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Correlation and Path Analysis Studies in Post Rainy Sorghum (Sorghum Bicolor l.) Genotypes

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Abstract: *The present study was conducted with 48 genotypesinvolving 25 land races, 20 advanced breeding lines and 3 varieties, for post flowering drought tolerance of post rainy sorghum (Sorghum bicolor L. An experiment was conducted to determine the character association for grain yield and its component characters and their direct and indirect effectsto provide necessary information that could be useful in post rainy sorghum improvement programmes aimed at improving grain yield. The significant and positive association of grain yield per plant with Panicle dry weight, days to 50 % flowering and total biomass. Grain yield per plant was strongly correlated with plant height, SCMR, leaf dry weight, 1000 grain weight, RLWC and number of leaves per plant. Total biomass had highest direct effect (28.33), followed by stem dry weight, panicle dry weight, leaf dry weight and days to 50% flowering. Indirect effect on grain yield/plant were also estimated it was found that panicle dry weight showed maximum indirect effect via total biomass while indirect effect of total biomass was also positive via stem weight and panicle dry weight.*

Keywords: *Post rainy sorghum, Correlation, Path analysisand Drought tolerant.*

1. INTRODUCTION

Sorghum is one of the main staples for the worlds. The crop is genetically suited to hot and dry agro-ecologies, where it is difficult to grow other food grains and these are also areas subject to moisture stress condition.Its importance is ever increasing as the source of food for rural masses, food for teeming cattle population and raw material for the industries. Also with the present scarcity situation sorghum cultivation is the heart of dry land agriculture, being C4 plant it can utilize sunlight and water efficiently. It is unique to adapt to environmental extremes of a biotic and biotic stresses. Post-rainy sorghum is primarily used as a food due to its good grain quality and serves as a main source of fodder, especially during dry seasons.

Grain yield is complex trait, depend on many attributes characters. Yield potential accompanied with desirable combination of traits has always been the major objective of sorghum breeding program. Correlation measure the level of dependence traits and out of numerous correlation coefficient it is often difficult to determined the actual mutual effects among traits (Ikanovic, J., J. et. al. 2011). Estimates of correlations alone may be often misleading due to mutual cancellation of component traits. So, it becomes necessary to studypath coefficient analysis, which takes in to account the casual relationship in addition to degree of relationship (Mahajan, R.C., et. al., 2011).The path coefficient analysis initially suggested by (Wright, S., 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.

2. MATERIALS AND METHODS

The experimental material comprised of total 48advanced breeding lines, land races and varieties for post flowering drought tolerance of *post rainy* sorghum (*Sorghum bicolor* L.). These lines were evaluated for correlation coefficient and path analysis studies. The experiment was conducted in complete randomized block design with three replications during *rabi*season of 2012 under rainfed condition at Sorghum Research Station, Vasantrao Naik Krishi Vidyapeeth, Parbahni. Each genotype was assigned to a single row per plot of 3 mt length in each replication. The row to row and plant to plant distance was kept at 45 and 15 cm, respectively. During sowing only pre-sowing irrigation was applied to ensure proper seed germination. The all other recommended agronomical practiceswere followed to raise a good crop.Data were collected on Plant stand, Plant height (cm), Seed vigour , Days 50% flowering, Days to physiological maturity, Total number of leaves per plant, Leaf dry weightper plant (g) at physiological maturity , Stem dry weightper plant (g) at physiological maturity, panicle dry weightper plant (g) at physiological maturity, Relative water content (%), SCMR at 50% flowering, Total biomassper plant (gat physiological maturity), 1000 grain weight, Grain yieldper plant (g). Leaves, panicle and stem were separated from 5 randomly selected plants from each entry, were sun-dried and weighedby electronic balance again to record air-dry weight in grams.

The estimates of direct and indirect contribution of various characteristics to seed yield were calculated through path coefficient analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

3. RESULTS AND DISCUSSION

3.1 Correlation and Path Coefficient analysis

Correlation analysis provides the information ofinterrelationship of important plant characters and hence,leads to a directional model for direct and/or indirectimprovement in grain yield (Khan et al., 2004). Althoughdirect selection for various parameters could be misleading,indirect selection via related parameters with highheritability might be more effective than direct selection(Toker et al., 2004).

