**CORRELATION AND PATH COEFFICIENT ANALYSIS IN BLACKGRAM (*Vigna mungo* L.)**

**ABSTRACT**

The Blackgram is a short duration crop suitable for multiple cropping systems and intercropping. It is indeterminate in habit of flowering and fruiting and there is a continuous competition for available assimilates between vegetative and reproductive sinks throughout the growth period. The present study was undertaken to estimate genotypic associations between yield contributing characters along with path analysis for developing suitable selection criterion for blackgram improvement. The experiment was carried out at Tamil Nadu Agricultural University, Coimbatore during July to October, 2023. The blackgram (*Vigna mungo* L.) *var*. VBN 11 was studied in randomized block design with three replications for correlations, and direct and indirect effects for quantitative characters. Maximum coefficient value of highly significant positive correlation was recorded between leaf area index and chlorophyll content (0.989). The path analysis provided the cause and effect of the relationship between the variables by partitioning the association into direct and indirect effects through other independent variables. It was concluded that the yield contributing characters viz., plant height, number of leaves per plant, leaf area index, chlorophyll content, number of flowers per plant, conversion efficiency percentage, number of pods per plant, number of cluster per plant, pod yield per plant, seed yield per plant, seed recovery percentage, 100 see weight and pod yield per ha had strong positive association with seed yield per ha. The characters, leaf area index, chlorophyll content, conversion efficiency percentage, seed yield per plant and 100-seed weight had a positive direct effect on seed yield.

*Keywords: Blackgram; Correlation; direct and indirect effects for quantitative characters; Seed yield contributing characters*

1. **INTRODUCTION**

Blackgram **(***Vigna mungo***)** is a widely grown grain legume and belongs to the family fabaceae and assumes considerable importance from the point of food and nutritional security. It is a short duration crop suitable for multiple cropping systems and intercropping.

It plays an important role in vegetarian diets in South Asia due to its high nutritive value. Mature dry seeds of black gram possess approximately 24%–26% protein, 60% carbohydrates, 1.3% fats, phosphorus (345 mg/100 g), potassium, iron (8.7 mg/100 g), and calcium (185 mg/100 g) along with several essential amino acids (arginine, phenylalanine, leucine, lysine, valine, and isoleucine, etc.), vitamins such as vitamin B3 (niacin; 2 mg/100g), vitamin A (23 IU/100 g), vitamin B1 (thiamine; 0.42 mg/100 g), and vitamin B2 (riboflavin; 0.37 mg/100 g) [8]. The largest producer of black gram is India, but it does not meet domestic consumption. The insufficient production of pulses in India also makes it the largest importer of black gram [9].

In Tamil Nadu, black gram is cultivated in an area of 3.41 lakh ha with production of 1.21 lakh tonnes and productivity of 354 kg ha-1. It adds 42 kg N/ha in the soil. It possesses a deep root system which binds soil particles and thus, prevents erosion [10]. Black gram is basically indeterminate in habit of flowering and fruiting and there is a continuous competition for available assimilates between vegetative and reproductive sinks throughout the growth period. The source is highly limited in pulses with lowering translocation of assimilates to the growing reproductive sinks. Hence, leaf area is an important parameter to obtain higher source in terms of higher assimilation production.

Apart from this, major physiological constraints are flower drop and fruit drop. Therefore, present study was conducted to study the effect of nitrogen and plant growth regulators as a soil and foliar applications on growth attributes and yield of black gram.

As seed yield is a very complex character and depends upon numerous genetic factors interacting with the environment, it is always advisable to find out the interrelationship of yield component with highly heritable characters and giving selection pressure on these characters, which accounts for the indirect selection. To accumulate optimum contribution of yield contributing characters, it is essential to know the correlation of various characters along with path coefficients. The present study was undertaken to estimate genotypic associations between yield contributing characters along with path analysis for developing suitable selection criterion for blackgram improvement.

