield, sugar yield, extractable juice per cent and Brix value. Sugar content in stem was maximum at physiological maturity (120 DAS) in all the genotypes and the quality of stalk juice was superior at this stage. Grain yield and extractable juice per cent of Rio increased with an increase in nutrient level from 40:20:10 kg to 100:60:30 kg NPK/ha.

Introduction

Sweet sorghum is grown on a wide geographical range and is considered as sugarcane of the temperate zone. In the recent past, sweet sorghum has become a leading contender in biomass production for energy systems because of its high yield, high per cent of fermentable sugars and wide adaptability. The advantage of cultivating sweet sorghum is to get both grain yield and sugar and the quality of sugar or jaggery prepared from sweet sorghum is comparable to that of sugarcane (Kishan Singh and Bakhtawarsingh, 1986). Although it requires limited inputs and makes efficient utilization of solar radiation, it responds well to the applied nutrients. The quality of juice is controlled by genotypic growth stage and the environment in which it grows. Due to problems involved in the cultivation of sugarcane such as higher water requirement, longer duration, and the limited capacity of sugar industries to crush the canes in the season, farmers' attention is diverted for a substitute crop which could be easily managed. The present study is aimed at assessing the influence of nutrients on some of the important quality characters in sweet sorghum genotypes.

Material and Methods

A field experiment was conducted during kharif 1988-89 at the Agricultural College Farm, Dharwad to find out the effect of different nutrient levels on the quality and grain yield in sweet sorghum genotypes, SSV-84, SSV-96, SSV-119 and Rio. They were tested at F_0 (No fertiliser application), F_1 (40:20:10 kg NPK/ha), F_2 (80:40:20 kg NPK/ha) and F_3 (100:60:30 kg NPK/ha) levels. The crop was raised under normal conditions as per the recommended package of practices. The quality characters were assessed as per the procedure given below:

1. Extractable juice per cent =

$$\frac{\text{Weight of juice}}{\text{Weight of stalk}} \times 100$$

2. Brix - Brix hand refractometer was used to determine brix value of the extracted juice.

* Part of M.Sc. (Agri.) thesis submitted by the senior author to the University of Agricultural Sciences, Dharwad.

3. Pol sucrose = The extracted juice was filtered and observed through polariscope to find out pol sucrose.

The above quality characters were analysed in all the treatments at 80, 100 and 120 days after sowing (DAS). The crop was harvested at 120 DAS and the data on grain yield was recorded.

Results and Discussion

The study of various quality characters such as extractable juice per cent, brix, pol sucrose per cent and total soluble solids was made at 80, 100 and 120 DAS (Tables 1 – 3). The data revealed that extractable juice per cent was maximum at 80 DAS (34.92) and decreased thereafter until harvest (31.68). Further, it was observed that the extractable juice per cent increased with an increase in nutrient levels in all the genotypes. The decrease in the values at later stages could be attributed to the dessication of canes resulting in an increase in the total soluble solids (Table 2). The differences in the extractable juice per cent among genotypes was also significant which was mainly attributed to the differential response of genotypes to applied nutrition and could be due to differences in soil water absorption, transpirational loss of water from plant surface and differential responses in the plant water content. Such differences in juice extractability in sweet sorghum genotypes were also reported by Bapat *et al.* (1987).

Differences in the extractable juice per cent due to fertility levels could also be attributed to the differences in the accumulation of dry matter in the stem and green stalk yield (data unpublished). It was also observed in the field that even at the time of harvest, the stalks were green in the genotype Rio, particularly at higher doses of nutrients, which is mainly responsible for the increase in extractable juice per cent in this genotype. Higher extractability of juice at F_3 (100:60:30 kg NPK/ha) might have resulted due to combined effect of higher levels of N, P and K. Singh and Pancholy (1967) and Sadaphal and Singh (1969) reported that nitrogen has greater influence that P and K, and N in combination with P and K has greater impact on growth and yield of sorghum rather than N alone.

The total soluble solids of the extracted juice indicated an increase in brix readings from 80 (14.57) to 120 DAS (16.40). The maximum brix values were recorded in the genotype Rio at all the fertility levels and was maximum at F_3 in all the genotypes. Similar observation of increase in the brix value with an increase in the age of the crop was observed by Rao *et al.* (1971), Ferraris (1981) and Bapat *et al.*, (1987). On the contrary, brix values decreased with an increase in the N level beyond 100 kg N per ha (Meli, 1989). The decrease at very high levels of nitrogen could be attributed to profuse growth and succulent nature of the plants. Sweetness of the juice depends on the brix, in particular the sucrose content of the juice.

