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Studies on Correlation and Path Analysis for Seed Yield and Yield Attributing Characters in Blackgram (*Vigna mungo* (L.) Hepper)

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ABSTRACT

The present research on character association and path analysis was carried out with 78 genotypes for fifteen component characters i.e RARS, Lam during *Rabi* 2020-21. Character association and Path Analysis was studied for the characters plant stand, days to 50% flowering, days to maturity, plant height (cm), number of branches plant^{-1}, number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1}, pod length (cm), number of seeds pod^{-1}, 100 seed weight, protein content (%), iron content (mg/100g), zinc content (mg/100g) and seed yield plant^{-1} (g). Significant positive character association was recorded by characters plant height, number of branches plant^{-1}, number of clusters plant^{-1}, number of pods plant^{-1}, number of pods plant^{-1} and 100 seed weight and seed yield plant^{-1}. While the characters viz., plant stand, days to 50% flowering, days to maturity, pod length, number of seeds pod^{-1} and protein content showed non-significant positive association with seed yield plant^{-1}, whereas iron content and zinc content expressed non-significant negative association with seed yield plant^{-1}. High Positive direct effect was recorded by number of pods plant^{-1} for seed yield plant^{-1}. Low to negligible positive direct effect was recorded for seed yield plant^{-1} by the characters plant stand, days to maturity, plant height, number of branches plant^{-1}, pod length, number of seeds pod^{-1}, zinc content and iron content. The characters days to 50% flowering, number of clusters plant^{-1}, number of pods plant^{-1}, 100 seed weight and protein content recorded low to negligible negative direct effect for seed yield plant^{-1}.

Key words : *Blackgram, Correlation, Path Analysis*

Blackgram is an important short duration pulse crop grown in an extensive range of agro-climatic conditions in all the three seasons. It is suitable to various cropping patterns *viz*., mixed system, catch system, sequential system and grown as a sole crop under abiding soil moisture conditions after the paddy harvest. India produces 70% world's blackgram production and it accounts 10% of the total pulse production in India. Blackgram enriches soil environment through biological nitrogen fixation 50-55 kg of N/ha (Motsara *et al.* 2004) and prevents soil erosion as an cover crop, and also beneficial as a green manuring crop and fodder crop. Pulses are the chief and cheapest sources of plant-based dietary protein for the vegetarian people. Blackgram is rich in seed protein content (24-28%) and contributes 62-65% per cent carbohydrate, 1.0-1.5% oil, 3.5-4.5% fiber, 4.5-5.5% ash on dry weight basis with an excellent source of high quality easily digestible dietary protein and battering quality. Low productivity in the present day cultivars has been implicated to lack of variability in pulse crop breeding programmes. Correlation coefficient measures the degree of association of various component characters of yield among themselves and with the seed yield. Correlation studies help to determine the yield components but do not provide clear picture of each component characters direct and indirect influence on seed yield. Path coefficient analysis suggested by Dewey and Lu (1959) proves helpful in partitioning the correlation coefficient into its direct and indirect effects of a set of independent variables on the dependent variable. Direct effects occur when a variable has a direct influence on seed yield plant^{-1}, while indirect effects take place when a variable influences seed yield plant^{-1} through one or more intermediate variables. Hence the knowledge on correlation coefficient and path analysis in the present research work helps in devising efficient breeding programme to develop productive genotypes in blackgram.

MATERIAL AND METHODS

The experimental material is comprised 78 genotypes of released varieties, land races and advanced cultures of blackgram. The experiment was conducted at Regional Agricultural Research Station, Lam, Guntur during *Rabi* 2020-2021. Seventy eight blackgram genotypes along with five released varieties as checks, *viz*., LBG 623, LBG 752, LBG 787, OBG 103 and GBG 1 were sown in Augmented Block Design. Each entry was sown in 2 rows by dibbling the seeds in 4 m length rolo by adopting spacing of 30 cm between the rows and 10 cm within. For healthy crop recommended package of practices were implemented. The observations were recorded on five randomly taken plants to each genotype on plant stand, days to 50% flowering, days to maturity, plant height (cm), number of branches plant^{-1}, number of clusters plant^{-1}, number of pods cluster^{-1}, number of pods plant^{-1}, pod length (cm), number of seeds pod^{-1}, 100 seed weight (g), protein content (%), iron content (mg/100g), zinc content (mg/100g) and seed yield plant^{-1} (g).

