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Studies on correlation and path analysis for yield and yield related traits in greengram [*Vigna radiata* (L.) Wilczek]

Manivelan K, Karthikeyan M, Blessy V, Priyanka AR, Palaniyappan S and Thangavel P

Manivelan K
Department of Genetics and Plant Breeding, Annamalai University, Chidambaram, Tamil Nadu, India

Karthikeyan M
Department of Genetics and Plant Breeding, Annamalai University, Chidambaram, Tamil Nadu, India

Blessy V
Department of Genetics and Plant Breeding, AC & RI (TNAU), Madurai, Tamil Nadu, India

Priyanka AR
Department of Genetics and Plant Breeding, AC & RI (TNAU), Madurai, Tamil Nadu, India

Palaniyappan S
Department of genetics and plant breeding, AC & RI (TNAU), Madurai, Tamil Nadu, India

Thangavel P
Professor, Department of Genetics and Plant Breeding, Annamalai University, Chidambaram, Tamil Nadu, India

Correspondence
Thangavel P
Professor, Department of Genetics and Plant Breeding, Annamalai University, Chidambaram, Tamil Nadu, India

Abstract
Greengram is [*Vigna radiata* (L.) Wilczek] is one of the most important edible food legumes of south and Southeast Asia. It is the third most important pulse crop of India grown extensively in both tropical and sub-tropical regions of the world Yield is the principal factor for determining improvement of a crop. The most important objective in any crop improvement programme is to increase the seed yield through development of high yielding varieties with disease resistance. For selection, the relationship between the traits concerned is an important criterion. Thus an experiment was conducted using twenty one mungbean hybrids which were laid out in randomized block design with three replication. The hybrids were evaluated for yield and its component traits the estimation of correlation coefficient, and path coefficient analysis. Among the characters studied, plant height, clusters per plant, number of branches per plant, number of pods per plant, number of seed per pod showed high direct positive effect in path analysis and positive significant association with grain yield. Hence selection may be effective based on these characters.

Keywords: Correlation, path analysis, seed yield

Introduction
Greengram (*Vigna radiata* (L.) Wilczek) 2n= 2x = 22 is the third most important pulse crop cultivated widely in many parts of the world. Pulses are the chief source of protein to meet the nutritional requirement of the masses in the world. Pulse crop seeds, which are important for human nutrition, typically have 20 - 25% protein and 40 - 50% starch, are rich in dietary fibre, and usually have only small amounts of oil. Seeds are rich in minerals like calcium, iron, magnesium, phosphorus and potassium and vitamins like ascorbic acid, thiamine, riboflavin, niacin, pantothenic acid and vitamin A (Tang *et al.*, 2014) [10]. Pulse protein is high in the amino acids lysine and methionine, making pulses nutritionally complementary to cereals, which are deficient in these two essential amino acids. It is grown mainly in Madhya Pradesh, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka and Rajasthan. Recently domestic consumption of greengram has increased because of the rising popularity in Indian ethnic foods and perceived health benefits (Datta *et al.*, 2012) [3]. Despite the importance of pulse crops for nutrition and food security in developing countries, they are considered to be minor on a global scale, and pulse genomes have been less extensively studied than those of major crops (Yu *et al.*, 2012) [12]. The largest number of species found in Africa is cultivated (Polhill and Maesen, 1985). The dried seeds are consumed directly in different ways (boiled, steamed, roasted, mixed with other vegetables, etc., stored during lean period for propagation (Gupta *et al.*, 2009) [7]. Determination of correlation and path coefficient between yield and yield criteria is important for the selection of favourable plant types for effective plant breeding programmes. Hence, path analysis was done to determine the amount of direct and indirect effect of the causal components on the effective component, to study correlation and path analysis for yield and yield related traits which will help in isolating promising lines for hybridization programme and to explore high yield potential (Denton and Nwangburuka, 2011) [4]. Heritability coupled with genetic advance would provide a clearcut approach for selection of desirable trait. Correlation studies provide knowledge on contribution of various traits on yield (Allard, 1960) [1] whereas; it does not provide the relation among cause and effect.