The increase in the nutrient levels did not have any significant effect on the pol sucrose per cent. However, the differences were significant due to genotypes. In general, Rio recorded a significantly higher pol sucrose per cent (Table 3) at all the stages studied, indicating the superiority of Rio over other genotypes in terms of the sucrose content and the purity of juice. Although, no significant differences were observed due to nutrient levels, an increase in the nitrogen, phosphorus and potassium dose recorded numerically higher values. The increase in the sucrose per cent at later stages of the growth could be due to the more conversation of deposited glucose into sucrose which is further enhanced by the decrease in the water content, a common phenomenon at the later stages. The reduced level in the pol sucrose per cent in the genotypes SSV-84 and SSV-119 at all the growth stages could be ascribed to the utilization of sugar for metabolic activities. Similar results were obtained by Webster *et al.* (1954) and Broadhead (1969).

The data on grain yield (Table 4) indicated significant differences both due to genotypes and nutrient levels. Of the genotypes,

Table 1. The influence of nutrient levels on extractable juice per cent at different growth stage in sweet sorghum genotypes

Genotypes	Days after sowing														
	80					100					120 (harvest)				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
SSV-84	32.82	33.17	36.20	36.70	34.72	30.80	32.10	34.20	34.65	32.93	28.20	29.25	28.70	29.20	29.00
SSV-96	25.50	26.18	27.40	29.70	27.22	21.60	23.60	25.70	27.10	34.52	21.50	22.75	24.40	27.20	23.91
SSV-119	31.50	32.40	36.70	37.60	34.55	31.45	32.10	35.10	35.90	33.63	30.60	31.80	34.90	35.75	33.18
Rio	41.80	42.60	43.10	45.80	43.20	40.30	40.70	42.80	43.20	41.62	38.20	39.60	41.20	43.20	40.55
Mean	32.80	33.58	35.85	37.45	34.92	31.00	32.12	34.32	35.23	33.17	29.57	30.77	32.55	33.83	31.68

For comparing means of :

	Varieties (V)			Nutrient Levels (F)			Interaction (V x F)		
	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS
S. Em ±	0.33	0.39	0.20	0.33	0.39	0.20	0.66	0.15	0.40
C D at 5%	0.95	1.14	0.59	0.95	1.14	0.58	NS	NS	1.16

F_0 – Control F_1 – 40 : 20 : 10 NPK kg/ha F_2 – 80 : 40 : 20 NPK kg/ha F_3 – 100 : 60 : 30 NPK kg/ha

NS – Not significant

Table 2 . The influence of nutrient levels on total soluble solids (brix, degrees) at different growth stages in sweet sorghum genotypes

Genotypes	Days after sowing														
	80					100					120 (harvest)				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
SSV-84	14.34	14.43	14.55	14.65	14.49	15.27	15.37	15.41	15.45	15.37	16.17	16.21	16.26	16.32	16.24
SSV-96	14.44	14.54	14.64	14.65	14.56	15.62	15.65	15.75	15.82	15.71	16.50	16.53	16.63	16.64	16.57
SSV-119	14.32	14.36	14.44	14.54	14.41	14.34	14.41	14.51	14.56	14.45	15.32	15.37	15.42	15.46	15.39
Rio	14.64	14.71	14.90	15.16	14.85	16.17	16.27	16.33	16.34	16.27	17.33	17.41	17.47	17.52	17.43
Mean	14.43	14.51	14.63	14.75	14.57	15.35	15.42	15.50	15.54	15.45	16.33	16.38	16.44	16.48	16.40

For comparing means of :

	Varieties (V)			Nutrient Levels (F)			Interaction (V x F)		
	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS
S. Em ±	0.01	0.009	0.28	0.01	0.009	0.28	0.02	0.018	0.56
C D at 5%	0.03	0.02	0.81	0.03	0.02	NS	NS	NS	NS

F_0 – Control F_1 – 40 : 20 : 10 NPK kg/ha F_2 – 80 : 40 : 20 NPK kg/ha F_3 – 100 : 60 : 30 NPK kg/ha

NS – Not significant

Table 3. The influence of nutrient levels on pol sources (%) at different growth stage in sweet sorghum genotypes

Genotypes	Days after sowing														
	80					100					120 (harvest)				
	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean	F_0	F_1	F_2	F_3	Mean
SSV-84	6.94	7.54	7.65	7.96	7.47	7.42	8.02	8.13	8.18	7.83	7.93	8.53	8.65	8.85	8.48
SSV-96	7.14	7.56	7.62	7.68	7.50	7.76	8.04	8.35	8.31	8.11	8.24	8.64	8.85	8.92	8.66
SSV-119	6.77	6.96	7.07	7.15	6.98	7.25	7.44	7.78	7.63	7.52	7.76	8.09	8.12	7.96	7.98
Rio	8.11	8.06	8.16	8.26	8.14	9.09	9.49	9.64	9.74	9.49	10.43	11.05	11.15	11.25	10.97
Mean	7.24	7.53	7.62	7.71	7.52	7.88	8.24	8.47	8.46	8.23	8.59	9.07	9.19	9.24	11.14