RESULTS AND DISCUSSION

Correlation Studies

Character associations between yield, yield components and nutritional characters are presented in Table 1.1. The outcomes are discussed character by character below.

The trait days to 50% flowering exhibited significant and positive association with days to maturity (0.721**) and days to maturity it showed significant and positive association with number of clusters plant^{-1} (0.245*). Plant height had cogent and positive association with seed yield plant^{-1} (0.751**), number of pods plant^{-1} (0.718**), number of branches plant^{-1} (0.617**), number of pods cluster^{-1} (0.467**), number of clusters plant^{-1} (0.460**) and 100 seed weight (0.308*). These finding are in conscience with earlier works by Kumar *et al.* (2015b), Punithavathy (2020) and Gomathi *et al*. (2023) for seed yield plant^{-1}.

For the quantitative character, number of branches plant^{-1} exhibited significant and positive phenotypic association with seed yield plant^{-1} (0.781*), number of pods plant^{-1} (0.773**), number of clusters plant^{-1} (0.579**), number of pods cluster^{-1} (0.362**) and 100 seed weight (0.334*), indicating importance of this character in deciding the seed yield plant^{-1}. The quantitative character, number of clusters plant^{-1} recorded significant and positive phenotypic correlation with number of pods plant^{-1} (0.794**), seed yield plant^{-1} (0.668**) and 100 seed weight (0.273*), selecting this trait may improve seed yield plant^{-1}. These results are in conformity with those of Punithavathy (2020), Aman Mishra and G.R. Lavanya (2021), Lalam Gangadhar *et al.* (2022) and Gomathi *et al*. (2023) for seed yield plant^{-1}. For the character number of pods cluster^{-1} showed significant and positive association with seed yield plant^{-1} (0.474**), pod length (0.400**), number of pods plant^{-1} (0.389**) and number of seeds pod^{-1} (0.360*). Number of pods plant^{-1} which is important yield contributing character showed significant and positive phenotypic association with seed yield (0.933**) and 100 seed weight (0.250*). These results are in conformance with those of Punithavathy (2020), Rajalakshmi (2020), Aman Mishra and G.R. Lavanya (2021), Lalam Gangadhar *et al.* (2022) and Gomathi *et al*. (2023) for seed yield plant^{-1}. The character pod length exhibited significant and positive association with number of seeds pod^{-1} (0.878**). For 100 seed weight significant and positive association was observed for seed yield plant^{-1} (0.287*). Protein content of seed exhibited non-significant positive association with zinc content, iron content and seed yield plant^{-1}. Iron content recorded no association with any character under study. Zinc content recorded non-significant positive association with Iron content.

PATH ANALYSIS

The results on path coefficient analysis of yield components and nutritional characters with respect to seed yield plant^{-1} are presented in Table 1.2 and Figure 1.1 depicts the path diagram. The outcomes are discussed character by character below.

Days to 50% flowering showed positive correlation (0.1545) and negligible negative direct effect (-0.0211) on seed yield plant^{-1}. These findings are in agreement with the result of Arya *et al*. (2017) and Lalam Gangadhar *et al.* (2022). Days to maturity recorded positive association (0.1638) and negligible positive direct effects (0.0513) on seed yield plant^{-1}, similar result are reported by Arya *et al*. (2017), Rajasekar *et al*. (2017), Sateesh *et al*. (2018) and Sagar *et al*. (2021). The character plant height (cm) had recorded high positive and significant association (0.751**) on seed yield and negligible positive direct effect (0.0513). Number of branches plant^{-1} documented high positive and significant association (0.781**) with seed yield plant^{-1} and with negligible positive direct effect (0.0832) at phenotypic level and these results are supported by Prasanna *et al*. (2018), Sagar *et al.* (2021), Sathya *et al.* (2021) and Lalam Gangadhar *et al.* (2022). Direct selection of this trait will be effectual for improving seed yield. The character number of clusters plant^{-1}, exhibited high positive and significant association (0.668**) and negligible negative effect (-0.0715) on seed yield plant^{-1} and same reported by Arya *et al.* (2017), Jyothi *et al.* (2019) and Priyanka *et al.* (2022). In such situations the selection should be restricted to the causal factors showing positive indirect effects on seed yield plant. Number of clusters plant displayed significant and positive association (0.474**) and negligible negative direct effect (-0.018) on seed yield plant^{-1}.

