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Inter Relationship Among Grain Minerals And Grain Yield Components In Sorghum (*Sorghum bicolor* (L.) Moench)

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Abstract: ***Knowledge of association between yield and its component characters and among the component characters themselves can highly improve the efficiency of selection in plant breeding. Hence, association and path analysis studies were conducted among 58 genotypes of sorghum on nine quantitative and six nutritional traits. Traits panicle weight, 100 grain weight and panicle width showed positive and high significant correlation with grain yield per plant. Quality traits total iron and total zinc recorded moderate and significant positive correlation with grain yield indicating no compromise of yield for improving quality. Also high and positive significant interrelation between Fe and Zn help in simultaneous improvement of both the micronutrients. Partitioning of yield and yield components into direct and indirect effects revealed that high positive direct effect was exhibited by the character panicle weight on grain followed by total iron content. Taking into account the indirect effects, high and positive indirect effect was exhibited by 100 grain weight and total iron on grain yield via panicle weight. Hence panicle weight, 100 grain weight, panicle width, total iron and total zinc can be considered as important traits for selection in improving the grain yield owing to their positive associations with grain yield.***

Keywords: Sorghum, Yield, Correlation, Path analysis, Panicle weight, Micronutrients

1. Introduction

Sorghum (*Sorghum bicolor* (L.) Moench is an important food and feed crop in the semi-arid regions of the world where it is grown under rain fed and irrigated conditions (House, 1985). It is of great importance in the semi-arid tropics, where it is staple food for millions of people. The study of relationships among quantitative and quality traits is important for assessing the feasibility of joint selection of two or more traits by evaluating the effect of selection for secondary traits on genetic gain for 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. 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 their 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 aid in 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.

2. Materials and Methods

Fifty eight accessions of Sorghum maintained at Department of Millets which include seventeen varieties, twenty two R lines and nineteen B lines were used in this study. They were evaluated at Research farm, Tamil Nadu Agricultural University, Coimbatore during *kharif* 2012-13 in a randomized complete block design with two replications. Each entry was grown in a row of 4m length with a spacing 45×15 cm. Five randomly selected plants from each accession were used to record observations on days to 50 % flowering, days to maturity, plant height(cm), panicle length (cm), panicle width (cm), panicle weight (g), 100 grain weight (g), total iron (mg/ kg), total zinc (mg/kg), total calcium (mg/ 100g), total magnesium (mg/ 100g), crude protein (%), crude fat (%), biomass yield (g) and grain yield per plant (g). Except days to 50 % flowering, all the remaining parameters were recorded at maturity.

The genotypic and phenotypic correlations were worked out by employing the technique of variance-covariance matrix in which the total variability has been splitted into replications, treatments and error. Correlation coefficients among all the characters under study at genotypic levels were estimated as per formula given by Burton (1952), Wright (1960 and 1968). Path coefficient is a standard partial regression coefficient. It permits the partitioning of correlation coefficients into direct and indirect effects. The direct and indirect paths at genotypic levels were obtained by employing the method suggested by Dewey and Lu (1959) and Wright (1960).

3. Results and Discussion

Among the various characters studied panicle weight (r =0.962) followed by 100 grain weight (r = 0.457), panicle width (r =0.432) showed highly significant (P=0.01) and positive correlation with grain yield per plant. While total iron (r =0.374) and total zinc (r =0.270) recorded significant positive correlation with grain yield as given in table 01. Similar results were reported by Warkad *et al.* (2010) who

reported high and significant association between 1000 seed weight and grain yield per plant. Also Mahajan *et al.* (2011) reported grain yield per panicle had positive significant correlation with panicle length, panicle width and test weight.

Considering the inter-correlations positive and significant correlation (r =0.295) was observed between plant height and crude fat (r =0.295) but negative and significant correlation was observed between plant height and total calcium (r = -0.319), total magnesium (r = -0.276). These results were in conformity with Reddy *et al.* (2005). In this study days to 50 % flowering had positive and significant correlation with days to maturity (r =0.290). Similar results were reported by Ngugi and Maswili (2010). Panicle length expressed significant positive correlation with panicle weight (r =0.318) and biomass yield (r =0.441) whereas panicle width exhibited high significant positive correlation with panicle weight (r =0.418), total zinc (r =0.294) and total iron (r =0.268). Panicle weight had high significant associations yield governing traits 100 grain weight (r =0.458) and biomass yield (r =0.401). Also panicle weight reported moderate and significant associations with total iron (r =0.352) and total zinc (r =0.279). These results obtained were same as that reported by Vijay kumar *et al.* (2012). Among quality traits total iron content was positively and significantly correlated with total zinc (r=0.853) indicating good interdependence among these micronutrients and thus aid in the simultaneous improvement of both the quality traits. These results were in accordance with Ashokkumar *et al*. 2012, Musa *et al.* 2012) and Shegro *et al.* (2012) who reported high significant positive correlation between the grain iron and zinc content.

