The Pharma Innovation Journal 2018; 7(7): 202-204

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.03
TPI 2018; 7(7): 202-204

www.thepharmajournal.com
Received: 14-05-2018
Accepted: 16-06-2018

Pallavi
Department of Vegetable Science
GBPUA&T, Pantnagar,
Uttarakhand, India

YV Singh
Department of Vegetable Science
GBPUA&T, Pantnagar,
Uttarakhand, India

Alka Verma
Department of Vegetable Science
GBPUA&T, Pantnagar,
Uttarakhand, India

Manoj Kumar Bansala
DCAST Dehradun,
Uttarakhand, India

Correspondence
Pallavi
Department of Vegetable Science
GBPUA&T, Pantnagar,
Uttarakhand, India

Analysis of Combining Ability for Yield and its attributing Characters in Cowpea (*Vigna unguiculata* (L.) Walp)

Pallavi, YV Singh, Alka Verma and Manoj Kumar Bansala

Abstract

The study was carried out to determine combining ability and association of yield with its associated components among crosses that were derived from seven selected cowpea (*Vigna unguiculata* (L.) Walp.) parents. Twenty-one hybrids were generated from diallel crosses excluding reciprocals. Hybrids along with seven parents were studied for combining ability for seed yield. The result indicated that the general combining ability (*gca*) and specific combining ability (*sca*) were significant for all the characters indicating the importance of both additive and non-additive genetic components. Pant Lobia-5 had good general combining ability for plant height, green pod yield per plant, seed yield per hectare, 100-seed weight and seed weight per plant. Pant Lobia-1 was the best general combiner for number of pods per plant and 100-seed weight whereas, Pant Lobia-2 was found to be good general combiner for number of pods per plant, number of seeds per pod, seed weight per plant and seed yield per hectare. The parent Pant Lobia-3 was good general combiner for seed yield per hectare, seed weight per plant, number of seeds per pod, and days to pod maturity whereas, PCGP-59 and PCGP-63 were good general combiner for plant height whereas, PVCP-20 was good combiner for pod length and green pod weight per plant. The most promising specific combiners for yield and yield components were from crosses including Pant Lobia-5 x Pant Lobia-2, Pant Lobia-5 x Pant Lobia-3, PVCP-20 x PCGP-59, Pant Lobia-2 x Pant Lobia-1 and PGCP-63 X PGCP-53.

Keywords: Diallel analysis, combining ability, yield and cowpea

Introduction

Cowpea (*Vigna unguiculata* (L.) Walp.) is the most important grain legume of subfamily Faoideae (Papilionideae) of family Fabaceae (Leguminosae). Genus *Vigna* is pantropical with 120 species in Africa, around 22 species in India and South-East Asia and few in Australia and America. Cowpea has a number of common names including crowder pea, black eyed pea and southern pea and is generally called beans in Nigeria. Cowpea (*Vigna unguiculata* (L.) Walp.) is an herbaceous, warm-season annual plant requiring temperatures of at least 18ºC throughout all stages of its development and having an optimal growing temperature of about 28ºC (Craufurd *et. al*., 1997) [4]. It is cultivated in the tropical and subtropical regions of the world and it grows in diverse soil types and climatic conditions (Alghali, 1991) [1]. Cowpea fits well in variety of cropping systems and is grown as cover crop, mixed crop, catch crop and green manure crop in India. Variable yield of the crop under different environmental conditions has led to the development of cowpea improvement programs that depend on selection of lines based on desirable genetic attributes including high-grain yield. The nature and magnitude of gene action involved in expression of quantitative traits is important for successful development of crop varieties and cultivars through proper choice of parents for hybridization (Griffings, 1956; Baker 1978; Falconer 1989) [6, 3, 5].

