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INTERRELATIONSHIPS AMONG YIELD, YIELD COMPONENTS AND WATER USE EFFICIENCY RELATED TRAITS IN F_2 POPULATION OF LM 95 × EC 362096 CROSS IN MUNGBEAN

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ABSTRACT

Path coefficient analysis was carried out in F_2 populations of selected superior cross LM 95 × EC 362096 in mungbean for fourteen quantitative characters to estimate the direct and indirect effects of the individual characters on yield. Path analysis for seed yield revealed that direct effect of number of pods per plant was high and positive. Number of pods per plant, number of pods per cluster, days to maturity and SCMR are the major contributing factors to seed yield and hence emphasis should be given to these characters while making selection for realizing improvement in seed yield in mungbean.

KEYWORDS: Mungbean, correlation, water use efficiency

INTRODUCTION

Mungbean is an important grain legume grown worldwide in tropical and sub-tropical regions. In the developed countries, grain legumes are an important indirect source of protein. However, for many developing countries, pulses constitute cheap and readily available source of dietary protein. Therefore, enhancing the yield and quality parameters of pulse crop is the only practical means of solving the widespread protein malnutrition among the less privileged classes of society. Although intensive research work has been done on genetic architecture of yield and yield attributes of mungbean, limited work was done on yield attributes along with water use efficiency (WUE) and heat stress tolerance related traits. Realizing the significance of drought and heat stress on yield components there is an immediate need to enhance the genetic potential of mungbean genotypes with high yield and drought and heat stress tolerance.

Drought and heat stress resistance are quantitative characters with complex inheritance. In order to formulate proper and effective breeding objectives in a drought breeding program, the breeder should understand the nature of the trait to be manipulated. WUE can be used as a selection criterion for drought resistance (Teare *et al.,* 1982). Passioura (1996) proposed to view grain yield as a partial function of WUE in his equation ($Y = T \times WUE \times HI$) signifying the importance of total transpiration (T) and Water Use Efficiency (WUE) in determining the total biomass production and yield. This equation highlights that increase in yield can be achieved through increase in WUE.

To exploit the existing genetic variability for seed yield as efficiently as possible, the breeder would need a comprehensive knowledge regarding the association of component traits with yield. This would facilitate effective selection for simultaneous improvement of one or more yield influencing components. However, the correlation between yield and its component characters is often misleading, since it is affected by the inter-relationships among the component traits. Hence path coefficient analysis developed by Wright (1921) helps in partitioning of the correlation coefficients into direct and indirect effects and to assess the relative contribution of each component character to seed yield. Integration of information on correlation, path analysis for seed yield and its component traits and their application in selection of superior segregants will be helpful in bringing varietal improvement in mungbean. Path analysis provides information about the cause and effect in understanding the association between two variables. It reveals whether the association of characters with yield is due to their direct effect on yield or it is a consequence of their indirect effects *via.,* other component characters. Hence, the study of direct and indirect effects through path analysis enables the breeders to judge the important component characters

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during selection. It provides the basis for selection of superior genotypes from the diverse breeding populations.

MATERIAL AND METHODS

The present experiment was carried out at dry land farm of Sri Venkateswara Agricultural College, Tirupati, situated at an altitude of 182.9 m. above mean sea level, 32.27°N latitude and 79.36°E longitude, located geographically in Southern Agro Climatic Zone of Andhra Pradesh, India. The F_1s of three superior crosses selected based on their yield, WUE and heat stress tolerance related attributes *viz*., ML 267 × LGG 528, MGG 390 × LM 95 and LM 95 × EC 362096 and their five parents *viz*., ML 267, LGG 528, MGG 390, LM 95 and EC 362096 were sown at dry land farm, S.V. Agricultural College, Tirupati during *kharif,* 2017. The F_2 seed was harvested from selfed F_1 population.

The experimental material comprising of F_2 populations of three crosses *viz.,* ML 267×LGG 528, MGG 390×LM 95 and LM 95×EC 362096 were grown at the dry land farm, S.V. Agricultural College, Tirupati during *rabi,* 2017 in compact family block design with two replications. F_2 populations were raised in 10 rows of three-meter length following a spacing of 30 cm between the rows and 10 cm between the plants within a row. As a basal dressing, fertilizers *viz.,* urea and single super phosphate to supply 20 kg N and 40 kg $P_2O_5ha^{-1}$ were applied respectively to experimental plots. Thinning was done to leave single seedling per hill after 15 days of sowing. Irrigation, weeding and plant protection measures were taken up as and when needed during the crop growth period, as per the standard recommended package of practices to raise a good and healthy crop.

Observations were recorded on 80 randomly chosen competitive plants from each genotype in each replication for all the characters. The values of 80 competitive plants were averaged and expressed as mean of the respective characters. Path coefficient analysis was carried out by the procedure originally proposed by Wright (1921) which was subsequently elaborated by Dewey and Lu (1959) to estimate the direct and indirect effects of the individual characters on yield.