The genotypic correlation coefficients of grain yield per plant and the fifteen characters studied were further partitioned into direct, indirect and residual effects based on path analysis (table 02). High positive direct effect was exhibited by the character panicle weight (0.945) on grain yield per plant seems to be considerable and was followed by total iron content (0.907). The results obtained were in agreement with (Jeyaprakash *et al.* 1997 and Iyanar *et al.* 2001) who reported panicle weight exhibiting direct and maximum effect on yield.

Taking into account the indirect effects (fig. 01), high and positive indirect effect was exhibited by 100 grain weight (0.428) and total iron (0.322) on yield whereas moderate and positive indirect effect was exhibited by total zinc (0.254), total calcium (0.105), total magnesium (0.137) and crude fat (0.167) on the dependent variable grain yield *via* panicle weight. It can be inferred that yield can be improved by indirect selection of the above mentioned traits by means of panicle weight. The effect of residual factors on yield indicates that 19.49 % of variability is uncounted and there might be few more characters other than those studied in the present investigation, which might have been responsible for influencing the yield of sorghum.

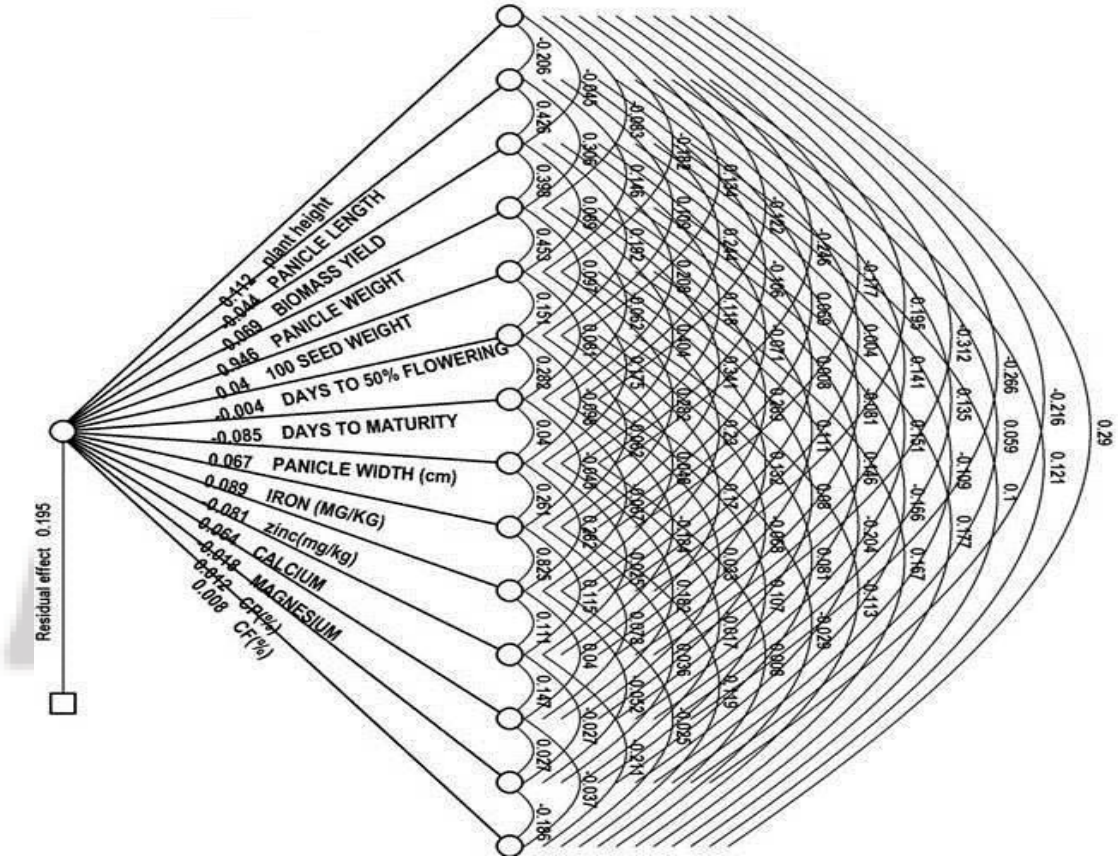

Figure 1: Path diagram for grain yield with yield components and nutritional traits

4. Conclusion

Association studies revealed that panicle weight, 100 grain weight, panicle width, total iron and total zinc were significantly and positively correlated with grain yield and also panicle weight had high positive direct effect on yield followed by total iron content. High and positive indirect effect exhibited by 100 grain weight followed by total iron on yield by means of panicle weight indicates the mere importance of this trait for improvement of grain yield.

