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Original Research Article

Correlation and Path Analysis Studies among Rabi Sorghum (*Sorghum bicolor* L. Moench) Mutants

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A B S T R A C T

Mutation was induced in sorghum cultivar 'Parbhani Moti' with the help of gamma rays and EMS. Mutants from different eight mutagenic treatments viz., T1 (10kR), T2 (20kR), T3 (30kR) were gamma rays treatments and T4 (0.1%), T5 (0.2%), T6 (0.3%) and T7 (0.4%) were EMS treatments and T8 (10kR + 0.1% EMS) with two control treatments viz., T9 (wet control) and T10 (dry control) were evaluated for correlation and path analysis for the grain yield and some of the independent traits. Study indicate that the traits viz., earhead length, days to maturity, plant height, seed weight, harvest index and number of Primaries per panicle are important characters for grain yield improvement. Hence these traits can be considered as selection indices for sorghum improvement programme. The component of residual effect of path analysis was 0.4241which indicate, 57.59% variability was contributed by characters studied.

Keywords

Sorghum mutants, Genotypic correlation, Phenotypic correlation and path analysis

Introduction

Sorghum (*Sorghum bicolor* (L) Moench), a C4 grass and relative of maize, ranks fifth in global cereal production and is an important source of food, feed, fiber and fuel. Sorghum was domesticated approximately 3000 years ago in Ethiopia, with additional centers of origin in parts of the Congo, India, Sudan, and Nigeria (Ayana and Bekele, 1998). Sorghum is especially adapted to growth in hot, arid, or semi-arid climates. Sorghum crop exhibits considerable differences in plant traits, panicle and grain characteristics including physiological responses to selection and is highly influenced by environmental factors (Ezeaku *et al.,* 1997). The study of relationships among quantitative traits is important for assessing the feasibility of joint selection of two or more traits and hence for evaluating the effect of selection for secondary traits on genetic gain for the primary trait under consideration. A positive genetic correlation between two desirable traits makes the job of the plant breeder easy for improving both traits simultaneously. Even the lack of correlation is useful for the joint improvement of the two traits. On the other hand, a negative correlation between two desirable traits impedes or makes it impossible to achieve a significant improvement in both traits. However, simple correlations do not give an insight into the true biological relationships of these traits with yield. Yield, being quantitative in nature is a complex trait with low heritability and depends upon several other components with high heritability (Grafius, 1959). These traits are in turn interrelated. Their interdependence influences the direct relationship with yield and as a result the information obtained on their association becomes unreliable (Khairwal *et al.,* 1999). The path coefficient analysis initially suggested by Wright (1921) and described by Dewey and Lu (1959) allows partitioning of correlation coefficient into direct and indirect contributions (effects) of various traits towards dependent variable and thus helps in assessing the cause-effect relationship as well as effective selection. Hence, this study is aimed to analyze and determine the traits having greater interrelationship with grain yield utilizing the correlation and path analysis.

Materials and Methods

Eight different mutagenic treatments of Parbhani Moti viz., T1 (10kR), T2 (20kR), T3 (30kR): gamma rays treatments and T4 (0.1%), T5 (0.2%), T6 (0.3%) and T7 (0.4%): EMS treatments and T8 (10kR + 0.1% EMS) obtained from B.A.R.C. Trombay, Mumbai, along with two control treatments viz., T9 (dry control) and T10 (wet control) were sown in *Randomized Block Design* with 3 replications, at spacing of 15 cm within plants and 45 cm between plants in M_2 at the field of Sorghum Research Station, VNMKV Parbhani during *rabi* 2016.

The observations were taken on selected 10 plants from each treatment. The treatments along with checks were studied for different thirteen yield and its attributing traits *viz.*, initial plant count, days to panicle initiation, days to 50 % flowering, days to maturity, plant height (cm), earhead length (cm), number of primaries per panicle, number of seeds per primary, fodder yield per plant (g), total biomass content (g), 100 seed weight (g), harvest index and grain yield per plant (g). The data were subjected to analysis of genotypic and phenotypic correlation (Johnson *et al.*, 1955) and path coefficients (Dewey and Lu, 1959).

Results and Discussion

Analysis of variance revealed that the presence of significant differences among the genotypes for all the characters indicating the presence of sufficient amount of variability among these characters Table 1.

The genotypic and phenotypic correlation coefficients are presented in table 2 and 3 respectively. Genotypic correlation coefficient provides an estimate of inherent association between two traits. Correlation coefficient helps in determining the direction of selection and number of characters to be considered in improving the grain yield. So it is a matter of great importance to the plant breeders to find out of the characters correlated with yield and also how they are associated among themselves. Grain yield per plant was found positively and significantly correlated with initial plant count, earhead length, 100 seed weight and harvest index at both genotypic and phenotypic level. In other words, these traits are important for improvement of grain yield in sorghum.

The results are in agreement with Kole *et al.*, (2008), Basak and Ganguli (1996), Nimbalkar *et al.*, (1988) and Veerabadhiran *et al.*, (2001) for 100-seed weight. Fodder yield per plant exhibit positive association with initial plant count, plant height, number of seeds per primary and harvest index at both phenotypic and genotypic level. Days to maturity have significant genotypic and phenotypic correlation with days to panicle initiation and days to 50% flowering.