Number of pods/plant had high positive and significant correlation (0.933**) and very high positive direct effect (0.895) on seed yield plant^{-1} and the results are in consonance by Jyothi *et al.* (2019), Aman Mishra and G.R. Lavanya (2021), Priyanka *et al.* (2022), Lalam Gangadhar *et al.* (2022) and Gomathi *et al*. (2023). As this character showed positive correlation with seed yield plant^{-1}, direct selection of this trait will be effective and rewarding. The quantitative characters pod length and number of seeds pod^{-1} had positive correlation and negligible direct positive effect (0.0669) on seed yield plant^{-1}.

100-seed weight expressed high positive and significant correlation (0.287*) and low direct negative effect (-0.0039) on seed yield plant^{-1}. These findings are in acceptance with the results of Venkatesan *et al*. (2004) and Gomathi *et al*. (2023). Protein content exhibited non-significant positive correlation, iron content and zinc content expressed negative and non-significant association with seed yield plant^{-1}.

Complete knowledge of all yield component traits in plant breeding is extremely difficult. The residual effect allows for a precise assesses the impact of possible independent variables that were excluded from the study on the dependent variable. Overall results revealed that 74.0 percent of variability for seed yield was expounded by characters included in the current research and a low residual effect of (0.26) from other traits not included.

Estimation of direct and indirect effects of 15 yield contributing characters, number of pods/plant had high positive and maximum direct effects on seed yield plant^{-1} followed by number of branches/plant, plant height, number of clusters/plant, number of pods/cluster, 100 seed weight and pod length and hence, direct selection based on these traits would be effective in increasing seed yield.

In the present study, out of 105 associations 24 associations were highly positively significant, 48 association were non-significant positive, 2 are significant negative association and rest 31 associations are negatively non-significant. Additive genetic model was suggested as the characters under the study expressed positive and significant associations and are not influenced by environmental fluctuations. Positive non-significant association, indicating the need for use of restricted simultaneous selection model for nullifying the undesirable indirect effects in order to make use of the high positive direct effects observed for the traits on seed yield plant and negative significant association refers to complex linked relations. Summary of research findings suggested the need for balanced selection while effecting simultaneous improvement of these traits. Plant height and number of branches/plant showed positive and significant associations with many characters, indicating importance of these characters for consideration during selection. Path analysis revealed that seed yield showed direct affinity with number of pods/plant, number of branches/plant, plant height, number of clusters/plant, number of pods/cluster and 100 seed weight by establishing significant positive associations and positive direct effects. Hence, these characters should be considered during selection of genotypes for improving the dependent variable *i.e.,* seed yield plant^{-1}.

For the seventy eight genotypes of blackgram under study for correlation and path effects for fifteen traits, plant height, number of branches/plant, number of clusters/plant, number of clusters/pod, number of pods/plant and 100 seed weight had positive and significantly association with seed yield plant^{-1} and these six traits can be used as a selection index for improving seed yield. Path analysis revealed that number of pods/plant was the principle component responsible for increasing seed yield in blackgram and it showed high positive and direct effects on seed yield.

Table 1.1 Character associations of yield, yield components, quality and nutritional traits in blackgram genotypes

Plant Stand	1.0000	0.0594	0.0479	0.0959	-0.0118	0.0668	-0.0218	0.0235	-0.1057	-0.1151	-0.0491	-0.1281	0.1058	-0.0218	0.0114
Days to 50% flowering		1.0000	0.721**	0.0204	0.0817	0.1320	0.0433	0.1614	0.0286	-0.0038	-0.0607	0.0273	-0.1837	0.0745	0.1545
Days to maturity			1.0000	0.0214	0.1653	0.245*	-0.1288	0.1631	-0.0324	-0.0764	0.0404	0.0266	-0.1337	0.0173	0.1638
Plant height (cm)				1.0000	0.617**	0.460**	0.467**	0.718**	0.1997	0.1633	0.308*	0.0237	-0.0017	0.0287	0.751**
Number of branches plant^{-1}					1.0000	0.579**	0.362*	0.773**	0.0685	0.0491	0.334*	0.0366	0.0493	-0.0926	0.781**
Number of clusters plant^{-1}						1.0000	-0.2134	0.794**	-0.268*	-0.266*	0.273*	0.0391	-0.0471	0.0035	0.668**
Number of pods cluster^{-1}							1.0000	0.389**	0.400**	0.360*	0.0515	-0.0388	-0.0623	-0.0114	0.474**
Number of pods plant^{-1}								1.0000	-0.0020	-0.0479	0.250*	0.0060	-0.0729	-0.0109	0.933**
Pod length (cm)									1.0000	0.878**	0.1820	0.1536	-0.0546	-0.0415	0.2165
Number of seeds pod^{-1}										1.0000	0.1586	0.2018	0.0221	-0.0915	0.1818
100 seed weight (g)											1.0000	-0.0711	-0.0381	0.1530	0.287*
Protein (%)												1.0000	0.0680	0.0536	0.0367
Zn (mg/100g)													1.0000	0.2060	-0.0232
Fe (mg/100g)														1.0000	-0.0136
Seed yield plant^{-1} (g)															1.0000

