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RESEARCH PAPER

Biophysical yield and juice quality in sweet sorghum genotypes

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Abstract : In sweet sorghum genotypes, rates of photosynthesis and transpiration , fresh cane weight differed significantly. The high yielding genotypes possessed higher rate of photosynthesis and transpiration. Juice parameters such as extraction percentage, brix, non-reducing sugars, total sugars and enzyme activity also differed among the genotypes. Fresh cane weight and brix were more in high yielding genotypes. There was a positive correlation between fresh cane weight and total sugars, non-reducing sugars and invertase enzyme activity. Photosynthesis rate had positive correlation with transpiration.

Key Words : Sweet sorghum, Biophysical Parameters, Brix, Yield

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INTRODUCTION

Sweet sorghum (*Sorghum bicolar* (L.) Moench.)is similar to grain sorghum with stalks rich in sugar and having high water use efficiency. It is a multipurpose crop. Livestock relish the sugar rich stalks and its digestibility is high compared to other stovers. The juice of sweet sorghum can be used for alcohol, jaggery and syrup production .(Anonymous, 2008). The quality of sugar or jaggery is comparable to that of sugarcane. The left over stalks after juice extraction can be used for generating power, as animal feed and for composting. In this study, sweet sorghum genotypes were valuated for various biophysical, quality characters and their association with yield.

MATERIALS AND METHODS

A field experiment was conducted with twelve sweet sorghum genotypes (SSV-84, SSV-12611, SSV-53, SSV-6928, SSV - 2525, SSV - 7073, SSV - 108, SSV -74, SSV-96, SSV-119, Rio and HES-4) at University of Agricultural Sciences, Dharwad. The experiment was laid out in Randomized Block Design with three replications. The rate of photosynthesis, photsynthetically active radiation, transpiration rate, stomatal resistance and leaf temperature were measured by using portable photosynthesis system(LICOR6400).The juice from the mature cane was extracted from mini crusher and was analyzed for quality parameters *viz.*, brix values, non-reducing sugars, total sugars and invertase enzyme activity. The brix values were recorded with hand refractometer. The non-reducing sugars and total sugars were estimated by following the method of Nelson (1944). The inveratse enzyme activity was analyzed as per the procedure of Gupta *et al.* (1985).

RESULTS AND DISCUSSION

The rate of photosynthesis and transpiration differed significantly among the genotypes (Table 1). The rate of photosynthesis was highest in SSV-6928 followed by SSV-74, SSV-108 and SSV-7073 and it ranged from 12.3 μ moles CO_2 m^{-2} s^{-1} (HES-4) to 21.2 μ moles CO_2 m^{-2} s^{-1} (SSV-6928). The high yielding genotypes possessed higher rate of photosynthesis

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Table 1: Genotypic differences in photosynthesis, photosynthetically active radiation , transpiration, stomatal resistance and leaf temperature at physiological maturity of sweet sorghum

Sr. No.	Genotype	Photosynthesis μ molesCO_2 m^{-2} s^{-1}	PAR μ Einstein m^{-2} s^{-1}	Transpiration μ moles H_2O m^{-2} s^{-1}	Stomatal resistance (cm/s)	Leaf temperature (^oC)
1.	SSV-84	16.86	1754.66	3.63	7.00	36.26
2.	SSV-12611	17.53	1935.00	4.10	7.03	37.50
3.	SSV-53	18.16	1988.33	4.23	7.13	38.36
4.	SSV-6928	21.16	1935.00	5.00	6.70	38.43
5.	SSV-2525	13.20	1908.00	3.50	10.40	39.26
6.	SSV-7073	19.86	1720.66	4.70	7.06	38.90
7.	SSV-108	20.23	1555.33	5.16	6.66	38.96
8.	SSV-74	20.96	1980.66	5.23	6.53	39.73
9.	SSV-96	18.86	1947.66	4.53	8.3	40.20
10.	SSV-119	14.36	1972.66	3.93	10.43	40.70
11.	Rio	17.23	1952.33	4.86	6.56	38.90
12.	HES-4	12.26	1961.33	3.8	11.83	41.66
	Mean	17.56	1855.11	4.39	7.97	39.07
	S.E. ±	0.72	33.07	0.13	0.43	0.08
	C.D.at 5%	2.13	96.99	0.40	1.26	0.24

