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Path Analysis Studies in Association with Quantitative and Qualitative Traits in Sorghum

Rekha Chittapur[*], Biradar B. D.[**], G. M. Sajjanar[***] & V. S. Vyakarnal[****]

Abstract: *Rabi sorghum is famous for its quality but it yield less compared to Kharif. In the present study different rabi sorghum germplasm were evaluated for variability and path analysis studies. The present study was initiated to understand the nature and association and cause and effect relationship between the yield components & quality traits. Path analysis studies reveal that some of the characters are positively contributing towards the grain yield. Such as days to flowering, Plant height, Panicle weight, Number of primaries, Test weight, Bulk density and Seed volume. Some quality traits are also contributed to grain yield. Such as Seed oil content is positively associated with the grain yield but other quality traits such as Seed protein and Seed reflectance are negatively associated with the grain yield. These characters can be used as selection criteria for increasing the grain yield along with the quality.*

Keywords: *Seed Reflectance, Seed Protein, Seed Volume, Seed Size and Grain Yield.*

INTRODUCTION

In India sorghum is cultivated in all three seasons *viz*., *kharif*, *rabi* and summer. The *rabi* sorghum (750 kg/ha) yields are lower than *kharif* (1100 kg/ha) even sorghum is grown mainly in Rabi because of its high grain quality. This is mainly because of excellent grain and fodder quality for sorghum. Hence in *rabi* sorghum, the study of grain quality component is as important as that of the yield components. In the present study along with the quantity traits quality traits are also studied. Grain yield being an important and complex character is a function of several component traits. Hence, the direct selection based on yield alone is not very effective (Grafius, 1964). It is necessary to study these yield components their inter-relationship with yield and their contribution. The present study was initiated to understand the nature and association and cause and effect relationship between the yield components & quality traits. In this study seed characters which were not reported in earlier studies were considered for evaluation such as Seed luster (seed reflectance) Seed Bulk density, Seed True density, Seed Volume, Seed Protein and Seed oil content. All these quality traits were studied in comparison with the Yield trait.

MATERIAL AND METHODS

The experimental material consisting of 100 *rabi* sorghum germplasm were grown in a randomized block design with three replications during *rabi* season at Regional Agricultural Research Station (RARS) Bijapur. The genotypes were chosen from different categories *i.e.* exotic lines (10), indigenous IS lines (21), all released *kharif* and *rabi* varieties (11), Land races (20, B and R lines (45) and special sorghum types (3). Each entry was planted in 1 row of 4 m length with a spacing of 60 x 15 cm, observations were recorded on five randomly selected plants from each genotype for 13 characters *viz*., days to 50 per cent flowering, plant height, panicle length, panicle weight, number of primaries per panicle, 100 seed weight, seed bulk density, seed true density, seed volume, seed size,

[*] Assistant professor, Department of Biotechnology & Crop Improvement, University of Horticulture Sciences, Bagalkot-587101, *E-mail: rekhah20@gmail.com*

[**] Professor, Department of Genetics & Plant Breeding, University of Agricultural Sciences, Dharwad, *E-mail: srsorghumbreeder@rediffmail.com*

[***] Professor, Department of Genetics & Plant Breeding, College of Agriculture, Bijapur, *E-mail: gmsajjanar@gmail.com*

[****] Professor Department of Seed Science & Technology, University of Agricultural Sciences, Dharwad

seed fat content, seed protein content and grain yield per plant except dead heart percentage and seed luster.

Path analysis is done with the main purpose of understanding the direct and indirect contributions of different characters towards the grain yield. The direct contribution of each component to the yield and the indirect effects and its association with other characters cannot be differentiated by simple correlations. Path coefficient analysis fulfills this lacuna. It was first developed and described by Wright (1921) as a tool in genetic analysis for deriving the direct and indirect effects of any set of variables themselves related to one another.

RESULTS & DISCUSSION

Path analysis was utilized to study the extent and nature of direct and indirect effect of yield. Analysis was carried out between the Grain yield and its components along with the important quality traits.yeild contributing characters and developmental traits on grain yield. Correlation Coeffecients of characters such as Plant height, Panicle weight, Number of primaries per pancle, Test weight are significant positively associated with yield. Some quality traits such as seed oil and seed protein are significant but negatively associated with Grain yield (Table 1). Extent and nature of direct and indirect effects on grain yeid are presented in Table 2 & 3. The diagonal values indicate direct effect on grain yield and other values are the indirect effects on Grain yield. The characters that have positive indirect effect on grain yield were plant height (0.147) Patel *et al.* 1980, Beranji 1990, Potduke *et al.* 1992 and panicle weight (0.147) Ivanar *et al.* 2001, Number primaries Thombre & Patil, Singh and Baghel 1977, Kukoidia 1980. Test weight (0.023) Geremew and Gebeyehu 1993. Bulk density (0.048) Ngygen *et al.* 1999 True density (0.0004), Seed Volume (0.041), Seed size (0.021) and Seed Reflectance (0.025). Among these panicle weight has high value of (0.564) on grain yield. This indicates that a genotype with high panicle weight directly increases the grain yield. Some quality parameters such as Seed volume, Seed True Density, Seed Bulk density, and Seed reflectance have also indirectly contributed towards the yield even though they have negligible amount of contribution.