Table 1.2 Direct and indirect effects of yield components, quality and nutritional traits in blackgram genotypes

	Plant Stand	Days to 50% flowering	Days to maturity	Plant height (cm)	Number of branches plant^{-1}	Number of clusters plant^{-1}	Number of pods cluster^{-1}	Number of pods plant^{-1}	Pod length (cm)	Number of seeds pod^{-1}	100 seed weight (g)	Protein (%)	Zn (mg/ 100g)	Fe (mg/ 100g)	Seed yield plant^{-1} (g)
Plant Stand	**0.0076**	0.0005	0.0004	0.0007	-0.0001	0.0005	-0.0002	0.0002	-0.0008	-0.0009	-0.0004	-0.0010	0.0008	-0.0002	0.0114
Days to 50% flowering	-0.0013	**-0.0211**	-0.0152	-0.0004	-0.0017	-0.0028	-0.0009	-0.0034	-0.0006	0.0001	0.0013	-0.0006	0.0039	-0.0016	0.1545
Days to maturity	0.0025	0.0369	**0.0513**	0.0011	0.0085	0.0126	-0.0066	0.0084	-0.0017	-0.0039	0.0021	0.0014	-0.0069	0.0009	0.1638
Plant height (cm)	0.0057	0.0012	0.0013	**0.0597**	0.0368	0.0275	0.0279	0.0429	0.0119	0.0098	0.0184	0.0014	-0.0001	0.0017	0.751**
Number of branches plant^{-1}	-0.0010	0.0068	0.0138	0.0513	**0.0832**	0.0482	0.0301	0.0643	0.0057	0.0041	0.0278	0.0030	0.0041	-0.0077	0.781**
Number of clusters plant^{-1}	-0.0048	-0.0094	-0.0175	-0.0329	-0.0414	**-0.0715**	0.0153	-0.0567	0.0191	0.0190	-0.0195	-0.0028	0.0034	-0.0002	0.668**
Number of pods cluster^{-1}	0.0004	-0.0008	0.0023	-0.0084	-0.0065	0.0038	**-0.0180**	-0.0070	-0.0072	-0.0065	-0.0009	0.0007	0.0011	0.0002	0.474**
Number of pods plant^{-1}	0.0211	0.1445	0.1460	0.6430	0.6921	0.7102	0.3485	**0.8950**	-0.0018	-0.0429	0.2241	0.0053	-0.0652	-0.0098	0.933**
Pod length (cm)	-0.0071	0.0019	-0.0022	0.0134	0.0046	-0.0179	0.0267	-0.0001	**0.0669**	0.0587	0.0122	0.0103	-0.0036	-0.0028	0.2165
Number of seeds pod^{-1}	-0.0171	-0.0006	-0.0113	0.0242	0.0073	-0.0394	0.0535	-0.0071	0.1303	**0.1484**	0.0235	0.0299	0.0033	-0.0136	0.1818
100 seed weight (g)	0.0002	0.0002	-0.0002	-0.0012	-0.0013	-0.0011	-0.0002	-0.0010	-0.0007	-0.0006	**-0.0039**	0.0003	0.0001	-0.0006	0.287*
Protein (%)	0.0018	-0.0004	-0.0004	-0.0003	-0.0005	-0.0006	0.0006	-0.0001	-0.0022	-0.0029	0.0010	**-0.0143**	-0.0010	-0.0008	0.0367
Zn (mg/100g)	0.0036	-0.0062	-0.0045	-0.0001	0.0017	-0.0016	-0.0021	-0.0025	-0.0019	0.0008	-0.0013	0.0023	**0.0340**	0.0070	-0.0232
Fe (mg/100g)	-0.0003	0.0010	0.0002	0.0004	-0.0013	0.0001	-0.0002	-0.0001	-0.0006	-0.0013	0.0021	0.0007	0.0028	**0.0137**	-0.0136
Seed yield plant^{-1} (g)	0.0114	0.1545	0.1638	0.751**	0.781**	0.668**	0.474**	0.933**	0.2165	0.1818	0.287*	0.0367	-0.0232	-0.0136	**1.0000**
Partial R^2	0.0001	-0.0033	0.0084	0.0448	0.0650	-0.0477	-0.0085	0.8348	0.0145	0.0270	-0.0011	-0.0005	-0.0008	-0.0002	