Table.1 Analysis of variance for yield and yield contributing characters in sorghum

Source of variation	d.f.	Mean sum of squares												
		Initial plant count	Days to panicle initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Earhead length (cm)	Number of primaries per panicle	Number of seeds per primary	Grain yield per plant (g)	100 seed weight (g)	Fodder yield per plant (g)	Total biomass content (g)	Harvest index
Replication	2	2.1	0.1	0.433	1.233	21.366	0.4503	1.754	2.7723	15.346	0.0102	337.818	10.744	42.851
Treatment	9	825.274**	40.163**	84.774**	33.574**	529.510**	2.1832**	27.077**	43.5008**	317.394**	0.2654**	849.95**	3766.767**	87.810**
Error	18	7.625	0.841	3.618	0.971	36.127	0.209	1.843	5.5012	10.558	0.0151	237.974	12.169	4.182

*and ** indicates significance at 5% and 1% level, respectively

Table.2 Genotypic correlation between yield and its components in sorghum

sr. No.	Characters	Initial plant count	Days to panicle initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Earhead length (cm)	No. of primaries per panicle	No. of seeds per primary	100 seed weight (g)	Total biomass content (g)	Harvest index (%)	Fodder yield per plant (g)	Grain yield per plant (g)
1	**Initial plant count**		-0.1753	-0.3164	-0.2892	-0.530**	0.6047**	0.0665	-0.2296	0.9528**	0.1336	0.4737*	0.0447	0.7512**
2	**Days to panicle initiation**			0.9886**	0.9904**	-0.2976	0.4076*	0.2481	-0.5561*	-0.0457	0.2274	-0.4774*	-0.8847**	-0.3929*
3	**Days to 50% flowering**				0.9949**	-0.1427	0.3636	0.3268	-0.4309	-0.2042	0.1718	-0.583**	-0.6389*	-0.5503**
4	**Days to maturity**					-0.2782	0.2969	0.2763	-0.5510*	-0.1460	0.2227	-0.4793*	-0.7646**	-0.4919*
5	**Plant height (cm)**						-0.3506	0.1519	0.8424**	-0.7339**	-0.3812	-0.0326	0.2451	-0.2703
6	**Earhead length (cm)**							0.3147	-0.1926	0.6697**	0.2458	0.1668	-0.4993	0.5483*
7	**No. of primaries per panicle**								0.4029	-0.1585	-0.4111*	0.1746	0.0736	-0.0851
8	**No. of seeds per primary**									-0.4098	-0.6392**	0.4698	0.5863	0.1161
9	**100 seed weight (g)**										0.1614	0.4850*	-0.0409	0.7524**
10	**Total Biomass content (g)**											-0.6223*	-0.4631	0.2109
11	**Harvest index (%)**												0.4148	0.6059**
12	**Fodder Yield/plant (g)**													0.0781
13	**Grain yield/plant (g)**													

*and** indicates significance at 5% and 1% level, respectively

Table.3 Phenotypic correlation between yield and its component in sorghum

sr. No.	Characters	Initial plant count	Days to panicle initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Earhead length (cm)	No. of primaries per panicle	No. of seeds per primary	100 seed weight (g)	Total biomass content (g)	Harvest index (%)	Fodder yield per plant (g)	Grain yield per plant (g)
1	**Initial plant count**		- 0.1764	-0.2798	-0.2830	-0.5061 **	0.4824 **	0.0828	-0.1754	0.8539 **	0.1314	0.4442 *	0.0057	0.7137 **
2	**Days to panicle initiation**			0.8957 **	0.9242 **	-0.2633	0.3812 *	0.2464	-0.4365 *	-0.0460	0.2270	-0.4464 *	-0.5816 **	-0.3918 *
3	**Days to 50% flowering**				0.8851 **	-0.1389	0.2696	0.3542	-0.3250	-0.2011	0.1611	-0.5078 **	-0.4602 *	-0.5224 **
4	**Days to maturity**					-0.2370	0.2506	0.2001	-0.4349 *	-0.1506	0.1994	-0.4342 *	-0.5216 **	-0.4195 *
5	**Plant height (cm)**						-0.2712	0.1127	0.6602 **	-0.6269 **	-0.3484	-0.0297	0.1262	-0.2648
6	**Earhead length (cm)**							0.2147	-0.2088	0.5412 **	0.2158	0.0903	-0.1151	0.4232 *
7	**No. of primaries per panicle**								0.3508	-0.0815	-0.3698 *	0.1565	-0.0448	-0.1239
8	**No. of seeds per primary**									-0.3275	-0.5352 **	0.3364	0.3538	0.1039
9	**100 seed weight (g)**										0.1460	0.4422 *	-0.0100	0.6735 **
10	**Total Biomass content (g)**											-0.5827 **	-0.3116	0.1947
11	**Harvest index (%)**												0.2254	0.5920 **
12	**Fodder Yield/plant (g)**													0.0210
13	**Grain yield/plant (g)**													

