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Character association and path analysis for yield and Yeild contributing traits in greengram [*Vigna radiata* (L.) Wilczek]

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Abstract
Greengram (*Vigna radiata* (L.) Wilczek) 2n= 2x = 22 is cultivated on a large scale in several parts of the world which is the third most valuable pulse crop. Pulses are the primary resource of protein to meet up the nutritional requirement of the world. The most important objective in any crop improvement programme is to increase the seed yield through development of high yielding varieties with resistance to pest and diseases. Thus during the course of *Rabi 2021*-2022, an experiment was put through to determine correlation and path analysis between yield and its components of Greengram. A total of 189 F_3 progenies derived from the cross VBN2 x V2802BG along with parents and checks were utilized for the study and observed for nine quantitative characters *viz.,* days to 50% flowering, plant height (cm), number of branches per plant, number of clusters per plant, number of pods per plant, pod length (cm), number of seeds per pod, 100 seed weight (g) and seed yield per plant (g). The results illustrated that pods per plant (0.969), clusters per plant (0.828), plant height (0.570) witnessed positive correlation coefficient with seed yield per plant which is highly significant. Pods per plant followed by plant height expressed highest positive direct effect on seed yield which is disclosed by path coefficient analysis. Thus while designing a breeding strategy foremost significance has to be given to these attributes to enhance the seed yield in greengram.

Keywords: Mungbean, correlation, path coefficient analysis, direct effect

1. Introduction

Mungbean (*Vigna radiata* (L.) Wilczek) commonly called as greengram belongs to the family Fabaceae and the subfamily Papilionoideae is an economically important pulse crop pertinent to nutrients. The diploid chromosome complement of crop is 2n = 2x = 22. (Karpechenko, 1925) [10]. The crop grown in the tropics and subtropics of Africa, America, Asia and Australia which contributes more than seven million hectares (AVRDC, 2019). However India is the world's pioneer grower of Mungbean with production of 30.9 lakh tonnes cultivated under 51.3 lakh hectares of area and 601 kg/ha productivity (*www.indiastat.com).* The crop is planted on 1,60,560 hectares in Tamil Nadu, with a production and productivity of 58,890 tonnes and 367 kg/ha respectively (*www.indiastat.com*). The nutrient status of the crop is compiled with Carbohydrates (56 percent), proteins (24-25 percent) whereas fibre and minerals contribute to about 4.1 percent and 3.5 percent respectively (Tiwari and Shivhare, 2016) [16].

Seed yield is a complicated and multifaceted characteristic that is represented by the culmination of various component characters. Studies on correlation between different yield components are prerequisite for improvement of yield. In field studies, degree and extent of link among significant plant attributes could be elucidated with correlation coefficient analysis, providing basic selection criteria and leading to a directional model based on yield and its components. For a successful breeding program, understanding the interrelationships between key developmental and productive features is essential. However, the correlation values disclose only how the yield contributing characters reveal the nature and degree of association on seed yield. Henceforth by using path coefficient analysis the correlation coefficients are partitioned into direct and indirect effects of independent variables on seed yield per plant. The path coefficient is used to determine the true contribution of various component features to seed yield in order to build a path for desired improvement. To effectively use the existing lines in mungbean improvement for seed yield, information on grain yield inheritance and its closely linked components is required (Khattak *et al.*, 2002) [11]. Therefore the present research in greengram was focussed on to assess the correlation among yield and component traits followed by path analysis of the F_3 population to discover which component features can be relied on for genetic improvement through selection.