Some characters have negative indirect effect on grain yield such as Days to flowering (-0.030) Pokriyal *et al.* 1976, Potdukhe *et al.* 1992. Quality traits such as Seed oil (Seed Fat) (-0.306), Seed protein (-0.213) El-Hifney *et al.* 1972, Crook & casady 1974, Abu El Gasim & Kambal 1975, Mobasser & Shahmoradi 1996. Both these characters have high effect and contributed negatively towards the grain Yield. This indicates that genotypes with high seed protein and Seed oil content may have low yielding ability.

The characters that have positive direct effect on grain yield are days to flowering (0.054), Asthana 1996, Plant height (0.373) Patel *et al.* 1980, Berenji 1990, Potdukhe 1992, Panicle weight (0.564) Ivanar et al.2001, Number of primaries/panicle (0.274), Test weight (0.0242) Patil *et al.* 1979, Gomez 1986, Potdukhe *et al.* 1994 & Potdukhe 1992. Seed bulk density was having Positive direct effect on grain yield (0.691) Ngygen *et al.* 1991, Wang & Qiu 199.. Seed volume (0.300) but earlier references were not reported with respect to this trait. Seed oil content (0.179) Ngygen *et al.* 1991. Of these characters that have high positive direct effect on grain yield are Panicle weight, Plant height, Bulk density and Seed volume. Moderate effect was observed for Number of primaries per panicle, and low effect was observed for seed oil and True density.

Some characters also have negative direct effect on grain yield such as Panicle length (-0.047) but is negligible, Patel *et al.* 1980 and seed size (-0.376) it has high effect on Grain yield. No records. Seed protein (-0.374) it has high effect on Grain yield El-Hifney et.al 1972, Crook & casady 1974, Abu El Gasim & Kambal 1975, Mobasser & Shahmoradi 1996.Seed reflectance (-0.016) has negligible effect on Grain yield but it has negative association with grain yield. It indicates that seed protein and seed refelectance both

Table 1
Phenotypic & Genotypic Correlation Co-effecients Yield components, Qualitative traits and grain yield in Rabi Sorghum

Traits	*Phenotypic Correlation Co-effecients on Grain Yeild*	*Genotypic Correlation Co-effecients on Grain Yeild*
DF	-0.040	-0.03
DH	-0.002	0.025
PH	0.0320**	0.393**
PW	0.619**	0.69**
PL	0.011	-0.019
NP	0.258**	0.312**
TW	0.304**	0.375**
BD	0.018	0.105*
TD	0.074	0.149
SV	0.181	0.252
SS	0.087	0.154
SO	-0.245*	-0.306**
SP	-0.152	-0.213*
SR	0.080	0.15

Table 2
Phenotypic Path analysis for Yield components, Yield & Qualitative traits in Rabi Sorghum

Traits	*DF*	*DH*	*PH*	*PW*	*PL*	*NP*	*TW*	*BD*	*TD*	*SV*	*SS*	*SO*	*SP*	*SR*	*GY*
DF	**-0.042**	-0.016	0.014	-0.11	0.08	0	0.003	-0.004	0	0.011	0.002	0.007	0.013	0.002	-0.04
DH	0.009	**0.079**	-0.025	0.014	0.07	0.001	0.006	0	0	-0.005	-0.003	-0.008	0.015	0	-0.02
PH	-0.004	-0.013	**0.147**	0.165	0.022	0.002	0.004	-0.002	0	0.001	0	-0.001	-0.002	0	0.3
PW	0.008	0.002	0.043	**0.564**	-0.042	0.004	0.008	-0.002	0	0.005	0.001	0.025	0.001	0.001	0.61
PL	0.021	0.035	-0.02	0.152	**-0.156**	0	-0.005	0	0	-0.009	-0.003	0.002	-0.004	-0.001	0.01
NP	0	-0.008	0.038	0.218	0.002	**0.01**	0.002	-0.006	0	0.004	-0.001	0.003	-0.002	-0.001	0.25
TW	0.006	-0.02	0.026	0.19	0.036	0.001	**0.023**	-0.001	0	0.018	0.008	0.016	0.011	0	0.3
BD	0.003	0	-0.007	-0.02	0	-0.001	-0.001	**0.048**	0.001	-0.002	0	-0.005	0	0.002	0.01
TD	0.005	-0.001	0.018	0.055	-0.015	0	0.001	0.011	**0.004**	-0.001	-0.001	-0.007	0.007	-0.002	0.07
SV	0.011	-0.009	0.002	0.075	0.035	0.001	0.01	-0.003	0	**0.041**	0.007	0.02	0.009	0.003	0.18
SS	0.003	-0.011	0.001	0.025	0.023	0	0.009	0.001	0	0.014	**0.021**	-0.007	0.012	0.003	0.08
SO	0.002	0.005	0.001	-0.115	0.003	0	-0.003	0.002	0	-0.007	0.001	**-0.122**	-0.01	-0.002	-0.24
SP	0.005	-0.01	0.002	-0.006	-0.005	0	-0.002	0	0	-0.003	-0.002	-0.011	**-0.119**	0	-0.15
SR	0.003	0	0	0.03	0.006	0	0	0.005	0	0.006	0.003	0.009	-0.001	**0.025**	0.08