Table 2 : Genotypic differences in fresh cane weight, juice extraction, brix, non-reducing sugar, total sugar, invertage activity and grain yield at physiological maturity of sweet sorghum

Sr. No.	Genotype	Fresh cane weight g/m^2	Juice extraction (%)	Brix (%)	Non-reducing sugars (g/100 g)	Total sugars (g/100g fresh wt)	Invertase activity μ mole glucose /mg protein	Grain yield (g/m^2)
1.	SSV-84	4049	23.2	11.0	0.69	0.83	2.09	471.6
2.	SSV-12611	3756	40.1	11.5	1.29	1.61	1.09	535.7
3.	SSV-53	3605	36.6	10.8	1.20	1.44	1.44	533.3
4.	SSV-6928	3358	38.5	13.0	0.78	0.94	1.36	491.3
5.	SSV-2525	3753	28.8	11.0	1.10	1.45	2.54	501.9
6.	SSV-7073	4000	26.2	16.3	1.26	1.96	1.51	577.7
7.	SSV-108	3556	29.0	12.5	0.25	0.42	1.78	488.8
8.	SSV-74	4247	35.1	13.2	0.13	0.26	1.44	595.0
9.	SSV-96	3654	30.3	13.0	0.66	0.85	1.32	496.3
10.	SSV-119	3309	31.1	11.2	0.38	0.52	1.09	432.1
11.	Rio	4593	32.6	15.8	1.64	1.3	4.86	232.4
12.	HES-4	4593	30.5	11.0	0.14	0.27	0.56	481.4
	Mean	3872	32.7	12.5	0.79	1.03	1.76	494.1
	S.E. ±	206	2.4	0.37	0.02	0.12	0.04	68.9
	C.D. at 5%	591	6.9	1.08	0.07	0.05	0.13	203.8

Table 3: Correlation between yield and juice parameters in sweet sorghum genotypes

Sr. No.	Parameters	' r ' values
1.	Photosynthesis vs transpiration	0.831 **
2.	Fresh cane weight vs Total sugars	0.472 *
3.	Fresh cane weight vs Non-reducing sugars	0.500 **
4.	Fresh cane weight vs Invertase	0.653 **
5.	Brix values vs Juice extraction	0.763 **
6..	Non-reducing sugars vs Total sugars	0.967 **

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

parameters such as photosynthetically active, radiation (μ Einstein m^{-2} s^{-1}), stomatal resistance (cm/s) and leaf temperature also differed significantly.

The quality parameters differed significantly among the genotypes (Table 2). At physiological maturity, the fresh cane weight was significantly higher in Rio, HES-4 and SSV- 74. Highest brix values were recorded in SSV-7073, Rio, and SSV 74. Similar observations were made by Jadhva *et al.,* (1991). Among the genotypes, higher levels of non-reducing sugars were recorded by Rio (1.64 g/100 g) and SSV12611 (1.29 g/100 g). Total sugars were highest in SSV-7073 (1.96 g/100 g) followed by in SSV12611 (1.61 g/100 g) and least was recorded by HES-4 (0.27 g/100 g). Similar trend was reported by Jadhv *et al.* (1994) who opined that higer the total sugars in the juice lower will be the amylase activity.

Invertase is an hydrolytic enzyme which acts on sucrose and results in the production of simple sugars and indicated the significant difference among the sweet sorghum genotypes. Similar results were reported by Kapur and Kanwar (1982) in sugar cane. The grain yield differed significantly among the genotypes. The genotypes SSV 74 and SSV7073 recorded higher grain yields of 595.0 grams per m^2 and 577.7 grams per m^2, respectively. These genotypes also had higher fresh cane weight, brix values and sugars.

The fresh cane weight, and total sugars, non-reducing sugars and invertase enzyme activity were positively correlated (Table 3). The photosynthetic rate was positively correlated with rate of transpiration (r = 0.831). The juice extraction percentage was positively correlated with brix values. The non-reducing sugars showed the positive association with total sugars (r = 0.967). It may be inferred that genotypes SSV-74 and SSV7073 are well suited for summer under irrigation conditions.

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