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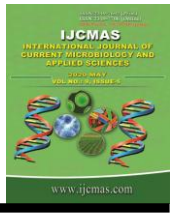

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Inter Relationship between Yield and its Attributing Traits in Cowpea (*Vigna unguiculata* (L.) Germplasm Accessions

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A B S T R A C T

Inter relationship among yield and its attributes in cowpea can be studied through correlation and path analysis. In the current study, 102 Indian cowpea genotypes were evaluated based on twelve quantitative characters to study the association between yield and its contributing traits. Single plant yield showed significant positive correlation with traits *viz.*, number of clusters per plant, number of pods per plant, pod length, number of seeds per pod, number of pods per cluster and hundred seed weight. The highest inter correlation was obtained between number of clusters per plant and number of pods per plant. Path analysis revealed that, the highest direct effect on single plant yield was obtained by number of pods per plant and it is followed by hundred seed weight and number of seeds per pod. The highest positive indirect effect on single plant yield was observed in number of clusters per plant through number of pods per plant. Hence, selection based on the traits *viz.*, number of clusters per plant, number of pods per plant, number of seeds per pod, hundred seed weight and pod length will be highly rewarding in cowpea yield improvement program.

Introduction

Cowpea (*Vigna unguiculata* (L.) is a self-pollinated crop with 2n=2x=22 chromosomes and belongs to the family *Fabaceae*. India and sub Saharan Africa are referred as the primary centers of origin. It is mainly grown by rural farmers for their socio economic livelihood (Lopes *et al.*, 2017, Torres *et al.*, 2016). It is a short duration legume crop which can be grown in harsh climatic conditions (drought tolerant) and undemanding soil conditions (Shi *et al.*, 2016). It is the third mostly grown legume

crop (Afutu *et al.,* 2017) and considered as "Poor man's meat" due to its rich source of nutrients especially high protein and vitamins (Diwaker *et al.,* 2018). It is an important arid legume crop with multidimensional uses *viz.,* green leaves as green leafy vegetable and as a fodder, roots as soil nitrogen enhancer through nodules, green pods as vegetable and dry pods as a grain legume for human and animal consumption (Freitas *et al.,* 2019, Nwofia *et al.,* 2013, Tyagi *et al.,* 2000). However, its low yielding potential and low production technology is a major shortcoming (Santos *et al.,* 2014b).

Yield improvement is one of the primary objectives of plant breeding in cowpea (Santos *et al.,* 2014a). Yield is a multifaceted quantitative trait which is governed by polygenes, highly influenced by various yield attributing traits and environment (Navaselvakkumaran *et al.,* 2019, Priyanka *et al.,* 2019). Correlation among the various traits should be well studied to develop a high yielding cowpea ideotype (Kumawat and Raje 2005). Linkage, heterozygosity and pleiotropy are the evolutionary reason behind correlation between two traits (Zhang *et al.,* 2011). Positive correlation between two desirable traits helps in simultaneous improvement of both, whereas negative correlation between a desirable and undesirable trait is of great advantage during stress resistance breeding (Navaselvakkumaran *et al.,* 2019). However, linear correlation studies between and yield and its contributing traits is puzzling due to the inter correlation among its attributing characters. Hence, study of direct and indirect effects of yield and its attributing traits in the form of path coefficient analysis is very crucial (Meena *et al.,* 2015). The success of path analysis is mainly based on breeder's preceding knowledge to formulate the cause and effect relationship (Silva *et al.,* 2005). Knowledge on correlation and path analysis will help the cowpea breeders in selection of desirable traits and superior genotypes which could be utilized in crop improvement program (Shanko *et al.,* 2014). Hence the present study is designed to study the intra and inter relationship between the twelve quantitative characters in cowpea germplasm.

Materials and Methods

The present examination was carried out at Agricultural College and Research Institute (AC &RI), Tamil Nadu Agricultural University (TNAU), Madurai, Tamil Nadu, India during *Kharif*, 2019.