References

[1] Ashokkumar A A, Reddy B V S, Ramaiah B, Sahrawat K L and Pfeiffer W H. 2012. Genetic Variability and Character Association for Grain Iron and Zinc Contents in Sorghum Germplasm Accessions and Commercial Cultivars. The European J. of Plant Sci and Biotech., 12(5): 24-29.
[2] Burton G W. (1952). Quantitative inheritance in grasses. Proceedings of the 6th International Grassland Congress, 1: 227-283.
[3] Dewey D R and Lu K H. 1959. A correlation and path coefficient analysis of components of crested wheatgrass seed production. Agron. J., 51: 515-518.
[4] Grafius J E. 1959. Heterosis in barley. Agron. J., 51: 551-554.
[5] Iyanar K, Gopalan A and Ramasamy P. 2001. Correlation and path analysis in sorghum. Ann. Agric. Res., 22(4): 495-497.
[6] Khairwal I S, Rai K N, Andrew D J and Harinarayana G. (1999). Pearl millet Breeding. Oxford and IBH Publishing Co., New Delhi. p.511.
[7] Mahajan R C, Wadikar P B and Pole S P. 2011. Genetic Diversity Studies in Sorghum (*Sorghum bicolor* (L.) Moench). Res. J. Agric. Sci., 1(4): 332-334.
[8] Musa U, Hati S S and Mustapha A. 2012. Levels of Fe and Zn in Staple Cereals: Micronutrient Deficiency Implications in Rural Northeast Nigeria. Food and Public Health, 2(2): 28-33.
[9] Ngugi K and Maswili R. 2010. Phenotypic diversity in Sorghum landraces from Kenya. African Crop Sci. J., 18 (3): 165-173.
[10] Reddy B V S, Ramesh S and Longvah T. 2005. Prospects of Breeding for Micronutrients and β-Carotene-Dense Sorghums. An Open Access Journal published by ICRISAT. SAT eJournal / ejournal.icrisat.org. 1 (1):22-28.
[11] Shergo G A, Shargie N G and Biljon A. 2012. Diversity in Starch, Protein and Mineral Composition of Sorghum Landrace Accessions from Ethiopia. J. Crop Sci. Biotech., 15 (4): 275 - 280.
[12] VijayaKumar N, Reddy C V C M and Reddy P V RM. 2012. Path analysis among rabi sorghum genotypes (*Sorghum bicolor* (L.) Moench). Plant Archives, 12 (2): 959-960.
[13] Warkad Y N, Tidke R T, Maske N M, Kharde A V and Potdukhe N R. 2010. Character association and path analysis in sorghum (*Sorghum bicolor* (L.) Moench). Int. J. Agric. Sci., 6 (1): 100-104.
[14] Wright S. 1921. Correlation and causation. J. Agri. Research., 20:557-585.
[15] Wright S. 1960. Path coefficient and path regression: alternative or complementary concepts? Biometrics 16: 189-202.
[16] Wright S. 1968. Evolution and the genetics of populations. Genetics and Biometrics Foundations. The University of Chicago.

Author Profile

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Table 1: Genotypic correlation coefficient of fifteen characters in Sorghum

Characters	*PH*	*DFF*	*DMT*	*PL*	*PWD*	*PWT*	*HSW*	*Fe*	*Zn*	*Ca*	*Mg*	*CP*	*CF*	*BY*	*GYP*
PH	1.000	0.140	-0.123	-0.206	-0.248	-0.082	-0.187	-0.180	-0.201	-0.319*	-0.276*	-0.224	0.295*	-0.206	0.015
DFF		1.000	0.290*	0.116	-0.096	0.104	0.164	-0.064	0.065	0.184	-0.071	0.075	-0.121	0.198	0.065
DMT			1.000	0.249	0.037	-0.062	0.082	-0.045	-0.067	-0.189	0.033	0.109	-0.028	0.210	-0.188
PL				1.000	-0.110	0.318*	0.156	0.069	0.016	0.149	0.138	0.068	0.128	0.441**	0.191
PWD					1.000	0.418**	0.176	0.268*	0.294*	-0.037	0.183	-0.018	0.006	0.121	0.432**
PWT						1.000	0.458**	0.352**	0.279*	0.116	0.149	-0.170	0.177	0.401**	0.962**
HSW							1.000	0.293	0.234	0.135	0.080	-0.207	0.170	0.088	0.457**
Fe								1.000	0.853**	0.120	0.076	0.034	0.120	-0.074	0.374**
Zn									1.000	0.116	0.044	-0.056	-0.026	0.010	0.270*
Ca										1.000	0.153	-0.030	-0.222	-0.083	0.156
Mg											1.000	0.030	-0.222	0.152	0.099
CP												1.000	-0.209	-0.110	-0.183
CF													1.000	0.100	0.204
BY														1.00	0.262
GYP															1.000