2. Materials and Methods

The experiment was implemented in the research fields of Department of Pulses, Tamil Nadu Agricultural University (TNAU), Coimbatore during *Rabi 2021*-22. For this analysis 189 F_3 lines of the cross VBN2 x V2802BG along with checks and parents were utilized. The spacing adopted between rows was 30 cm and between plants was 15 cm. The crop was thinned out on the tenth day after seeding, leaving only one viable seedling per hill. Agronomic recommendations as well as need-based plant protection measures were followed. From each 189 F_3 lines along with parents and checks five randomly selected plants were tagged to note down the nine quantitative traits that contribute for yield *viz.*, days to 50% flowering, plant height(cm), number of primary branches per plant, number of clusters per plant, number of pods per plant, pod length(cm), number of seeds per pod, 100 seed weight(g) and seed yield per plant (g). The mean value was computed for all the quantitative traits and the data was subjected to analysis using the TNAU STAT open data software for correlation and path analysis.

3. Results and Discussion

a) Association Analysis

Plant breeders should understand the extent of the relationship between yield and its related components in order to select plants with preferred traits. Knowledge on association of seed yield with different characters as well among the component characters is very much important for breeders to formulate an effective breeding programme. The correlation coefficients for 189 F_3 lines were computed along with checks and parents (Table 1). The results illustrated that pods per plant (r=0.969**), clusters per plant (r=0.828**) and plant height (r=0.570**) declared highly significant and positive correlation with seed yield per plant, which are in association with results of Sandhiya and Saravanan (2018) [15]; Majhi *et al*. (2020) [19]; Anand *et al.* (2016) [1] for number of pods per cluster. Hemavathy *et al.* (2015) [15] stated similar results, for number of clusters per plant while Gaurav Kumar Garg *et al.* (2017) [5]; Canci and Toker (2014) [3] pointed out the commensurate results for plant height having positive correlation with seed yield per plant. The results further revealed that significant and positive correlation values for characters *viz.,* seeds per pod (r=0.350**), pod length (r=0.244**) followed by hundred seed weight (r=0.220**), branches per plant (r=0.155*) with single plant yield which were concurrence with Gul *et al*. (2008) [6] and Sandhiya and Saravanan (2018) [15]. The negative non- significant correlation with seed yield per plant was contributed by days to 50% flowering. In accordance with above discussion yield attributes like pods per plant, clusters per plant, and plant height were given a specified place for elevating the seed yield per plant.

Apart from correlation with seed yield per plant correlation among other yield contributing traits are also important to execute fruitful selection for plant yield. Plant height displayed negative correlation with days to fifty percent flowering which is non-significant. Positive correlation was revealed by clusters per plant with plant height, pods per plant, and seeds per pod which is greatly significant. Byregowda *et al.* (1997) [2] and Rao *et al.* (2006) [12] conveyed the related results for pods per plant. Characters *viz.*, plant height followed by seeds per pod and pod length showed highly significant positive correlation with pods per plant. These results are in accordance with Rohman *et al.* (2003) [14]; Yadav (2017) [18]; Parihar *et al.* (2018) [13] for plant height. Pod length disclosed significant positive correlation with plant height, seeds per pod and hundred seed weight, which was in agreement with Venkateswarlu (2001) [17] for seeds per pod.

Table 1: Simple correlation between seed yield per plant and its component traits in greengram

Traits	DFF	PH	NBP	NCPP	NPPP	PL	NSPP	HSW	SPY
DFF	1.000								
PH	-0.074	1.000							
NPB	0.135	-0.026	1.000						
NCP	-0.017	0.497**	0.019	1.000					
NPPP	-0.038	0.568**	0.115	0.867**	1.000				
PL	-0.038	0.436**	0.173*	0.166*	0.233**	1.000			
NSPP	-0.005	0.392**	-0.115	0.278**	0.366**	0.490**	1.000		
HSW	-0.064	0.092	0.172*	0.150*	0.197**	0.224**	0.049	1.000	
SPY	-0.020	0.570**	0.155*	0.828**	0.969**	0.244**	0.350**	0.220**	1.000