1. **MATERIALS AND METHODS**

The experiment was carried out at Tamil Nadu Agricultural University, Coimbatore during July to October, 2023. Correlation between yield and yield components characters was estimated according to the method given by Singh and Chaudhary (1977) [1]; whereas path coefficient analysis was done by the method given by Dewey and Lu (1959) [2].

1. **RESULTS AND DISCUSSION**

The estimates of correlation coefficients between different characters of black gram are presented in Table 1. Among the various traits studied, leaf area index (1.008), chlorophyll content (0.996), pod yield plant-1(1.000), seed recovery percentage (0.999) and 100 seed weight (1.000) had highly significant positive correlation with seed yield. Conversion efficiency percentage (0.954) and pod yield ha-1 (0.980) had a significant correlation with seed yield. Significant negative correlation with yield was observed in flower drop percentage (-0.963).

**Table 1. Genotypic correlation coefficient values among seed yield and yield components in black gram VBN 11 during October, 2023**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **PH** | **LEA** | **LAI** | **CC** | **FLO** | **POD** | **CE** | **FD** | **CLU** | **PYPL** | **SYPL** | **SR** | **100** | **PYHA** | **SYHA** |
| **PH** | 1 | 0.609 | 0.665 | 0.821\* | 0.800\* | 0.703 | 0.536 | -0.181 | 0.676 | 0.750 | 0.929\*\* | 0.662 | 0.750 | 0.752 | 0.757\* |
| **LEA** |  | 1 | 0.832\* | 0.844\* | 0.879\* | 0.910\*\* | 0.537 | -0.587 | 0.857\* | 0.794\* | 0.886\*\* | 0.769\* | 0.759\* | 0.865\* | 0.779\* |
| **LAI** |  |  | 1 | 0.989\*\* | 0.854\* | 0.918\*\* | 0.635 | -0.513 | 0.910\*\* | 0.958\*\* | 1.000\*\* | 1.002\*\* | 1.000\*\* | 1.000\*\* | 1.000\*\* |
| **CHC** |  |  |  | 1 | 0.950\*\* | 0.961\*\* | 0.739 | -0.362 | 0.876\* | 0.973\*\* | 1.000\*\* | 0.975\*\* | 1.000\*\* | 1.000\*\* | 1.000\*\* |
| **FLO** |  |  |  |  | 1 | 0.981\*\* | 0.837\* | -0.168 | 0.836\* | 0.921\*\* | 0.972\*\* | 0.833\* | 0.879\*\* | 0.971\*\* | 0.927\*\* |
| **POD** |  |  |  |  |  | 1 | 0.838\* | -0.277 | 0.902\*\* | 0.948\*\* | 1.000\*\* | 0.951\*\* | 0.927\*\* | 0.965\*\* | 0.987\*\* |
| **CE** |  |  |  |  |  |  | 1 | 0.299 | 0.612 | 0.757\* | 0.750 | 0.777\* | 0.725 | 0.733 | 0.799\* |
| **FD** |  |  |  |  |  |  |  | 1 | -0.514 | -0.327 | -0.391 | -0.382 | -0.356 | -0.375 | -0.332 |
| **CLU** |  |  |  |  |  |  |  |  | 1 | 0.960\*\* | 1.000\*\* | 1.009\*\* | 0.884\*\* | 0.921\*\* | 0.938\*\* |
| **PYPL** |  |  |  |  |  |  |  |  |  | 1 | 1.000\*\* | 1.000\*\* | 0.979\*\* | 1.000\*\* | 0.975\*\* |
| **SYPL** |  |  |  |  |  |  |  |  |  |  | 1 | 1.000\*\* | 1.000\*\* | 1.000\*\* | 1.000\*\* |
| **SR** |  |  |  |  |  |  |  |  |  |  |  | 1 | 1.000\*\* | 0.997\*\* | 1.000\*\* |
| **100** |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1.000\*\* | 1.000\*\* |
| **PYHA** |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 | 1.000\*\* |
| **SYHA** |  |  |  |  |  |  |  |  |  |  |  |  |  |  | 1 |