***Significant at 5% level** ****Significant at 1% level**

PH - PLANT HEIGHT
DFF - DAYS TO 50 % FLOWERING
DMT - DAYS TO MATURITY
PL - PANICLE LENGTH
CF - CRUDE FAT
PWD - PANICLE WIDTH
PWT - PANICLE WEIGHT
HSW - 100 SEED WEIGHT
Fe - TOTAL IRON
BY - BIOMASS YIELD
Zn - TOTAL ZINC
Ca - TOTAL CALCIUM
Mg - TOTAL MAGNESIUM
CP - CRUDE PROTEIN
GYP - GRAIN YIELD/ PLANT

Table 2: Direct (diagonal) and indirect effects of fourteen characters on grain yield per plant in Sorghum

Characters	PH	DFF	DMT	PL	PWD	PWT	HSW	Fe	Zn	Ca	Mg	CP	CF	BY	GYP
PH	0.1117	0.0150	-0.0137	-0.0230	-0.027	-0.0092	-0.0203	-0.0198	-0.0217	-0.0349	-0.0298	-0.0242	0.0324	-0.0050	0.0151
DFF	0.0005	-0.004	-0.0011	-0.0004	-0.0004	0.0004	-0.0006	0.0003	-0.0002	-0.0007	0.0003	-0.0003	0.0005	-0.0004	0.0650
DMT	0.0104	-0.0239	-0.0928	-0.0207	-0.0034	0.0053	-0.0068	0.0038	0.0057	0.0156	-0.0028	-0.0090	0.0024	-0.0176	-0.1879
PL	0.0090	-0.0048	-0.0106	-0.0437	0.0046	-0.0134	-0.0064	-0.0030	-0.0002	-0.0062	-0.0059	-0.0026	-0.0053	-0.0186	0.1908
PWD	-0.0165	-0.0066	0.0027	-0.0071	0.0672	0.0272	0.0117	0.0175	0.0190	-0.0017	0.0122	-0.0011	0.0005	0.0079	0.4319
PWT	-0.0781	0.0918	-0.0590	0.2899	0.3824	0.9459	0.4282	0.3222	0.2543	0.1052	0.1378	-0.1567	0.1670	0.3761	0.9620
HSW	-0.0072	0.0060	0.0032	0.0058	0.0069	0.0180	0.0397	0.0112	0.0091	0.0052	0.0032	-0.0081	0.0066	0.0035	0.4571
Fe	-0.0157	-0.0055	-0.0040	0.0061	0.0231	0.0302	0.0250	0.9071	0.0732	0.0102	0.0069	0.0032	0.0106	-0.0063	0.3738
Zn	0.0157	-0.0039	0.0054	-0.0003	-0.0228	-0.0217	-0.0186	-0.0667	-0.0902	-0.0090	-0.0033	0.0042	0.0021	-0.0006	0.2690
Ca	-0.0199	0.0108	-0.0117	0.0090	-0.0016	0.0071	0.0084	0.0073	0.0071	0.0636	0.0093	-0.0017	-0.0134	-0.0051	0.1558
Mg	0.0048	0.0012	-0.0006	-0.0024	-0.0032	-0.0026	-0.0014	-0.0014	-0.0007	-0.0026	-0.0179	-0.0005	0.0007	-0.0027	0.0996
CP	-0.0026	0.0010	0.0013	0.0007	-0.0002	-0.0020	-0.0024	0.0004	-0.0006	-0.0003	0.0003	0.0118	-0.0022	-0.0013	-0.1828
CF	0.0022	-0.0009	-0.0002	0.0009	0.0001	0.0013	0.0013	0.0009	-0.0002	-0.0016	-0.0003	-0.0014	0.0076	0.0008	0.0204
BY	0.0031	-0.0133	-0.0144	-0.0294	-0.0081	-0.0275	-0.0062	0.0049	-0.0006	0.0056	-0.0104	0.0076	-0.0069	-0.0691	0.2619

PH - PLANT HEIGHT
DFF - DAYS TO 50 % FLOWERING
DMT- DAYS TO MATURITY
Fe - TOTAL IRON
CF - CRUDE FAT
PWD - PANICLE WIDTH
PWT - PANICLE WEIGHT
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Mg - TOTAL MAGNESIUM
PL - PANICLE LENGTH
GYP - GRAIN YIELD PER PLANT