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Original Research Article

Character Association and Component Analysis for Juice Yield in Sweet Sorghum [*Sorghum bicolor* (L.) Moench]

P. B. Wadikar*, S. V. Kuptekar and A. S. Deshmukh

Department of Agricultural Botany, College of Agriculture, Latur,
Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani 431 402 (M.S.), India
**Corresponding author*

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Correlation, Path analysis, Sweet Sorghum

A B S T R A C T

Correlation and path analysis studies were worked out for fifteen characters in forty five genotypes of sweet sorghum [*Sorghum bicolor* (L.) Moench]. Genotypic path analysis is outlined by Dewey and Lu (1959) was carried out to find out the direct and indirect effect of various components on juice yield. Among all the characters studied the juice extraction percentage, fresh cane weight and total biomass had significant and positive direct effect on juice yield and significant positive correlation with juice yield. pH of juice, grain yield and non-reducing sugar had non-significant positive direct effect and negative association with juice yield. Increase in these character leads to decrease in juice yield. Hence selection for low pH and non-reducing sugar is preferred. Therefore, desirable plant type in sweet sorghum should be juice extraction per cent, fresh cane weight, total biomass.

Introduction

Sorghum [*Sorghum bicolor* (L) Moench.] is the fifth most important, cereal crop in the world after Wheat, Rice, Maize and Barley. It was introduced for the first time in USA in 1850. It is a major cereal crop of semi-arid tropics. Particular varieties of sorghum with an ability to accumulate 10-25 per cent sugar in its stalk juice are referred to as sweet sorghum. It is also called as sorgos. In this context, sweet sorghum, which is similar to grain sorghum but with sugar rich stalks and a juice recovery of 65 per cent is an alternative when compared to grain sorghum. The sweet sorghum is currently being developed for the simultaneous production of grain and sweet stalk. Recently, high-sucrose sweet sorghum cultivars have been developed with potential as a sugar crop. Because of the rapid increase in crude oil prices, sweet sorghum has been investigated as a potential source of fermentable sugars for ethanol fuel production.

Materials and Methods

The present investigation compromising 43 genotypes of sweet sorghum with 2 checks are evaluated for genetic variability among them. This experiment conducted with randomized block design and two replications. The observations recorded are days to 50% flowering, plant height at 50% flowering (cm), days to physiological maturity, plant height at physiological maturity (cm), fresh cane weight (ton/ha) at physiological maturity, total biomass(t/ha) at physiological maturity, grain yield (q/ha),

brix at 15 days after flowering (soft dough stage), brix reading at physiological maturity, juice extraction percentage, juice yield (q/ha), P^H of juice, reducing sugar, total soluble sugar, non-reducing sugar. Observations were recorded on five randomly selected competitive plants in each genotype from replication of each set separately. Genotypic path analysis is outlined by Dewey and Lu (1959) was carried out to find out the direct and indirect effect of various components on juice yield.

Results and Discussion

Genotypic correlation coefficient provides an estimate of an inherent association between any two characters. The estimates of correlation coefficient may be help to identify the characters that prove to be little or no importance in selection program. Direct effect of any components characters on juice yield gives an idea about reliability of indirect selections to be made through that character to bring about improvement in juice yield.

In the present studies total biomass yield (Table 1 and 2) had very high positive direct effect on juice yield (1.6984) at the same time this trait also had positive and significant association with juice yield (0.484). Fresh cane weight had very high positive direct effect on juice yield (0.7094) at the same time this trait also had positive and significant association with juice yield (0.468).

Juice extraction percentage had significant and positive direct effect on juice yield (0.8113) while it was significantly and positively correlated with juice yield (0.614) Unche *et al.,* (2008) found similar results. The character plant height at 50 per cent flowering had high direct effect (0.5998) and positive correlation juice yield.

Grain yield had high positive direct effect but negative association with juice yield (-0.331) Bangarwa *et al.,* (1985) reported similar results. Days to 50 percent flowering had negative direct effect (-0.2488) and positive correlation (0.363) with juice yield. So that direct effect with positive correlation will be increasing to significant level.

Similar results were reported by Choudhari *et al.,* (2001) for 50 percent flowering and plant height. Days to physiological maturity had moderate positive direct effect (0.3491) and it was positively correlated with juice yield. Plant height at physiological maturity had negative direct effect on juice yield (-0.3773) but it was significantly correlated with juice yield (0.310). Based on present investigation the most desirable characters in sweet sorghum should have fewer days require to 50 per cent flowering, more biomass yield and more plant height at 50 per cent flowering for more juice yield.

Brix at 15 days after flowering had positive high direct effect on juice yield (0.4875), while it was negatively correlated with juice yield (-0.299). This might be due to high positive indirect effect via Non reducing sugar and juice extraction percentage. Indirect selection through these characters would be for juice yield improvement. Brix at physiological maturity had positive high direct effect on juice yield (-0.4140) while it was negatively and non-significantly correlated with juice yield. Similar findings were reported by Thakare *et al.,* (2002). pH of juice had non-significant positive direct effect on juice yield while it was negatively correlated with juice yield. Non reducing sugar also had very high direct effect on juice yield (1.645) and negative association with the juice yield (-0.317). Increase in these character leads to decrease in juice yield. Hence selection for low pH and non-reducing sugar is preferred.