RESULTS AND DISCUSSION

In F_2 population of the cross, LM 95 x EC 362096, path coefficient analysis was done for the traits *viz*., days to maturity, plant height, number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant and SCMR which exhibited significant correlation with seed yield per plant and the results were presented in the Table 1. In the present study, the residual effect was 0.12 in the path coefficient analysis which indicated that the traits considered in this experiment are sufficient to account for variation in yield.

The significant positive correlation of days to maturity with seed yield per plant (0.219) was mainly due to its low positive direct effect (0.0994) and its moderate indirect positive effect through number of pods per plant (0.2118).

Plant height had negligible negative direct effect (-0.0002) on seed yield per plant but its high positive indirect effect through number of pods per plant (0.7691) resulted in its significant positive correlation (0.612) with seed yield per plant.

The trait, number of branches per plant showed significant positive correlation (0.683) with seed yield due to its high indirect positive effect (0.8034) through number of pods per plant even though its direct effect was negligible (0.0003).

The direct effect of number of clusters per plant (-0.2366) on seed yield per plant was negative but it showed significant positive correlation (0.754) with seed yield per plant due to high positive indirect effect *via.,* number of pods per plant (0.8852).

Significant positive correlation of number of pods per cluster with seed yield (0.253) was observed due to its low positive direct effect (0.1103) and its high indirect effect through pods per plant (0.3238).

The trait, number of pods per plant exhibited very high positive direct effect (1.1121) on seed yield per plant which resulted in its significant positive correlation with seed yield per plant (0.945) in spite of its low negative indirect effect through clusters per plant (-0.1804).

SPAD chlorophyll meter reading had negligible positive direct effect (0.0382) on seed yield per plant but it exhibited significant positive correlation with seed yield per plant (0.197) which was mainly due to its indirect moderate positive effect through number of pods per plant (0.2041).

These results are in accordance with Kumar *et al.* (2017) for days to maturity, Lakshman and Ruben (1989),

Table 1. Direct and indirect effects of yield components and WUE related traits as partitioned by path analysis in mungbean in F_2 population of LM 95 × EC 362096

	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}	SPAD chlorophyll meter reading	Seed yield plant^{-1} (g)
Days to maturity	**0.0994**	0.0032	-0.0017	-0.0324	-0.019	0.2118	-0.0427	0.219**
Plant height (cm)	0.0049	**-0.0002**	0.0002	-0.1848	0.0169	0.7691	0.006	0.612**
Number of branches plant^{-1}	0.0117	-0.0001	**0.0003**	-0.1986	0.0599	0.8034	0.0068	0.683**
Number of clusters plant^{-1}	0.0142	-0.0001	0.0003	**-0.2366**	0.0833	0.8852	0.0079	0.754**
Number of pods cluster^{-1}	-0.011	0	-0.0001	-0.1711	**0.1103**	0.3238	0.0007	0.253**
Number of pods plant^{-1}	0.01	-0.0001	0.0142	-0.1804	-0.0206	**1.1121**	0.0094	0.945**
SPAD chlorophyll meter reading	0.0044	0	0.0001	-0.0469	-0.0031	0.2041	**0.0382**	0.197**

Lavanya and Toms (2009), Kumar *et al*. (2013), Srikanth *et al*. (2013), Rupal *et al.* (2017) for number of clusters per plant; Naidu *et al*. (1994), Venkateswarlu (2001), Wani *et al*. (2007), Lavanya and Toms (2009), Reddy *et al*. (2011), Ahmad *et al*. (2013), Kate *et al*. (2017) Rupal *et al.* (2017) for number of pods per plant; Swathi (2013) for SCMR.

Results of path analysis for seed yield revealed that direct effect of number of pods per plant was high and positive. It indicates that this trait is the major contributing factor to seed yield and hence emphasis should be given to this character while making selection for realizing improvement in seed yield in mungbean. Pods per plant was identified as important yield component by Lakshman and Ruben, (1989), Pandey *et al.* (2007), Khajudparn and Tantasawat (2011), Ahmad *et al.* (2013), Jyothsna and Anuradha (2013), Srikanth *et al.* (2013), Lalinia and Khameneh (2014), Kate *et al.* (2017). In the cross, LM 95 × EC 362096 emphasis should be laid on number of pods per plant, number of pods per cluster, days to maturity and SCMR during selection for breeding high yielding types.

Path analysis for seed yield revealed that direct effect of number of pods per plant was high and positive. Closer scrutiny of results further revealed that in the cross MGG 390 × LM 95 selection based on number of pods per plant, specific leaf area, hundred seed weight and number of branches per plant may result in high yielding types.

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