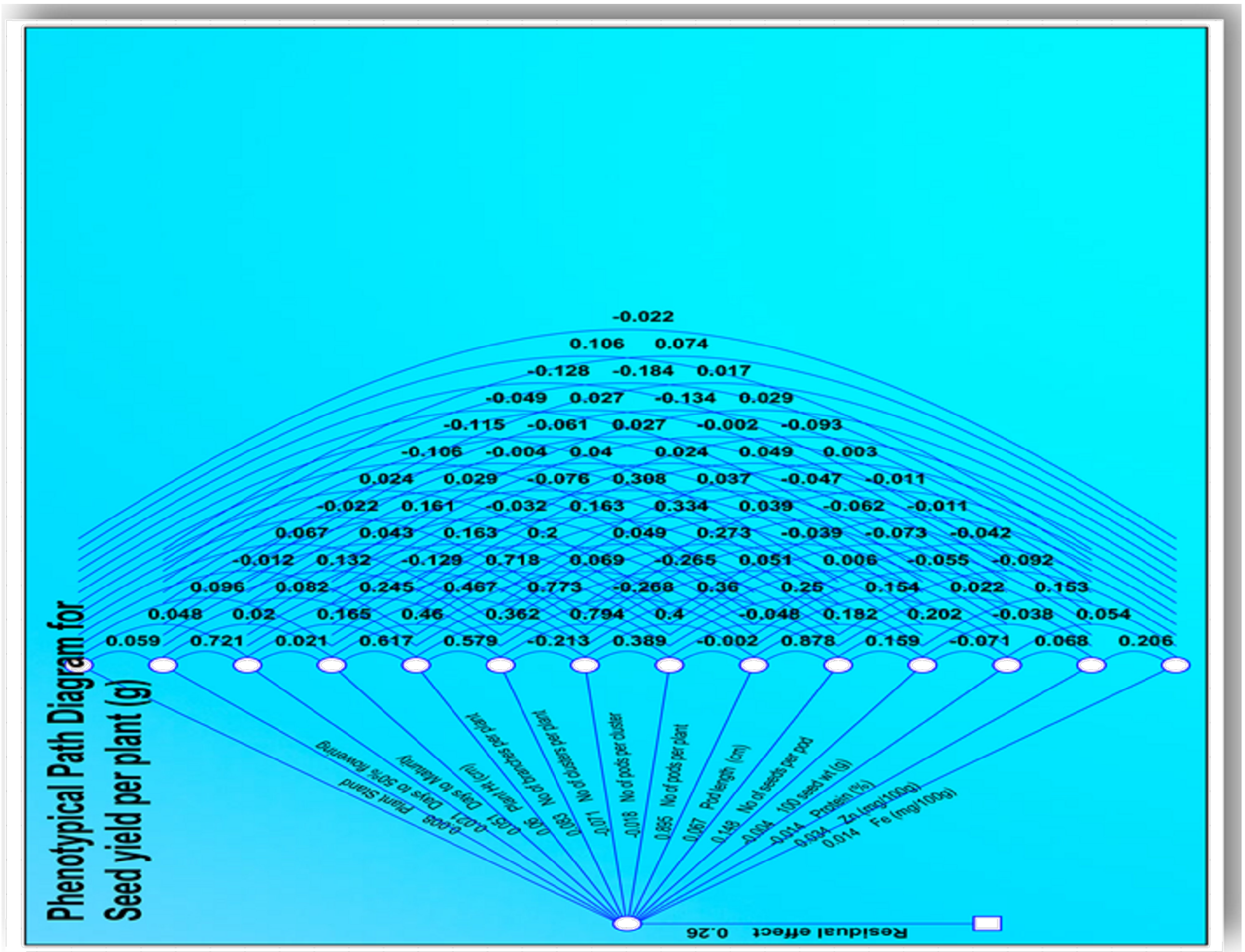

Fig. 1.1. Phenotypic path diagram for seed yield and its components in blackgram (*Vigna mungo* L.)

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