\* Significant at P : 0.05 \*\* Significant at P : 0.01

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| PH-plant height | LEA- number of leaves plant-1 | LAI-leaf area index | CC-chlorophyll content | FLW-number of flowers plant-1 |
| POD-number of pods plant-1 | CE-conversion efficiency | FD-flower drop (%) | CLU-number of cluster plant-1 | PYPL-pod yield plant-1 |
| SYPL-seed yield plant-1 | SR-seed recovery (%) | 100 seed weight | PYHA-pod yield ha-1 | SYHA- seed yield ha-1 |

* 1. **Interrelationship among different traits**

Plant height had highly significant positive association with seed yield per plant (0.929) and had significant positive association with chlorophyll content (0.821) and number of flowers per plant (0.800).

Number of leaves per plant exhibited highly significant positive relationship with number of pod per plant (0.910) and seed yield per plant (0.886) and had significant positive relationship with leaf area index (0.832), chlorophyll content (0.844), number of flowers per plant (0.879), number of pods per plant (0.910), number of cluster plant (0.857), pod yield per plant (0.794), 100 seed weight (0.759 ), seed recovery percentage (0.769) and pod yield per ha (0.865).

Maximum coefficient value of highly significant positive correlation was recorded between leaf area index and chlorophyll content (0.989). Leaf area index showed highly significant positive association with number of pods per plant (0.918), number of cluster per plant (0.910), pod yield per plant (0.958), seed yield per plant (1.023),100 seed recovery percentage (1.002), 100 seed weight (1.000) and pod yield ha (1.000) and had significant positive number of flowers per plant (0.854). Chlorophyll content recorded highly significant positive relationship with number of flowers per plant (0.950), number of pod per plant (0.961), pod yield per plant (0.973), seed yield per plant (1.000), 100 seed recovery percentage (0.975), 100 seed weight (1.000) and pod yield per plant (1.000) and had significant positive relationship with number of cluster per plant (0.876). Number of flowers per plant showed highly significant positive relationship with number of pods per plant (0.981), pod yield per plant (0.921), seed yield per plant (0.972), 100 seed weight (0.879) and pod yield per ha (0.971) and had significant positive association with conversion efficiency (0.837), number of cluster per plant (0.836) seed recovery percentage (0.833). Number of pods per plant had highly significant positive relationship with number o of cluster per plant (0.902), pod yield per plant (0.948), seed yield per plant (1.009), seed recovery percentage (0.951), 100 seed weight (0.927) and pod yield per ha (0.965) and had significant positive relationship with conversion efficiency (0.838). Conversion efficiency percentage registered a significant positive relationship with pod yield per plant (0.757) and seed recovery percentage (0.777). Number of clusters per plant registered a significant positive relationship with pod yield per plant (0.960), seed yield per plant (1.000), seed recovery percentage (1.000), 100 seed weight (0.884) and pod yield per ha (0.921). Pod yield per plant had highly significant positive association with seed yield per plant (1.000), seed recovery percentage (1.000) and 100 seed weight (0.979).

Seed yield per plant had highly significant positive association with seed recovery percentage (1.000) 100 seed weight (1.000) and pod yield ha (1.000). Seed recovery percentage registered significant positive relationship with 100 seed weight (1.000) and also pod yield per ha (0.997). Similar result were reported by Santha and Paramasivam (1999) [3].

**3.2. Path coefficient analysis**

Path coefficient analysis was done to obtain information on interrelationship among characters and their effects on seed yield. The path analysis provided the cause and effect of relationship between the variables by partitioning the association into direct and indirect effects through other independent variables. The direct and indirect effect of the studied characters towards the seed yield is presented in tables 2.