Combining ability refers to the capacity or ability of a genotype to transmit superior performance to its crosses. Sprague and Tatum (1942) [10] in maize proposed the concept of combining ability as a measure of gene action and from their results Sprague and Tatum (1942) [10] concluded that the general combining ability was mainly the results of additive gene action while the specific combining ability due to dominance, epistasis and genotypic environment interaction. According to them the general combining ability (gca) is the comparative ability of the line to combine with other lines. It is deviation of the mean performance of all the crosses involving a parent from overall mean. Specific combining ability (sca) was defined as the deviation in the performance of specific cross from the performance expected on the basis of general combining ability effects of parents involved in the crosses. A positive general combining ability (gca) indicates a parent that produces above average progeny, where as parent with negative gca produces progeny that performs below average of the population. Specific combining ability (sca) can be either negative or positive and sca always refers to specific cross and never to particular parent itself. The diallel cross has been defined as the group of all possible crosses among several genotypes (Griffings, 1956) [6]. Diallel analysis has been used in cowpea to provide important information on general and *sca*, determine genetic variances, estimate heritability, and maternal effects, among others (Hazra *et al*. 1994) [7].

Grain yield is a quantitative trait which is polygenetically controlled (Oseni 1994; Asíns 2004) [9, 2]. Selection on the basis of grain yield alone is usually not effective and efficient, whereas selection along with its component characters could be more efficient and reliable. Consequently, information on the association between yield and yield components and among the component characters themselves can improve the efficiency of selection in plant breeding programs. In crop improvement programme, the success rests upon isolation of valuable gene combinations on determination in the form of lines with high combining ability. The lines which produce good progenies on crossing are of immense value to the plant breeders. The knowledge of gene action and combining ability helps in identifying the best combiners which may be hybridized either to exploit heterosis or to accumulate gene through selection and in understanding the quantitative characters to choose the proper selection method to be followed in breeding programmes. The objectives of this study were to determine combining ability and association of yield and yield components among cross-combinations of seven selected cowpea (*Vigina. unguiculata* (L.) Walp) parents. The selected promising parents could then be used in cowpea breeding programs.

Materials and methods

The present investigation was carried out at the Breeder Seed Production Center of G. B. Pant University of Agriculture & Technology, Pantnagar. The center is situated in the foot hills of *Shivalik* range of Himalayas in the narrow belt called *Tarai*. Geographically, it is situated at an altitude of 243.84 m above mean sea level, and between 29°N latitude and 79.3° East longitude. The experimental material for the study comprised of twenty one F_1s derived by crossing in all possible combinations excluding reciprocals of seven parents (Pant Lobia-1, Pant Lobia-2, Pant Lobia-3, Pant Lobia-5, PGCP-59, PGCP-63 and PVCP-20) following dialyze wasting design was laid out in a randomized block design with three replications during 2014/15 cropping season. The spacing was 45 cm between rows and 15 cm between plants. Standard agronomical practices were followed to raise when required to a good crop. Five competitive plants were randomly selected for recording the observations on different characters like days to 1st flowering, number of pods per plant, pod length (cm), number of seeds per pod, green pod weight per plant (g), green pod yield per plant (g/plant), days to pod maturity, seed weight per plant (g), 100-seed weight (g), plant height (cm),seed yield per hectare (q/ha) iron content (mg/kg) and zinc content (mg/kg). The combining ability analysis was done by following Model 1, Method 2 of Griffing (1956) [6].

Results and discussion

The mean squares due to general and specific combining ability variances for all the characters studied are presented in Table-1. The variances due to general combining ability and specific combining ability were found to be significant for all the characters. Importance of both additive and non-additive effects for various characters was reported earlier by (Jatasra *et. al.*, 1980 and Hazra *et. al.*, 1994) [8, 7]. General combining ability study helps in making the choice of the parents and also helps in the isolation of suitable germplasm for further improvement. General combining ability is primarily a function of additive and additive x additive gene action. In present study significant and negative GCA effects were considered desirable for days to 1st flowering, days to pod maturity and plant height whereas, for other characters significant and positive GCA effects were considered desirable.