The experimental field is geographically located at of 9° 54' N latitude and 78° 54' E longitude with annual rainfall of 856 mm. The biological material used in the study constituted of 102 Indian cowpea genotypes. Randomized Block Design (RBD) with two replications was followed as an experimental design. Normal recommended package of practices were followed as per Crop Production Guide (CPG) (TNAU 2019).

The observations on twelve quantitative traits*viz.,* plant height (PH) (cm), number of primary branches (NPB), days to fifty per cent flowering (DF), peduncle length (PeL) (cm), days to maturity (DM) (days), number of clusters per plant (NC), number of pods per cluster (NPC), pod length (PoL) (cm), number of pods per plant (NPP), number of seeds per pod (NSP), hundred seed weight (HSW) (g) and single plant yield (SPY) (g) on fifteen plants per replication were taken based on the descriptor developed by the International Board for Plant Genetic Resources (IBPGR 1983). Correlation and path coefficients were calculated by using the formula developed by Dewey and Lu (1959). The statistical analyses were carried out using the software R Studio (version: 1.0.136).

Results and Discussion

The magnitude and amount of different quantitative traits contribute to the yield can be well studied from correlation analysis (Almeida *et al.,* 2014). Estimates of correlation coefficients for twelve quantitative traits in cowpea germplasm are given in the table 1. Single plant yield showed significant positive correlation with traits like number of clusters per plant (r = 0.77), number of pods per plant (r = 0.76), pod length (r = 0.38), number of seeds per pod (r = 0.4), number of pods per cluster (r = 0.31) and hundred seed weight (0.45). Selection based on these traits will improve the single plant yield significantly. Similar reports were conveyed by Manggoel *et al.,* (2012), Ngugi *et al.,* (1996) and Romanus *et al.,* (2008).

The negative negligible association of single plant yield was noticed with number of primary branches (r = -0.01). Similar findings were obtained bySrinivas *et al.,* (2017) and Tyagi *et al.,* (2000).In the present study, plant height was positively associated with the singleplant yield. It was on par with the results of Malik *et al.,* (2007), Udensi *et al.,* (2012) and Val *et al.,* (2017). On contrary, plant height recorded negatively significant association with singleplant yield which was also reported by Li *et al.,* (2013) and Mebrahtu and Devine (2008). Though, increase in plant height increased the plant vigour which might lead to unnecessary vegetative growth. It was recommended that crop with semi dwarf stature improved the yield (Diondra *et al.,* 2008).

Knowledge on inter correlation between quantitative traits may facilitate breeders to decide the direction of selection on related traits for improvement. The highest inter correlation (r = 0.74) among yield traits was obtained between number of clusters per plant and number of pods per plant.

It was followed by inter association between pod length and hundred seed weight (r = 0.66). Positive significant association were also noted between number of pods per cluster with number of pods per plant (r = 0.62) and days to fifty per cent flowering and days to maturity (r = 0.49). These results are in accordance with Almeida *et al.,* (2014), Freitas *et al.,* (2019) and Shanko *et al.,* (2014).

Significant negative association were obtained for days to fifty per cent flowering with number of primary branches (r = -0.29), number of pods per cluster with hundred seed weight (r = -0.27), days to fifty per cent flowering with peduncle length (r = -0.27) and plant height with number of primary branches (r = -0.26). Similar results were reported by Biradar *et al.,* (2010), Sheela and Gopalan (2006) and Udensi *et al.,* (2012).