**3.3 Direct effect of different traits on seed yield (Table 2)**

The direct effect of yield contributing characters towards the seed yield revealed that the characters, chlorophyll content (0.896), conversion efficiency (0.475) and leaf area index (0.469) showed the highest positive direct effect on seed yield. The seed yield per plant (0.267) and 100 seed weight (0.221) recorded moderate positive direct effect on seed yield. Umadevi and Meenakshi (2005) [4] reported positive direct effect of number of clusters per plant on seed yield per plant. Kingshlin and Vanniarajan (2000) [5] and Mahala. et al. (2001) [6] and Krishna Surendar (2013)[7] reported positive direct effect for these characters.

Negative direct effect on seed yield was observed by the traits *viz*., pod yield per plant (-0.048), flower drop percentage (-0.111), seed recovery percentage (-0.126), number of flowers per plant (-0.228), number of pods per plant (-0.301) and pod yield per ha (-0.506).

**3.4 Indirect effect of different traits on seed yield**

Maximum value of positive indirect effect on yield was contributed by pod yield per ha (0.908) followed by 100 seed weight (0.897), leaf area index (0.887), seed recovery percentage (0.873), number of flower per plant (0.851) and number of pods per plant (0.861) through chlorophyll content and had the highest negative effect on pod yield per plant (-0.036) followed by flower drop percentage (-0.033).

**Table 2. Path correlation coefficients analysis of seed yield with yield attributing parameters in black gram VBN 11 during October, 2023**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **LAI** | **CC** | **FLW** | **POD** | **CE** | **FD** | **PYPL** | **SYPL** | **SR** | **100SW** | **PYHA** |
| **LAI** | 0.469 | 0.887 | -0.194 | -0.277 | 0.302 | 0.057 | -0.046 | 0.226 | -0.126 | 0.224 | -0.510 |
| **CC** | 0.464 | 0.896 | -0.216 | -0.290 | 0.351 | 0.040 | -0.046 | 0.233 | -0.122 | 0.221 | -0.513 |
| **FLW** | 0.400 | 0.852 | -0.228 | -0.295 | 0.398 | 0.019 | -0.044 | 0.227 | -0.105 | 0.194 | -0.491 |
| **POD** | 0.431 | 0.862 | -0.223 | -0.301 | 0.398 | 0.031 | -0.045 | 0.238 | -0.119 | 0.205 | -0.488 |
| **CE** | 0.298 | 0.663 | -0.190 | -0.252 | 0.475 | -0.033 | -0.036 | 0.184 | -0.097 | 0.160 | -0.371 |
| **FD** | -0.240 | -0.324 | 0.038 | 0.084 | 0.142 | -0.111 | 0.016 | -0.095 | 0.048 | -0.079 | 0.189 |
| **PYPL** | 0.449 | 0.872 | -0.209 | -0.286 | 0.360 | 0.036 | -0.048 | 0.250 | -0.130 | 0.216 | -0.536 |
| **SYPL** | 0.396 | 0.782 | -0.193 | -0.268 | 0.326 | 0.039 | -0.045 | 0.267 | -0.125 | 0.193 | -0.439 |
| **SR** | 0.470 | 0.874 | -0.189 | -0.286 | 0.369 | 0.042 | -0.049 | 0.266 | -0.126 | 0.239 | -0.504 |
| **100SW** | 0.476 | 0.897 | -0.200 | -0.279 | 0.344 | 0.039 | -0.047 | 0.234 | -0.136 | 0.221 | -0.524 |
| **PYHA** | 0.473 | 0.909 | -0.221 | -0.291 | 0.348 | 0.042 | -0.051 | 0.232 | -0.125 | 0.229 | -0.506 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| LAI-leaf area index | CC-chlorophyll content | FLW- number of flowers plant-1 | POD-number of pods plant-1 | CE- conversion efficiency |
| FD- flower drop (%) | PYPL- pod yield plant-1 | SYPL- seed yield plant-1 | SR- seed recovery (%) | 100 seed weight |
| PYHA- pod yield ha-1 |  | Residual effect =0.248 |  |  |