Genotypic and phenotypic correlations are presented in Table 1 and 2.In general the genotypiccorrelation was generally of higher magnitude than phenotypiccorrelation indicating that inherent associationbetween various characters studied.Evaluation of advanced breeding lines, land races andpromising lines for post flowering drought tolerance indicates the significant and positive association of grain yield per plant with Panicle dry weight (0.784), days to 50 % flowering (770) and total biomass (0.635) at genotypic level.Sriram and Rao (1983) also reported the importance of panicle dry matter contribution to grain yield in sorghum. Similar results have also been reported by P. Sanjana Reddy, et. al., (2012).According to Saini and Paroda (1978), the genotypes attaining late maturity accumulates more dry matter for maximum expression of these characters. The present study revealed that grain yield per plant was strongly correlated with plant height, SCMR, leaf dry weight, 1000 grain weight, RLWC and number of leaves per plant. SPAD chlorophyll meter reading (SCMR) under water deficit conditions indicates that higher chlorophyll concentration is vital for adaptation to water deficit conditions during post flowering growth period.Positive relationships was exhibited by SCMR with total biomass and 1000 grain weight. Days to 50 % flowering showed positive and significant correlation with days to physiological maturity. Whereas positive but non-significant association with 1000 grain weight. Seed vigor had positive non significant association with leaves per plant and SCMR. Total number of leaves per plant showed positive but non- significant correlation with leaf dry weight , panicle dry weight, relative water content, SCMR and total biomass. Moreover leaf dry weight had positive and significant correlation with total biomass and positive but non significant association with stem dry weight, panicle dry weight, SCMR and 1000 grain weight. Stem dry weight exhibited positive and significant correlation with total biomass and positive but non significant correlation with RLWC and SCMR indicating the importance of these characters when crop is grown under moisture deficit condition.Whereas, panicle dry weight showed positive and significant correlation with total biomass but it was non- significantly correlated with RLWC, 1000 grain weight.Relative water contentwas positively but significantly correlated with total biomass and 1000 grain weight. RLWC is the ability of a plantto maintain high water in theleaves under moisture stress conditions and has been used as an index to determine drought tolerance in crop plants (Barrs, H. D. et. al., 1962). Blum, et al.(1989) reported that higher leaf RLWC allows the plant to maintain turgidity, and this would exhibit relatively less reduction in biomass and yield.

At phenotypic level total biomass g/plant and panicle dry weight gram per plant exhibited significant and positive association with grain yield per plant at phenotypic level. While stem dry weight and panicle dry weight gram per plant showed positive and significant association with total biomass per plant .

Correlation coefficients help in determining the direction of selection and number of characters to be considered in improving the grain yield.In other words panicle dry weight, days to 50 % flowering and total biomass are the important traits in improving plant productivity. While, physiological characters like RLWC, SCMR plays a vital role in improving grain yield under moisture stress condition by maintaining optimum turger pressure at cellular level and photosynthetic activities, respectively .

Knowledge of correlation alone is often misleading as the correlation observed may not be always true. Two characters may show correlation just because they are correlated with a common third one. In such cases, it becomes necessary to study a method which takes in to account the causal relationship between the variables in addition to the degree of such relationship. Path coefficient analysis measures the direct influence of one variable upon the other and permitsseparation 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 charactersand thus forms the basis for selection to improve the yields.

The results pertaining to the path analysis are resented in Table3. It can be notice from the table that out of 14 characters, ten exhibited positive direct effect on grain yield per plant. Total biomass had highest direct effect (28.33), followed by stem dry weight (17.59), panicle dry weight (15.81), leaf dry weight (2.51) and days to 50% flowering (0.326).Similarresults were found byVeerbhadhiran and Kennedy (2001) for days to 50 % flowering.

Indirect effect on grain yield/plant were also estimated it was found that panicle dry weight showed maximum via total biomass while indirect effect of total biomass was also positive via stem weight and panicle dry weight. Similarly

indirect effect of panicle dry weight via stem dry weight , number of leaves per plant via panicle dry weight, SCMR via stem dry weight and RLWC via panicle and stem dry weight werepositive on grain yield per plant.

The path coefficient analysis revealed the direct and indirect contribution of total biomass, stem dry weight, panicle dry weight, leaf dry weight, days to 50% flowering and relative water content on seed yield. The above findings revealed that whatever may be the characters chosen for increasing grain yield, the improvement could be achieved mainly through these traits. The residual effect was found to be moderate which indicates that there may be some more components that are contributing towards grain yield.

Table 1: Genotypic correlation coefficient between grain yield and its component characters in sorghum

	Plant stand	**Plant height (cm)**	**Seed vigor**	**Days 50% flowering**	**Days to physiological maturity**	**Total number of leaves per plant**	**Leaf dry weight (g/plant)**	**Stem dry weight (g/plant)**	**Panicle dry weight (g/plant)**	**Relative water content (%)**	**SPAD at 50% flowering**	**Total biomass (g/plant)**	**1000 grain weight (g)**	**Grain yield (g/plant)**
Plant stand	-1.000	0.352	0.700**	-0.161	-0.830**	-1.231	-0.346	0.627**	0.684**	0.591	0.622*	0.726**	-1.228	0.612**
Plant height (cm)		1.000	0.066	0.186	0.195	0.110	0.007	0.033	0.173	0.087	-0.152	0.113	-0.100	0.160
Seed vigor			1.000	0.022	-0.033	-0.382	-0.126	0.050	-0.302	-0.102	0.055	-0.137	-0.112	-0.115
Days 50% flowering				1.000	0.984**	0.085	-0.003	-0.650	0.074	-0.020	-0.364	-0.002	0.110	0.770
Days to physiological maturity					1.000	0.085	-0.002	-0.056	0.103	-0.013	-0.332	0.019	0.059	0.130
Total number of leaves per plant						1.000	0.207	0.055	0.267	0.217	0.218	0.192	-0.115	0.089
Leaf dry weight (g/plant)								0.463	0.244	-0.079	0.265	0.498	0.133	0.335
Stem dry weight (g/plant)								1.000	0.390	0.105	0.178	0.868**	0.088	0.312
Panicle dry weight (g/plant)									1.000	0.114	0.092	0.791**	0.186	0.784**
Relative water content (%)										1.000	0.002	0.119	0.131	0.094
SPAD at 50% flowering											1.000	0.181	-0.268	0.110
Total biomass (g/plant)												1.000	0.164	0.635**
1000 grain weight (g)													1.000	0.256
Grain yield (g/plant)														1.000