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

DFF-Days to 50% flowering; PH-Plant height (cm); NPB-No. of primary branches per plant; NCPP-No. of clusters per plant; NPPP-No. of pods per plant; PL-Pod length(cm); NSPP-No. of seeds per pod; HSW-100-seed weight (g) and SPY-Single plant yield

b) Path analysis

To partition the genotypic correlation coefficient between a component trait and seed yield per plant into direct and indirect effects on seed yield, path coefficient analysis was adopted. These direct and indirect effects are presented in Table 2. The residual effect (0.23) indicates that the component characters under study were responsible for about 77% of variability in seed yield per plant. The positive direct effect on seed yield was exhibited by pods per plant, plant height, branches per plant, hundred seed weight and days to 50% flowering. Among the various yield parameters studied, pods per plant followed by plant height revealed highest direct effect on seed yield per plant. These results are in agreement with the results of Venkateswarlu (2001) [17] and Mallikarjuna Rao *et al.* (2006) [12] for pods per plant and Lokesh and Lavanya (2019) [20] for plant height. Pods per plant conveyed positive indirect effect through plant height, branches per plant and hundred seed weight. It has negative indirect effect through days to 50% flowering, clusters per plant, pod length and seeds per pod. Plant height exhibited positive indirect effect through pods per plant and hundred seed weight and negative indirect effect through days to 50%

flowering, branches per plant, clusters per plant, pod length and seeds per pod. Negative direct effect was exhibited by clusters per plant, pod length and seeds per pod. These results are in agreement with Canci and Toker, (2014) [3]; Das (2015) [4] for pod length. Clusters per plant exhibited positive indirect effect through plant height, pods per plant, branches per plant and hundred seed weight and negative indirect effects through days to 50% flowering, pod length and seeds per pod. Pod length showed positive indirect effect through plant height, primary branches per plant, pods per plant and hundred seed weight and negative indirect effects through days to 50% flowering, clusters per plant, pod length and seeds per pod.

Table 2: Estimates of direct and indirect effects of different traits on seed yield per plant

Traits	DFF	PH	NPB	NCPP	NPPP	PL	NSPP	HSW	SPY
DFF	0.016	-0.003	0.005	0.0006	-0.037	0.0001	0	-0.001	-0.020
PH	-0.001	0.039	-0.001	-0.018	0.553	-0.001	-0.002	0.002	0.570**
NPB	0.002	-0.001	0.037	-0.0007	0.112	-0.0004	0.0008	0.004	0.155*
NCPP	-0.0003	0.019	0.0007	-0.03	0.844	-0.0004	-0.002	0.004	0.828**
NPPP	-0.0006	0.022	0.004	-0.03	0.973	-0.0006	-0.002	0.005	0.969**
PL	-0.0006	0.017	0.006	-0.006	0.227	-0.002	-0.003	0.005	0.244**
NSPP	-0.0001	0.015	-0.004	-0.010	0.356	-0.001	-0.007	0.001	0.350**
HSW	-0.001	0.003	0.006	-0.005	0.191	-0.0006	-0.0004	0.026	0.220**

Residual effect: 0.23 **Significant at 1% level *Significant at 5% level

DFF-Days to 50% flowering; PH-Plant height (cm); NBP-No. of primary branches per plant; NPPC-No. of clusters per plant; NPPP-No. of pods per plant; PL-Pod length (cm); NSPP-No. of Seeds per pod; HSW-100-seed weight (g) and SPY-Seed yield per plant.

4. Conclusion

Understanding the relationship between yield characters helps to improve the desired trait through direct and indirect improvement of many other traits. The correlation study examines the possibility of improving yield through the indirect selection of other yield attributes. The correlation coefficient between yield and its attributing traits were worked out in order to determine the extent of association with each component traits. From the present study of correlation and path analysis, it could be inferred that the yield contributing traits *viz.*, pods per plant, plant height, hundred seed weight and branches per plant evinced positive correlation and exhibited positive direct effects on seed yield per plant were suitable for selection to bring out improvement in greengram for seed yield.

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