For comparing means of :

	Varieties (V)			Nutrient Levels (F)			Interaction (V x F)		
	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS	80 DAS	100 DAS	120 DAS
S. Em ±	0.17	0.20	0.23	0.17	0.20	0.23	0.35	0.40	0.46
C D at 5%	0.51	0.58	0.67	NS	NS	NS	NS	NS	NS

F_0 – Control F_1 – 40 : 20 : 10 NPK kg/ha F_2 – 80 : 40 : 20 NPK kg/ha F_3 – 100 : 60 : 30 NPK kg/ha

NS – Not significant

Table 4. Influence of nutrient levels on grain yield (q/ha) in sweet sorghum genotypes

Genotypes	Grain yield (q/ha)				
	F_0	F_1	F_2	F_3	Mean
SSV–84	9.15	12.17	15.06	17.02	13.35
SSV–96	7.80	9.35	12.34	13.19	10.67
SSV–119	9.21	12.91	15.99	18.17	14.07
Rio	14.02	18.25	21.84	27.04	20.28
Mean	10.04	13.17	16.30	18.85	14.59

For comparing means of:

Varieties (V):

S.Em ± 0.35

C D at 5% 1.03

Nutrient levels (F):

S.Em ± 0.35

C D at 5% 1.03

Interaction (V x F):

S.Em ± 0.71

C D at 5% 2.06

F_0 – Control

F_1 – 40 : 20 : 10, NPK kg ha^{-1}

F_2 – 80 : 40 : 20 NPK kg ha^{-1}

F_3 – 100 : 60 : 30 NPK kg ha^{-1}

tested, Rio recorded one and half times higher yield in comparison to other genotypes in all the nutrient levels indicating the potentiality of this genotype. The increase in the nutrient level from 40:20:10 kg NPK per ha to 100:60:30 kg NPK per ha increased grain yield substantially. The increased grain yield in the genotype Rio was mainly attributed to an increase in the 1000-grain weight, dry matter accumulation particularly in the earhead (data not indicated). The increased accumulation of dry matter in the earhead indicates the better partitioning of the available photosynthates and efficiency of translocation towards economically important parts. Further, it is quite evident that the increased levels of nitrogen, phosphorus and potassium have marked effect on the increase in the translocation efficiency.

In conclusion, the genotype Rio was found to be superior over other genotypes tested both in terms of quality characters and grain yield at all the nutrient levels, particularly at F_3. Other genotypes were also found to contain high stem sugars in addition to grain yield, thus indicating the potentiality of growing sweet sorghum genotypes for dual purpose in sorghum growing areas.

References

BAPAT, D. R., JADHAV, H. D. AND SALUNKE, C. B., 1987, Screening and development of sweet sorghum varieties for syrup and jaggery production. Paper presented at *Annual Sorghum Workshop held at Parbhani, May, 25-27,* 1987.

BROADHEAD, D. M., 1969, Sugar production from sweet sorghum as affected by planting date, after ripe harvesting and storage. *Agronomy Journal,* **61**: 811-812.

FERRARIS, R., 1981, Early assessment of sweet sorghum as an agro-industrial crop–2. maturity factors. *Australian Journal of Experimental Agriculture and Animal Husbandry,* **21** : 83-90.

KISHAN SINGH AND BAKHTAWAR SINGH, 1986, Sweet sorghum an ancillary sugar crop. *Indian Farming,* **7** : 11-16.

MELI, S. S., 1989, Studies on fertilizer and plant population requirements of sweet sorghum for increased growth and recovery. *Ph.D. Thesis, Univ.* Agril. Sci., Dharwad.

RAO, D. V. N., REDDY, G. S. R., DAMODARAN, G. AND PARTHASARTHY, A. V., 1971, Studies on the presence of total solids in different stages of sorghum crop. *Madras Agricultural Journal,* **58** : 662-664.

SADAPHAL, M. N., AND SINGH, R. S. P., 1969, Response of hybrid sorghum (CSH-1) to rates and methods of phosphorus application. *Indian Journal of Agronomy,* **14** : 280-282.

SINGH, R. H., AND PANCHOLY, J. K., 1967, Uptake of P by *Sorghum vulgare* (Pers.) as affected by nitrogen and phosphorus application. *Madras Agricultural Journal,* **54** : 512-517.

WEBSTER, J. E., BENEFIEL, D. AND DAVLES, F., 1954, Yield and composition of sorghum juice in relation to time of harvest in Oklahoma. *Agronomy Journal,* **46** : 157-160.