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Research Note

Genetic improvement of greengram (*Vigna radiata* (L.) Wilczek) for yield through pod and seed characters

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Abstract

Grain yield is a polygenically controlled trait which depends on many other component characters. But all the component characters are not directly associated with seed yield. Trait based yield improvement is always convenient for the plant breeders. In the present investigation, association analysis was carried out with five greengram genotypes (VGG 15-030, VGG 16-029, VGG 16-046, VGG 16-058 and VBN (Gg)2) of different duration, pod length and seed weight categories. Among the five genotypes, VGG 16-058 an extra early (55 days) and bold seeded (5.24g). VGG 15-030 was small seeded (2.94 g) genotype with small pod length (7.8 cm). Association analysis revealed that, in all the duration, pod length and seed weight categories, number of branches per plant, number of clusters per plant and number of pods per cluster was positively correlated with seed yield per plant. Genotype (VGG 16-029) with long pod (10.1 cm) and medium sized seed (4.4 g) alone had positive and significant association of all the yield traits with seed yield per plant. Besides, number of branches per plant, number of clusters per plant, number of pods per cluster, the other yield attributes also can be considered like long pod (>10 cm) and medium sized seed (3.0-5.0 g) category as important parameters for the improvement of greengram yield.

Key words

Greengram, association analysis, earliness, pod length and seed characters

Greengram (*Vigna radiata* (L.) Wilczek) is an important pulse crop of Asia, Africa and Latin America, where it is consumed as dry seeds, fresh green pods (Karuppanapandian *et al.*, 2006). It is also known as mungbean, greenbean, mashbean, goldengram and greensoy as it is an excellent source of easily digestible proteins with low flatulence which complements the staple rice diet in Asia. It is a self pollinated diploid grain legume ($2n=2x=22$) crop belonging to the Leguminaceae family and has the genome size of 560 mb (Arumuganath and Earle, 1991).

It is one of the predominant sources of protein and certain essential amino acids like lysine and tryptophan in vegetarian diets. It is relatively drought tolerant and well adapted to a range of soil conditions including light soils and can thrive under limited irrigation. Moreover, it is suited for crop rotation and crop mixtures. However, this crop is suffering from the yield advantage as realized in case of C4 cereals.

Presently, the yield level of greengram as like other pulses is well below the optimum level. The average yield of greengram is very low not only in India (425 kg/ha) but in entire tropical and subtropical Asia. In Tamil Nadu it is cultivated in an area of 1.67 lakhs hectare with a production of 0.51 lakhs tonnes (Anonymous, 2017). Yield is a complex character which is determined by many traits. This study was taken up with this objective to find out the characters which are high influence to the yield. Hence, the present investigation was carried out to understand the pattern of association of component characters with seed yield in different pod and seed categories.

Five entries of greengram viz., VGG 15-030, VGG 16-029, VGG 16-046, VGG 16-058 and VBN (Gg)2 of different duration, pod length and seed weight categories were evaluated in a Randomized complete block design with three replications during *kharif* 2017 season at National Pulses Research Centre, Tamil Nadu Agricultural University, Vamban, Tamil Nadu. Each entry was evaluated

in a plot size of 12 m². The observations were recorded in fifty randomly selected plants on plant height (cm), number of branches per plant, number of clusters per plant, number of pods per cluster, number of pods per plant, pod length (cm), number of seeds per pod, hundred seed weight (g.) and single plant yield (g.). Association between single plant yield and other quantitative traits were estimated as per the method suggested by Goulden (1952). Single plant yield was treated as dependent variable and all other measures were treated as independent variables. The data were subjected to statistical analysis as per the standard procedure using statistical software TNAUSTAT statistical package (Manivannan, 2014)

For rational approach towards the improvement of yield and its component characters, the association of characters with yield and among themselves and the extent of environmental influence on the characters are very much essential. Therefore, the knowledge of association of component characters with yield has great importance to plant breeders, as it helps in the selection with more precision and accuracy. The degree of relationship and association of these components

with yield can be measured by correlation coefficients. (Codawat, 1980).