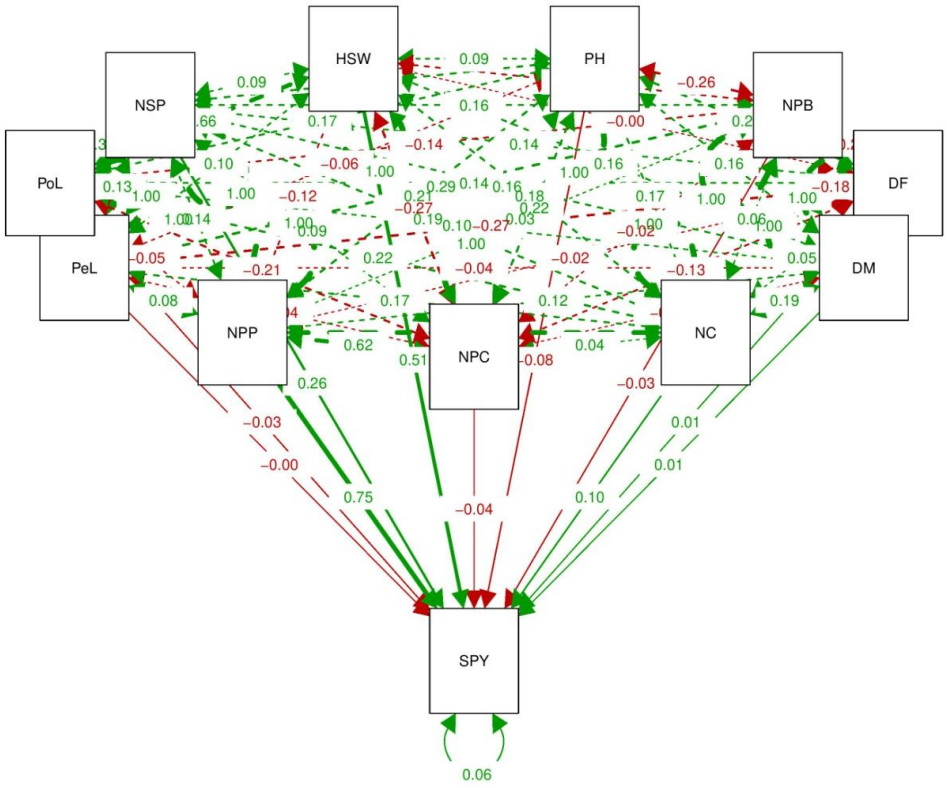
The correlation coefficient estimates were used to calculate only the presence of mutual association between two traits. The genuine contribution of a yield component and its influence through other characters could be arrived through segregating of correlation into direct and indirect effects by path analysis (Priyanka *et al.,* 2019, Shanko *et al.,* 2014).

It is very difficult to get the complete information on different traits contributing yield. Hence, residual effect provides valuable information on all possible independent yield components which are not included in the study (Nehru and Manjunath 2009).

In the present study, residual effect found to be as low as six per cent indicating greater contribution of studied twelve quantitative traits towards single plant yield.Direct and indirect effects of twelve quantitative traits in 102 cowpea germplasm were portrayed in the fig., 1.

Table.1 Correlation between twelve quantitative traits in cowpea

PH- Plant height, DF-Days to fifty per cent flowering, DM- days to maturity, NPB- number of primary branches, PeL- peduncle length, NC- number of clusters per plant, NPC- number of pods per cluster, NPP- number of pods per plant, PoL- pod length, NSP- number of seeds per pod, HSW- hundred seed weight and SPY - single plant yield



*Residual effect – 6%, PH- Plant height, DF-Days to fifty per cent flowering, DM- days to maturity, NPB- number of primary branches, PeL- peduncle length, NC- number of clusters per plant, NPC- number of pods per cluster, NPP- number of pods per plant, PoL- pod length, NSP- number of seeds per pod, HSW- hundred seed weight and SPY - single plant yield

In the current study, traits *viz.*, number of pods per plant (0.755), hundred seed weight (0.511) and number of seeds per pod (0.257) showed the highest and significant direct effect on single plant yield. These results were parallel with the findings of Alle *et al.*, (2016), Meena *et al.*, (2015) and Paliwal *et al.*, (2005). The highest negative indirect effect on single plant yield was noticed innumber of pods per cluster through hundred seed weight and it is followed by hundred seed weight through number of pods per plant.

Positive significant indirect effects on single plant yield were observed for number of clusters per plant through number of pods per plant (0.558) and number of pods per cluster through number of pods per plant (0.468). High indirect effects acts as an indication for high genetic gain through indirect selection (Cabral *et al.*, 2011).

From the association analysis, it was determined that employing selection techniques for the major yield contributing traits *viz*., hundred seed weight, number of cluster per plant, number of pods per plant, pod length, number of seeds per pod and number of pods per cluster would be more rewarding in bringing yield improvement in cowpea.

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