Materials and methods

Hybridization was done between ten genotypes *viz.*, VGG-8, CDM Local, RM8-662, HUM-12, RM8-663, V-3518, Nagalur Local, ADT-2, ADT-3, KM-2. In plant breeding form, Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University during summer season. 21 f1s were evaluated in randomized block design with three replication during kharif season. Each genotype was grown in 4-row plots, 6 m long with 30 X 10 cm spacing. The experimental material comprised of ten genotypes of green gram *viz.*, VGG-8, CDM Local, RM8-662, HUM-12, RM8-663, V-3518, Nagalur Local, ADT-2, ADT-3,KM-2. The recommended packages of practices were followed to raise the crop. Data on the basis of five randomly selected competitive plants were recorded on Plant height, Number of branches per plant, Number of clusters per plant, number of seeds per pods, number of pods per plant, hundred grain weight, seed yield per plant. The genotypic and phenotypic correlation coefficients were computed using genotypic and phenotypic variances and covariance (Hanson *et al.*, 1956) [8]. The path coefficient analysis was done according to the method suggested by Dewey and Lu (1959) [5].

Results and discussion

To know the extent of relationship between yield and its various components, it is important for the plant breeder to select plants which consists of desirable characteristics. Phenotypic correlation coefficient was higher for all the important characters like yield and yield related characters. Grain yield had significant and positive association with yield per plant (0.658). Number of branches per plant and number of pods per plant (0.613) exhibited significant and positive association with hundred grain weight (0.587), followed by number of seeds per pod (0.574) genotypically. Number of clusters per plant showed significant positive inter correlation with hundred grain weight (0.660), number of seed per pod (0.385), number of pod per plant and number of branches (0.525) genotypically. Number of branches per plant showed significant and positive inter correlation with hundred grain weight (0.540) and number of seeds per pod (0.457) genotypically similar results were observed by Verma and Hari Kesh **(**2017) [11]. Number of pods per plant exhibited significant positive correlation with hundred grain weight (0.5401), number of seed per pod (0.457). Number of seeds per pod showed significant and positive association with hundred grain weight (0.505) genotypically. Hundred grain weight showed significant and positive association with number of branches and number of plant per pod (0.525). (Table 1)

The seed yield had significant and positive association with number of clusters per plant (0.635) followed by number of branches per plant, number of pods per plant (0.586), number of seed per plant (0.565), hundred grain weight (0.572) phenotypically. Number of clusters per plant showed significant and positive association with hundred grain weight (0.632), number of seeds per pod (0.377), number of pods per plant and number of branches per plant (0.490). Number of branches per plant also showed significant and positive inter correlated phenotypically with hundred grain weight (0.511), number of seed per plant (0.432). Number of pods per plant also had significant and positive, phenotically inter correlated with hundred grain weight (0.511) and number of seed per plant (0.432) these results were similar with Divya Ramakrishnan *et al.* (2018) [6]. Number of seeds per pod significant and positive inter correlation phenotypically with hundred grain weight (0.496) (Table 2).

Path analysis

Number of pods per plant (0.3781) shows high direct effect with single plant yield. Number of clusters per plant (0.3957) showed moderate direct effect followed by number of seed per pod (0.2121) to single plant yield respectively and it showed similar results with Anil Kumar *et al*. (2018) [2]. Plant height showed indirect effect with number of pod per plant. Number of clusters per plant had indirect effect with number of branches per plant, number of pods per plant, number of seed per pod and seed yield per plant. Number of branches per plant had positive indirect effect (0.1719) with number of clusters per plant, number of pods per plant, number of seed per pod and seed yield. Sandhiya *et al*. (2018) [9] reported similar results in green gram. Number of pods per plant had range positive (0.3781) indirect effect with plant height, number of clusters per plant, number of branches per plant, number of seed per pod and seed yield per plant. Number of seed per pod showed positive indirect effect (0.1212) with number of clusters per plant, number of branches per plant and seed yield per plant. Hundred grain weight shows positive indirect effect with number of pods per plant, number of clusters per plant, number of branches per plant, plant height, number of seed per pod and seed yield per plant. Similar study was conducted by (Gupta *et al*., 2009) [7] in greengram. (Table 3)