(Residual: 0.5 Diagonal values indicate direct effects on grain yield.)

DF - Days to 50% flowering
DH - Dead heart (%)
PH - Plant height at maturity
PW - Panicle weight
PL - Panicle length
NP - Number of primaries per panicle
TW - Test weight
BD - Seed bulk density
TD - Seed true density
SV - Seed volume
SS - Seed size
SO - Seed oil content
SP - Seed protein
SR - Seed reflectance
GY - Grain yield

Table 3
Genotypic Path analysis for Yield components, Yield & Qualitative traits in Rabi Sorghum

Traits	*DF*	*DH*	*PH*	*PW*	*PL*	*NP*	*TW*	*BD*	*TD*	*SV*	*SS*	*SO*	*SP*	*SR*	*GY*
DF	**0.054**	-0.025	0.048	-0.077	0.03	0.004	0.039	-0.201	-0.012	0.104	-0.061	0.01	0.057	-0.002	-0.03
DH	-0.012	**0.108**	-0.072	0.011	-0.024	-0.032	-0.07	0.028	0.003	-0.048	0.087	-0.015	0.068	0	0.025
PH	0.007	-0.021	**0.373**	0.112	0.011	0.08	0.059	-0.238	0.016	0.002	-0.007	0	-0.001	0	0.393
PW	-0.01	0.003	0.112	**0.373**	-0.011	0.114	0.093	-0.097	0.007	0.062	-0.011	0.045	0.01	-0.001	0.69
PL	-0.034	0.056	-0.09	0.085	**-0.047**	-0.02	-0.078	0.074	0.015	-0.09	0.13	0.01	-0.031	0.001	0.019
NP	0.001	-0.013	0.109	0.156	0.003	**0.274**	0.014	-0.266	0	0.011	0.016	0.003	-0.023	0.001	0.312
TW	0.009	-0.031	0.091	0.144	0.016	0.016	**0.242**	-0.124	-0.003	0.195	-0.265	0.03	0.057	0	0.375
BD	-0.016	0.004	-0.129	-0.052	-0.005	-0.105	-0.043	**0.691**	-0.005	-0.069	-0.045	-0.02	-0.099	-0.003	0.105
TD	-0.012	-0.006	0.113	0.05	-0.013	0.002	-0.014	-0.059	**0.055**	-0.03	0.025	-0.027	0.061	0.006	0.149
SV	0.019	-0.017	0.003	0.077	0.014	0.037	0.157	-0.159	-0.005	**0.3**	-0.245	0.041	0.031	-0.001	0.252
SS	0.009	-0.025	0.007	0.011	0.016	-0.012	0.171	0.082	-0.004	0.196	**-0.376**	0.004	0.078	-0.002	0.154
SO	-0.003	0.009	0	-0.094	-0.003	-0.006	-0.041	0.076	0.008	-0.069	0.008	**0.179**	-0.021	0.002	-0.306
SP	-0.008	-0.02	0.001	-0.01	0.004	0.019	-0.037	0.184	-0.009	-0.025	0.078	-0.01	**-0.374**	0.001	-0.213
SR	0.006	0	-0.007	0.029	0.003	-0.015	0.003	0.149	-0.019	0.027	-0.05	0.023	0.017	**-0.016**	0.15

(Residual: 0.1 Diagonal values indicate direct effects on grain yield.)

DF - Days to 50% flowering
DH - Dead heart (%)
PH - Plant height at maturity
PW - Panicle weight
PL - Panicle length
NP - Number of primaries per panicle
TW - Test weight
BD - Seed bulk density
TD - Seed true density
SV - Seed volume
SS - Seed size
SO - Seed oil content
SP - Seed protein
SR - Seed reflectance
GY - Grain yield

are negatively associated with the grain yield. The germplasm with high protein and seed reflectance have less yield potential.

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