In the present investigation, among the five greengram genotypes evaluated for different quantitative characters, the mean performances were given in **Table 1**. Among the genotypes VGG 16-058 was found to be extra early in duration (<55 days) with bold seeds (>5.0 g) and more number of seeds per pod. The development of extra early or super early greengram genotypes will help in horizontal expansion of greengram cultivation in India, especially during the summer season as well as in rice fallows in peninsular India. The major constraint for an expansion of area in greengram as a summer crop in rice - wheat system is a short-season window with very hot weather (maximum temperatures touching 44 °C) conditions. Similarly, during rainy season, the crop invariably witnesses rains at the time of pod maturity, leading to deterioration of seed quality as well as pre harvest sprouting. Short duration greengram crop can avoid the adverse effects of terminal heat stress during summer season and untimely rains at the time of harvest during rainy season.

Table 1. Mean performance of five greengram genotypes for yield contributing attributes

Sl. No	Genotypes	Days to maturity	Plant height (cm)	Number of branches / plant	Number of clusters / plant	Number of pods / cluster	Number of pods / plant	Pod length (cm)	Number of seeds / pod	Hundred seed weight (g)	Seed yield / plant (g)
1.	VGG15-030	65	57.96*	3.08	10.58	3.58	41.48*	7.79	11.10	2.94	10.35
2.	VBN (Gg) 2	70	47.90	2.42	7.92	2.82	26.50	8.43	11.74	3.29	7.47
3.	VGG 16-058	55*	52.78	1.38	6.86	4.00	25.58	9.30	12.12	5.24*	8.42
4.	VGG16-029	60	49.88	3.04	10.16	3.18	32.06	10.11	12.00	4.41	13.58*
5.	VGG 16-046	65	48.84	2.50	8.54	3.06	30.30	10.05	11.00	5.04	11.89*
	S.E	2.55	1.81	0.31	0.69	0.21	2.83	0.45	0.23	0.46	1.11
	C.D. (5%)	9.97	7.11	1.20	2.71	0.81	11.09	1.78	0.90	1.80	4.36
	CV %	9.05	7.89	27.65	17.60	13.99	20.34	11.11	4.44	24.62	24.09

*Significantly superior than VBN(Gg)2 at 5% probability

In the early duration and bold seed category (VGG 16-058), association analysis (**Table 2.**) revealed that, number of branches per plant (0.32), number of cluster per plant (0.73), number of pods per cluster (0.28) and number of pods per plant (0.82) registered significant and positive association with seed yield per plant. The present findings are in accordance with the reports of (Rao *et al.*, 2006). Hence, for the yield improvement of extra early greengram genotypes with bold seeds, number of branches per plant, number of cluster per plant, number of pods per cluster and number of pods per plant can be characters for consideration. Whereas the pod length (-0.11) exhibit negative association for seed yield per plant. Hence, the pod length cannot be used as

selection criterion for the early duration and bold seed category. VGG 15-030 was found to be the genotype with small pod (7.8 cm) and small seed (2.9 g). In the small pod and small seeded genotypes, plant height (0.44), number of branches per plant (0.50), number of clusters per plant (0.63) and number of pods per plant (0.83) were significant and positively associated with single plant yield. Similar results were earlier reported by (Rahim *et al.*, 2010). At the same time, number of pods per cluster, pod length, number of seeds per pod and hundred seed weight were not significantly correlated with seed yield. This indicates that selection based on these characters may results in the improvement of seed yield of small seeded genotypes.

Table 2. Genotypic association among the yield attributes with single plant yield in five genotypes of different categories in greengram