Table 1: Analysis of variance (ANOVA) for different characters Cowpea

d. f.	Days to 1st flowering	Number of pods / plant	Pod length (cm)	Number of seeds per pod	Green pod weight per plant (g)	Green pod yield per plant (g/plant)	Days to pod maturity	Seed weight per plant (g)	100-Seed weight (g)	Plant height (cm)	Seed yield per hectare (q/ha)	Iron content (mg/kg)	Zinc content (mg/kg)
Replication	2	0.0972	0.092	0.081	0.072	0.224	0.333	0.674	0.23	0.205	0.772	0.472	0.152
Treatment	27	18.368**	77.668**	55.531**	15.570**	86.876**	1629.621**	25.790**	37.421**	19.833**	114.676**	76.453**	148.85**
Error	54	0.892	0.084	0.053	0.1	0.268	0.394	0.555	0.128	0.182	1.824	0.272	0.206
CD at 1%		2.059	0.633	0..503	0.689	1.129	1.363	1.625	0.78	0.931	2.944	1.133	0.99
CD at 5%		1.546	0.475	0.378	0.518	0.848	1.023	1.22	0.586	0.669	2.944	0.851	0.743
CV (%)		2.309	2.226	1.191	2.099	1.324	0.114	1.133	2.011	2.278	3.042	2.055	0.588
SEM±		0.545	0.167	0.133	0.182	0.299	0.361	0.43	0.206	0.246	0.7796	0.3002	0.262
Replication	2	0.0972	0.092	0.081	0.072	0.224	0.333	0.674	0.23	0.205	0.772	0.472	0.152

*,**Significant at 5% and 1% level of significance.

Pant Lobia-1 was the best general combiner for number of pods per plant and 100-seed weight whereas, Pant Lobia-2 was found to be good general combiner for number of pods per plant, seed weight per plant and seed yield per hectare. The parent Pant Lobia-3 had good general combining ability for seed yield per hectare, seed weight per plant, and days to pod maturity whereas, Pant Lobia-5 was good general combiner for plant height, seed yield per hectare, 100-seed weight and seed weight per plant whereas, PGCP-59 and PGCP-63 were good general combiners for plant height whereas, PVCP-20 was a good combiner for green pod weight per plant and pod lengths (Table-2.)

Table 2: Analysis of variance (ANOVA) for general combining ability (gca) and specific combining ability (sca) effects

d. f.	Days to 1st flowering	Number of pods / plant	Pod length (cm)	Number of seeds per pod	Green pod weight per plant (g)	Green pod yield per plant (g/plant)	Days to pod maturity	Seed weight per plant (g)	100-Seed weight (g)	Plant height (cm)	Seed yield per hectare (q/ha)	Iron content (mg/kg)	Zinc content (mg/kg)
GCA	6	11.039**	36.721**	77.747**	11.463**	78.641**	24757.483**	18.301**	19.843**	13.137**	118.942**	36.721**	324.211**
SCA	21	4.718**	22.721**	1.58**	3.397**	14.763**	20766.591**	5.823**	10.367**	4.746**	15.162**	22.794**	14.021**
Error	54	0.297	0.281	0.017	0.033	0.0895	0.131	0.1852	0.0427	0.608	0.608	0.09	0.068

*,**Significant at 5% and 1% level of significance.

Specific combing ability analysis indicated that the cross Pant Lobia- 3 x Pant Lobia-2 was the best cross combination for days to 1st flowering, for number of pods per plant; Pant Lobia-2 x Pant Lobia-1 was the best cross combination and cross PGCP-63 x PVCP-20 showed the highest value for pod length, cross Pant Lobia-3 x Pant Lobia-2 for number of seeds per pod was the best cross combination. Cross PVCP-20 x Pant Lobia-5 gave the highest positive SCA effect for green pod weight per plant while cross Pant Lobia-2 x Pant Lobia-1 was the best cross combination for green pod yield per plant and for days to pod maturity, PVCP-20 x Pant Lobia-3 was the best cross combination. Cross Pant Lobia-2 x Pant Lobia-1 was the best combination for seed weight per plant, while cross Pant Lobia-3 x Pant Lobia-1 was found to be best combination for 100-seed weight and Pant Lobia-5 x Pant Lobia-1 was the best cross combination for plant height. The cross Pant Lobia-2 x Pant Lobia-1 had highest positive value for seed yield per hectare. Thus, these crosses could be judged as outstanding crosses for simultaneous improvement of seed yield and one or more component characters (Table-3).