Table.1 Genotypic correlation coefficient of fifteen characters in sweet sorghum

Characters	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**
Days to 50% flowering	1	0.718	0.189	0.258	0.58	-0.424	0.626	-0.411	-0.48	0.045	-0.021	-0.197	-0.237	-0.241	0.363*
Days to physiological maturity		1	0.193	0.261	0.501	-0.483	0.531	-0.246	-0.287	-0.251	-0.059	-0.32	-0.044	-0.04	0.050
Plant height at 50% flowering			1	0.96	0.594	-0.538	0.559	-0.275	-0.02	-0.055	-0.234	0.197	0.12	0.18	0.266
Plant height at physiological maturity				1	0.652	-0.612	0.622	-0.278	-0.046	-0.037	-0.163	0.201	0.061	0.117	0.310*
Total biomass					1	-0.833	0.998	-0.525	-0.44	-0.026	-0.329	-0.089	-0.2	-0.169	0.484**
Grain yield						1	-0.835	0.198	0.233	0.026	0.198	0.07	0.031	0.031	-0.331*
Fresh cane weight							1	-0.549	-0.454	-0.034	-0.22	-0.121	-0.19	-0.166	0.468**
Brix at 15 days after flowering								1	0.842	-0.015	0.268	0.086	0.401	0.358	-0.299*
Brix at physiological maturity									1	0.225	0.352	0.155	0.555	0.536	-0.147
Juice extraction										1	0.243	-0.081	0.161	0.119	0.614**
PH of juice											1	-0.118	0.078	0.09	-0.163
Reducing sugar												1	0.099	0.185	0.036
Non-reducing sugar													1	0.996	-0.317*
Total soluble sugar														1	-0.289
Juice Yield															1

** and * indicates significant at 1% and 5%, respectively

Table.2 Genotypic Path Analysis of Fourteen Characters on Juice Yield in Sweet Sorghum

Characters	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Days to 50% flowering	**-0.2488**	0.25072	0.1135	-0.09734	0.98489	-0.2463	-0.44438	-0.20016	0.19885	0.03655	-0.00294	-0.07785	-0.38948	0.48637
Days to physiological maturity	-0.1787	**0.3491**	0.11608	-0.09833	0.85138	-0.2811	-0.37675	-0.11988	0.11878	-0.20351	-0.00814	-0.12629	-0.07238	0.07995
Plant height at 50% flowering	-0.0471	0.06755	**0.59989**	-0.36226	1.00932	-0.3129	-0.39661	-0.13405	0.00827	-0.04473	-0.03217	0.07794	0.19732	-0.3648
Plant height at physiological maturity	-0.0642	0.09098	0.57593	**-0.37733**	1.1076	-0.3556	-0.44132	-0.13539	0.01922	-0.02971	-0.02233	0.07923	0.10014	-0.2366
Total biomass	-0.1443	0.17499	0.35649	-0.24606	**1.69844**	-0.4842	-0.70803	-0.25603	0.18218	-0.021	-0.04521	-0.03529	-0.32881	0.3411
Grain yield	0.10545	-0.16878	-0.3228	0.23079	-1.4144	**0.58152**	0.59243	0.09639	-0.0964	0.0211	0.02716	0.02751	0.05095	-0.062
Fresh cane weight	-0.1558	0.18539	0.33537	-0.23473	1.6950	-0.4856	**0.70943**	-0.26758	0.18783	-0.02744	-0.03025	-0.04782	-0.31271	0.3362
Brix at 15 days after flow	0.10217	-0.08583	-0.1649	0.10478	-0.8918	0.11497	0.38935	**0.48756**	-0.3487	-0.01187	0.03672	0.03406	0.65898	-0.7240
Brix at physiological maturity	0.11951	-0.10013	-0.0119	0.01751	-0.7472	0.13544	0.32181	0.41059	**-0.4140**	0.18234	0.04834	0.06104	0.91344	-1.0835
Juice extraction	-0.0112	-0.08757	-0.0330	0.01382	-0.0439	0.01512	0.02399	-0.00713	-0.0930	**0.81133**	0.03338	-0.03209	0.26508	-0.2407
PH of juice	0.00534	-0.0207	-0.1405	0.06139	-0.5594	0.11506	0.15634	0.13044	-0.1458	0.19729	**0.13726**	-0.04654	0.12874	-0.1817
Reducing sugar	0.04905	-0.11163	0.11838	-0.07569	-0.1517	0.04051	0.0859	0.04205	-0.0639	-0.06591	-0.01617	**0.39495**	0.16349	-0.3734
Non-reducing sugar	0.05893	-0.01536	0.07196	-0.02297	-0.3394	0.01801	0.13486	0.19531	-0.2299	0.13074	0.01074	0.03925	**1.64501**	-2.0144
Total soluble sugar	0.05987	-0.01381	0.10826	-0.04416	-0.2865	0.01783	0.11797	0.1746	-0.2219	0.09661	0.01234	0.07295	1.63908	**-2.0217**

Residual Effect = 0.5165253

Reducing sugar had significant positive direct effect on juice yield (0.3949) while it was positively correlated with juice yield. Total soluble sugar had very high negative direct effect (-2.0217) on juice yield and negatively correlated with juice yield. These results are in agreement with the findings of Kadam *et al.,* (2000), Veerabhadiran *et al.,* (2001), Unche *et al.,* (2008) and Sandeep *et al.,* (2009).

Considering both the correlation coefficient and path coefficient, it can be concluded that, juice extraction per cent, fresh cane weight, total biomass are important juice yield contributing characters and should be given due importance during selection as they were correlated significantly with juice yield and also among themselves.

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