Character	Genotype	PH	NBP	NCP	NPC	NPP	PL	NSP	HSW
NBP	VGG15-030	0.35*							
	VCN Gg 2	0.68**							
	VGG 16-058	0.04							
	VGG16-029	0.26							
	VGG 16-046	0.16							
NCP	VGG15-030	0.17	0.66**						
	VCN Gg 2	0.53**	0.86**						
	VGG 16-058	0.07	0.42**						
	VGG16-029	0.39**	0.62**						
	VGG 16-046	0.22	0.32*						
NPC	VGG15-030	0.17	-0.08	-0.12					
	VCN Gg 2	0.30*	0.36**	0.30*					
	VGG 16-058	0.1	0.22	-0.02					
	VGG16-029	0.01	0.38**	0.11					
	VGG 16-046	0.19	-0.08	-0.18					
NPP	VGG15-030	0.35*	0.71**	0.77**	0.12				
	VCN Gg 2	0.63**	0.86**	0.89**	0.49**				
	VGG 16-058	0.04	0.28*	0.80**	0.33*				
	VGG16-029	0.22	0.65**	0.78**	0.55**				
	VGG 16-046	0.42**	0.27	0.79**	0.14				
PL	VGG15-030	0.18	-0.07	0.05	-0.12	0.01			
	VCN Gg 2	0.42**	0.29*	0.33*	0.14	0.38**			
	VGG 16-058	0.08	0.02	-0.19	-0.13	-0.26			
	VGG16-029	0.32*	0.14	0.17	0.2	0.15			
	VGG 16-046	0.08	0.08	0.07	0.03	0.05			
NSP	VGG15-030	0.08	0.13	0.06	-0.09	0.08	0.4		
	VCN Gg 2	0.41**	0.26	0.18	0.09	0.25	0.34*		
	VGG 16-058	0.35*	0.16	0.15	-0.09	0.14	0.24		
	VGG16-029	0.22	0.36**	0.19	0.17	0.2	0.63**		
	VGG 16-046	-0.24	-0.07	-0.09	0.09	-0.09	0.47**		
HSW	VGG15-030	0.17	-0.18	-0.04	-0.24	-0.18	0.37**	0.19	
	VCN Gg 2	0.07	0.04	-0.06	0.08	-0.04	0.17	0.04	
	VGG 16-058	-0.05	0	0.02	-0.19	-0.07	-0.02	-0.13	
	VGG16-029	0.12	0.17	0.22	0.09	0.14	0.34*	0.27	
	VGG 16-046	-0.36*	-0.03	-0.01	-0.01	-0.15	0.15	0.17	
SPY	VGG15-030	0.44**	0.50**	0.63**	0.06	0.83**	0.2	0.09	0.12
	VCN Gg 2	0.66**	0.83**	0.80**	0.44**	0.89**	0.32*	0.34*	0.04
	VGG 16-058	0.08	0.32*	0.73**	0.28*	0.82**	-0.11	0.04	0.16
	VGG16-029	0.29*	0.68**	0.75**	0.47**	0.91**	0.28*	0.33*	0.34*
	VGG 16-046	0.44**	0.29*	0.76**	0.09	0.80**	0.14	-0.12	0.07

*,** -Significance at 5%, 1% respectively.

PH - Plant height , **NBP** - Number of branches / plant, **NCP** - Number of clusters / plant, **NPC** - Number of pods / cluster, **NPP** - Number of pods / plant, **PL** - Pod length , **NSP** - Number of seeds / pod, **HSW** - Hundred seed weight , **SPY** - Seed yield / plant.

VBN (Gg) 2 was found to be the late maturing (70 days) variety with medium sized pod length (8.4cm) and medium sized seed (3.3g). In this category, except 100 seed weight all other characters viz., plant height (0.66), number of branches per plant (0.83), number of clusters per plant (0.80), number of pods per cluster (0.44), number of pods per plant (0.89), pod length (0.32) and number of seeds per pod (0.34) were positively and significantly correlated with seed yield.

VGG 16-029 was found to have long pod (10.1cm) and medium sized seed (4.4g). Under long pod medium sized seed category, all the traits studied viz., plant height (0.29), number of branches per plant (0.68), number of clusters per plant (0.75), number of pods per cluster (0.47), number of pods per plant (0.91), pod length (0.28), number of seeds per pod (0.33) and 100 seed weight (0.34) were positively and significantly correlated with single plant yield. Hence, for the long pod and medium seed size genotypes the seed yield per plant can be improved by selecting segregants with more number of branches per plant, clusters per plant, number of pods per cluster, number of pods per plant, pod length and hundred seed weight. Since all the characters studied under this investigation were positively and significantly correlated with seed yield.

Among the five genotypes evaluated, VGG 16-046 was the genotypes with long pod (10.1cm) and bold seeds (5.0g). Plant height (0.44), number of branches per plant (0.29), number of clusters per plant (0.76) and number of pods per plant (0.80) were the characters positively associated with seed yield per plant in the long pod and bold seeded category. whereas, number of seeds per pod exhibited negative association (-0.12) with seed yield. This indicates that the selection based on the number of seeds per pod for the bold seeded type will not be suitable.

Hence, for all the categories of different duration, pod length and seed weight categories the essential traits for the critical evaluation and the selection will be based on number of branches per plant, number of clusters per plant and number of pods per cluster for the improvement of greengram yield (Ragul *et al.*, 2018; Ragul *et al.*, 2020). Some the traits viz., pod length for early duration, medium pods and bold seed category and number of seeds per pod for medium duration, long pods and bold seed category should not be involved in the selection procedure for the green gram improvement.

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