Association analysis suggested that selection based on number of plant height, clusters per plant, number of branches per plant, number of pods per plant, number of seed per pod will be effective to improve yield potential as they showed high direct positive effect in path analysis and positive significant association with grain yield. The estimate of residual effects was high (0.5875) which indicated that the yield attributing characters considered in the present investigation only explained around 41 percentage of variability in seed yield, indicating possibilities of some other characters effecting seed yield per plant.

Table 1: genotypic Correlation coefficient among yield and yield components

	PH	**NCP**	**.NBP**	**NPP**	**NSP**	**HSW**	**SYP**
PH	1.000	-0.257	-0.190	-0.190	-0.313	0.073	-0.139
NCP		1.000	0.525*	0.525*	0.385*	0.660 *	0.658*
NBP			1.000	1.000	0.457*	0.540*	0.613*
NPP				1.000	0.457*	0.540*	0.613*
NSP					1.000	0.508*	0.574*
HSW						1.000	0.587*
SYP							1.000

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

PH - Plant height (cm), NCP – Number of Clusters per plant, NBP – Number of branches per plant, NPP – Number of pod per plant, NSP – Number of Seeds per pod, HSW – Hundred seed weight (g), SYP - Seed yield per plant (g)

Table 2: phenotypic Correlation coefficient among yield and yield components

	PH	NCP	.NBP	NPP	NSP	HSW	SYP
PH	1.000	-0.246	-0.188	-0.188	-0.307	0.069	-0.134
NCP		1.000	0.490*	0.490*	0.377*	0.632*	0.635*
NBP			1.000	1.000	0.432*	0.511*	0.586*
NPP				1.000	0.432*	0.511*	0.586*
NSP					1.000	0.496*	0.565*
HSW						1.000	0.572*
SYP							1.000

*Significant at 5% probability level **Significant at 1% probability level

PH - Plant height (cm), NCP – Number of Clusters per plant, NBP – Number of branches per plant, NPP – Number of pod per plant, NSP – Number of Seeds per pod, HSW – hundred seed weight (g), SYP - Seed yield per plant (g)

Table 3: Path coefficient of the phenotypic traits on single plant yield

	PH	NCP	.NBP	NPP	NSP	HSW	SYP
PH	0.0075	-0.1015	-0.0326	0.0656	-0.0664	-0.0114	-0.1388
NCP	-0.0019	0.3957	0.0902	0.1960	0.0816	-0.1035	0.6581
NBP	-0.0014	0.2075	0.1719	0.2222	0.0969	-0.0847	0.6125
NPP	0.0013	0.2051	0.1010	0.3781	0.1198	-0.1167	0.6887
NSP	-0.0024	0.1523	0.0786	0.2134	0.2121	-0.0797	0.5744
HSW	0.0005	0.2612	0.0928	0.2813	0.1078	-0.1568	0.5868

Residual effect: 0.5875

PH - Plant height (cm), NCP – Number of Clusters per plant, NBP – Number of branches per plant, NPP – Number of pod per plant, NSP – Number of Seeds per pod, HSW- hundred seed weight (g), SYP - Seed yield per plant (g)

Results

In both phenotypic and genotypic association, except plant height all other trait *viz.*, Plant height, number of clusters per plant, number of branches per plant, number of pods per plant, number of seed per pod, 100 seed weight and seed yield per plant had exhibited positive and significant association with seed yield per plant. Number of clusters per plant showed significant and positive association with number of branches per plant, number of pods per plant, number seed per plant, hundred grain weight. Number of branch per plant showed significant and positive association with number of seed per pod and hundred grain weight.

Significant and positive association were observed for number of seed per pod, hundred seed weight with number of pods per plant, number of seed per pod, showed significant and positive association with hundred seed weight.

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