Table 2: Phenotypic correlation coefficient between grain yield and its component charectares in sorghum

	Plant stand	Plant height (cm)	Seed vigor	Days 50% flowering	Days to physiological maturity	Total number of leaves per plant	Leaf dry weight (g/plant)	Stem dry weight (g/plant)	Panicle dry weight (g/plant)	Relative water content (%)	SPAD at 50% flowering	Total biomass (g/plant)	1000 grain weight (g)	Grain yield (g/plant)
Plant stand	1	0.019	-0.102	-0.06	-0.047	-0.012	0.01	0.129	0.042	0.073	-0.2	0.105	-0.048	0.043
Plant height (cm)		1	0.026	0.176	0.177	0.107	-0.004	0.027	0.167	0.087	-0.125	0.105	-0.113	0.139
Seed vigor			1	0.055	0	-0.191	-0.127	0.021	-0.216	-0.045	0.047	-0.113	-0.077	-0.117
Days 50% flowering				1	0.915**	0.011	-0.031	-0.048	0.029	0.002	-0.311	-0.018	0.036	0.043
Days to physiological maturity					1	-0.006	-0.042	-0.033	0.045	0.011	-0.291	-0.001	0.005	0.077
Total number of leaves per plant						1	0.118	0.6	0.152	0.101	0.114	0.129	-0.125	0.041
Leaf dry weight (g/plant)							1	0.378	0.188	-0.117	0.141	0.433	0.116	0.258
Stem dry weight (g/plant)								1	0.369	0.097	0.122	0.864**	0.071	0.293
Panicle dry weight (g/plant)									1	0.11	0.09	0.780**	0.123	0.743**
Relative water content (%)										1	-0.03	0.109	0.102	0.059
SPAD at 50% flowering											1	0.138	-0.225	0.029
Total biomass (g/plant)												1	0.12	0.602*
1000 grain weight (g)													1	0.173
Grain yield (g/plant)														1

Table 3: Direct and Indirect effects of characters on grain yield/plant in sorghum

	Plant stand	Plant height (cm)	Seed vigor	Days 50% flowering	Days to physiological maturity	Total number of leaves per plant	Leaf dry weight (g/plant)	Stem dry weight (g/plant)	Panicle dry weight (g/plant)	Relative water content (%)	SPAD at 50% flowering	Total biomass (g/plant)	1000 grain weight (g)
Plant stand	0.043	0.013	0.126	0.052	-0.259	0.218	-0.87	11.039	10.818	0.06	-0.045	-20.58	-0.001
Plant height (cm)	-0.015	0.038	0.011	-0.06	0.06	-0.02	0.004	0.595	2.75	-0.008	0.011	-3.208	0
Seed vigor	-0.03	0.002	0.18	-0.007	-0.01	0.067	-0.318	0.896	-4.779	-0.001	0.004	3.897	-0.001
Days 50% flowering	0.007	0.007	0.004	0.326	0.307	-0.01	-0.009	-1.15	1.17	-0.002	0.026	0.057	0
Days to physiological maturity	0.036	0.007	-0.006	-0.321	-0.312	-0.02	-0.006	-0.987	1.64	-0.001	0.024	-0.552	0

Total number of leaves per plant	0.053	0.004	-0.069	-0.027	0.026	-0.18	0.052	0.97	4.237	0.022	-0.015	-5.45	0
Leaf dry weight (g/plant)	0.015	0	-0.022	0.001	0	-0.04	2.514	8.152	3.86	-0.008	-0.019	-14.12	-0.001
Stem dry weight (g/plant)	-0.027	0.001	0.009	0.021	-0.017	-0.01	1.165	17.592	6.182	0.01	-0.013	-24.6	0.0001
Panicle dry weight (g/plant)	-0.029	0.006	-0.054	-0.024	0.032	-0.05	0.614	6.877	15.812	0.011	-0.006	-22.41	0
Relative water content (%)	-0.025	-0.003	-0.018	0.006	-0.004	-0.04	-0.2	1.589	1.802	0.102	0	-3.386	0.0001
SPAD at 50% flowering	-0.027	-0.005	0.001	0.118	-0.103	-0.04	0.668	3.132	1.467	0	-0.073	-5.137	-2E-04
Total biomass (g/plant)	-0.031	0.004	-0.024	0	0.006	-0.03	1.253	15.279	12.509	0.012	-0.013	-28.33	0.0004
1000 grain weight (g)	0.053	-0.003	-0.02	-0.036	0.018	0.02	0.334	1.56	2.944	0.013	0.0196	-4.65	0.0008

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