Table 3: Estimation of general combining ability effects of parents in cowpea.

d. f.	Days to 1st flowering	Number of pods / plant	Pod length (cm)	Number of seeds per pod	Green pod weight per plant (g)	Green pod yield per plant (g/plant)	Days to pod maturity	Seed weight per plant (g)	100-Seed weight (g)	Plant height (cm)	Seed yield per hectare (q/ha)	Iron content (mg/kg)	Zinc content (mg/kg)
Pant Lobia-1	,-0.41*	1.91**	,-1.20**	,-2.00**	,-2.06**	35.03	0.57**	,-0.85**	1.39**	1.67**	,-0.80**	5.27**	2.39**
Pant Lobia-2	2.10**	3.03**	,-0.22**	1.05**	,-0.14**	96.87**	1.57**	0.59**	,-0.30**	1.22**	1.03**	10.09**	1.01**
Pant Lobia-3	,-0.20*	,-2.09**	,-0.81**	0.75**	,-076**	,-69.62**	,-1.79**	1.13**	,-0.35**	0.187**	1.84**	,-4.25**	1.61**
Pant Lobia-5	,-0.91**	0.53**	,-0.29**	1.24**	,-0.31**	29.83**	,-1.95**	2.21**	1.74**	,-1.86**	3.05**	0.26*	0.73**
PGCP-59	,-0.87**	,-0.34**	,-1.92**	,-0.49**	,-1.34**	,-15.81**	,0.14	,-1.56**	,-0.14	,-1.36**	,-1.93**	,-3.99**	,1.66**
PGCP-63	,-0.60**	,-0.45**	,-2.03**	,-0.42**	,-1.88**	,-25.04**	0.20*	,-1.85**	,-1.82**	,-1.04**	,-1.50**	,-0.13	,-0.96**
PVCP-20	0.90**	,-2.58**	6.47**	,-0.13*	6.49**	,-27.06**	1.54**	0.34**	,-0.52**	,-6.11**	,-1.72**	,-7.24**	,-3.12**
SEM± (gi)	0.41	0.13	0.1	0.14	0.23	0.27	0.32	0.16	0.19	0.59	0.23	0.2	0.19

*,**Significant at 5% and 1% level of significance.

The ranking of high SCA crosses for seed yield showed the parents having high estimates of GCA did not necessarily record high estimates of SCA. Out of ten crosses only one cross namely Pant Lobia-5 x Pant Lobia-2 had both the good general combiner parents. This cross is therefore amenable for improvement through selection. Remaining nine crosses exhibiting significant positive SCA effects for seed yield combined either both or at least one poor/average general combiners. The results therefore, indicate the operation of dominant × dominant and or additive × dominant gene interactions for the genetic control of expression of yield in these crosses. Based on this heterosis breeding appears to be the best approached for the exploitation of available genetic variability. Similar results were reported by Hazra *et. al.* (1994) [7], Oseni (1994) [9] and Asins (2004) [2].

References

1. Alghali AM. Studies on cowpea farming practices in Nigeria with emphasis on insect pest control. Tropical Pest Management. 1991; 37:71-74.
2. Asíns MJ. Present and future of quantitative trait locus analysis in plant breeding. Plant Breed, 2004; 121:281-291.
3. Baker RJ. Issues in diallel analysis. Crop Sci. 1978; 18:533–536.
4. Craufurd PQ, Aiming Q, Summerfield RJ, Ellis RH, Roberts EH. Development in cowpea (*Vigna unguiculata* (L.)Walp.). Effects of temperature and photoperiod on time to flowering in photoperiod-sensitive genotypes and screening for photothermal responses. Expl. Agric. 1997; pp.32:29-40.
5. Falconer DS. Introduction to Quantitative Genetics, 3rd edition. Longman Scientific and Technical, London, 1989.
6. Griffings B. Concept of general and specific combining ability in relation to diallel crossing systems. Aust J. Biol Sci. 1956; 9:463-493.
7. Hajra P, Das PK, Som MG. Combining ability for three important pod yield components cowpea. Indian J. Hort. 1994; 51(4):372-376.
8. Jatasara. Combining ability for grain weight in cowpea. Indian J. of Geneti. 1980; 40:330-333.
9. Oseni TO. Correlation and path coefficients of eight components of grain yield of cowpea (*Vigna unguiculata* (L.)Walp). Ind. J. Agric Sci. 1994; 11:43-47.
10. Sprague GF, Tatum LA. General vs specific combining ability in single cross of corn. J. of American Society of Agronomy. 1942; 34:923-932.
11. Stuber CW. Heterosis in plant breeding. Plant Breed Rev. 1994; 12:227-251.