\* Significant at P : 0.05 \*\* Significant at P : 0.01

Re

**4. CONCLUSION**

From this study, it could be concluded that the seed yield per plant and 100 seed weight recorded a moderate positive direct effect on seed yield. Negative direct effect on seed yield was observed by the traits *viz*., pod yield per plant, flower drop percentage, seed recovery percentage, number of flowers per plant, number of pods per plant and pod yield per ha. Maximum value of positive indirect effect on yield was contributed by pod yield, followed by 100 seed weight, leaf area index, seed recovery percentage, number of flowers per plant and number of pods per plant, through chlorophyll content and had the highest negative effect on pod yield per plant followed by flower drop percentage.

The yield contributing characters viz., plant height, number of leaves per plant, leaf area index, chlorophyll content, number of flowers per plant, conversion efficiency percentage, number of pods per plant, number of cluster per plant, pod yield per plant, seed yield per plant, seed recovery percentage, 100 see weight and pod yield per ha had strong positive association with seed yield per ha. The characters, leaf area index, chlorophyll content, conversion efficiency percentage, seed yield per plant and 100-seed weight had a positive direct effect on seed yield.

Disclaimer (Artificial intelligence)

Option 1:

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

Option 2:

Author(s) hereby declare that generative AI technologies such as Large Language Models, etc. have been used during the writing or editing of manuscripts. This explanation will include the name, version, model, and source of the generative AI technology and as well as all input prompts provided to the generative AI technology

Details of the AI usage are given below:

1.

2.

3.

**REFERENCE**

1.Singh, RK. and Chaudhari, BD. Biometrical methods in quantitative genetic analysis. Kalyani Publishers, New Delhi. 1977: pp.3938.

2.Dewey, DR. and Lu, KH. A Correlation and path coefficient analysis of component of wheat   
grass production. Agron J.1959 : 51 : 515-518

3.Santha, S. and Paramasivam, K. Correlation and path analysis in rice follow black gram (*Vigna mungo*). Madras Agric. J.,1999: 86 (7-9): 397-400.

4.Umadevi. M. and Meenakshi. NG. Correlation and path analysis for yield and yields components in black gram (*Vigna mungo* (L.)Hepper.) Madras Agric. J.2005: 92 (10-12): 731-734.

5.Kingshlin, M. and Vanniarajan, C. Association of yield attributes and component analysis among the quantitative characters of rice fallow urdbean genotypes. Crop. Res., 2000: 19 (1): 102-105.

6.Mahala CPS, Dahheech RC,Ulhari RK. Effect of plant growth regulators on   
growth and yield of black gram (Vigna mungoL.) at varying levels of phosphorus. Crop Res.2001;18(1):163-165.

7.Krishna Surendar K, Vincent S, Mallika Vanagamudi, Vijayaraghavan H. Plant Growth Regulators and Nitrogen Responses on Improving Nutrient Content of Black Gram (Vigna mungo L.). Plant Gene and Trait.2013;4(12):66-69.

8. Nair RM, Chaudhari S, Devi N, Shivanna A, Gowda A, Boddepalli VN, Pradhan H, Schafleitner R, Jegadeesan S, Somta P. Genetics, genomics, and breeding of black gram [*Vigna mungo* (L.) Hepper]. Frontiers in plant science. 2024 Jan 15;14:1273363.

9. Khine NA, Kundu KK, Malik DP, Devi M. Production and trade performance of blackgram (*Vigna mungo*) and greengram (Vigna radiata) in India and Myanmar. Asian J. Agric. Ext. Econ. Sociol. 2021;39(10):231-43.

10. Taksalkar BP, Satale BM, Pawar AD. Effect of Different Plant Spacings on Growth and Yield of Blackgram Varieties (*Vigna mungo* (L.) Hepper). J. Sci. Res. Rep. 2024 Aug. 23;30(9):27-31.

.