*and** indicates significance at 5% and 1% level, respectively

Table.4 Path coefficient analysis

Sr. No.	Characters	Initial plant count	Days to panicle initiation	Days to 50% flowering	Days to maturity	Plant height (cm)	Earhead length (cm)	No. of primaries per panicle	No. of seeds per primary	100 seed weight (g)	Total biomass content (g)	Harvest index (%)	Fodder yield per plant (g)	Correlation with Grain yield/plant (g)
1	Initial plant count	**-0.1137**	0.54	0.2039	-0.4525	-0.4799	1.0288	0.0217	0.4857	-0.6786	-0.0466	0.2614	-0.0192	0.7512**
2	Days to panicle initiation	0.0199	**-3.0805**	-0.6371	1.5495	-0.2654	0.6935	0.0808	1.1763	0.0325	-0.0792	-0.2634	0.3803	-0.3929*
3	Days to 50% flowering	0.036	-3.0452	**-0.6445**	1.5565	-0.2654	0.6186	0.1064	0.9114	0.1454	-0.0599	-0.3222	0.2746	-0.5503**
4	Days to maturity	0.0329	-3.051	-0.6412	**1.5645**	-0.2481	0.5051	0.0899	1.1656	0.104	-0.0776	-0.2645	0.3287	-0.4919*
5	Plant height (cm)	0.0612	0.9167	0.092	-0.4352	**0.892**	-0.5965	0.0494	-1.782	0.5227	0.1328	-0.018	-0.1053	-0.2703
6	Earhead length (cm)	-0.0687	-1.2557	-0.2343	0.4644	-0.3127	**1.7014**	0.1024	0.4075	-0.4769	-0.0856	0.092	0.2146	0.5483*
7	No. of Primaries per panicle	-0.0076	-0.7643	-0.2106	0.4323	0.1355	0.5354	**0.3255**	-0.8522	0.1129	0.1432	0.0964	-0.0316	-0.0851
8	No. of seeds/primary	0.0261	1.713	0.2777	-0.8621	0.7514	-0.3278	0.1311	**-2.1153**	0.2919	0.2227	0.2592	-0.252	0.1161
9	100 seed weight (g)	-0.1083	0.1406	0.1316	-0.2284	-0.6546	1.1394	-0.0516	0.8669	**0.7122**	-0.0562	0.2676	0.0176	0.7524**
10	Total Biomass content (g)	-0.0152	-0.7004	-0.1107	0.3484	-0.34	0.4181	-0.1338	1.3521	-0.1149	**-0.3484**	-0.3434	0.1991	0.2109
11	Harvest index (%)	-0.0538	1.4706	0.3764	-0.7499	-0.0291	0.2837	0.0568	-0.9937	-0.3454	0.2168	**0.5518**	-0.1783	0.6059**
12	Fodder Yield/plant (g)	-0.0051	2.7252	0.4118	-1.1962	0.2186	-0.8495	0.0239	-1.2402	0.0291	0.1613	0.2289	**-0.4299**	0.0781

Earhead length was found significantly positively correlated with initial plant count, days to panicle initiation and 100 seed weight. The estimation of correlation coefficient indicates only the extent and nature of association between yield and its attributes, but does not show the direct and indirect effects of different yield attributes on yield *per se.*

Path coefficient analysis measures the direct influence of one variable upon the other and permits separation of correlation coefficient into components of direct and indirect effects. Partitioning of total correlation into direct and indirect effects provides actual information on contribution of characters and thus forms the basis for selection to improve the yields.

The results pertaining to the path analysis are resented in Table4. It can be notice from the table that out of thirteen characters, six characters exhibited positive direct effect on grain yield per plant. Out of which trait earhead length exhibited highest positive direct effect on grain yield followed by days to maturity, plant height, seed weight, harvest index and number of Primaries per panicle. Similar results were reported by Kole *et al.,* (2008) and Puspitasari *et al.,* (2012) for plant height and 100 seed weight. The characters, initial plant count, days to panicle initiation, days to 50% flowering, number of seeds per primary, total biomass content and fodder yield per plant showed negative direct effect on grain yield per plant. Initial plant count had indirect effect on grain yield with significant positive correlation through some other traits viz., earhead length, days to panicle initiation, number of seeds per primary, days to 50% flowering, number of Primaries per panicle, number of seeds per primary and harvest index. Total biomass content also has indirect association with grain yield through days to maturity, earhead length, number of seeds per primary and fodder yield per plant. Other independent traits exhibiting negative direct effect have indirect effect on grain yield through other independent traits (Table 4). Thus, the present study indicated that the traits viz., earhead length, days to maturity, plant height, seed weight, harvest index and number of Primaries per panicle are important characters for grain yield improvement. Hence these traits can be considered as selection indices for sorghum improvement programme.

The component of residual effect of path analysis was 0.4241which indicate, 57.59% variability was contributed by characters studied. The higher residual effect indicated the inadequacy of the trait chosen for the path analysis.

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