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International Journal of Current Research
Vol. 7, Issue, 08, pp.19332-19335, August, 2015

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

STUDIES ON GENETIC VARIABILITY, HERITABILITY, GENETIC ADVANCE AND CORRELATION ANALYSIS IN FIELDPEA (*PISUM SATIVUM* L.)

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ARTICLE INFO

Article History:
Received 08th May, 2015
Received in revised form
05th June, 2015
Accepted 25th July, 2015
Published online 31st August, 2015

Key words:

Analysis of variance, PCV, Heritability, Genetic advance, correlation coefficient.

ABSTRACT

The present experiment was conducted at Field Experimentation Center, Department of Genetics and Plant Breeding, Sam Higginbottom Institute of Agriculture Technology and Sciences, The experiment was carried out with 18 genotypes procured from Indian Institute of Pulses Research, Kanpur, U.P, and India and grown in Randomized Block Design (RBD) with three replications. Observations were recorded on five randomly selected plants for all eight traits from each replication except for days to 50 percent flowering and days to maturity, where the observations were on plot basis. Plant height, number of pods per plant recorded high heritability with high genetic advance as per cent of mean. Plant height showed positive and significant association on with seed yield per plant while seeds per pod negatively significant with seed yield so during selection the priority should be given for plant height, number of pods per plant.

***Citation*:** Navin Kumar, Ashish Tomar and Lavanya, G. R. 2015. "Studies on genetic variability, heritability, genetic advance and correlation analysis in Fieldpea (*Pisum sativum* L.)", *International Journal of Current Research*, 7, (8), 19332-19335.

INTRODUCTION

Pulses have been given the status of wonder crop a unique gift bestowed by nature to mankind for number of reasons. Pulses are important and excellent crop for natural resources management, environment security, crop diversification and consequently for viable agriculture. This is inexpensive source of protein for millions of people. Despite being the largest producer in the world, the country is short in supply of pulses. Pulses have a special role in meeting protein requirement of predominantly vegetarian population of India. Pulses contain 20-25% protein dry seed weight basis, which is nearly 2-3 times higher than that in cereals (Prasad, 2004). The protein content of pea ranges from 15.5-39.7% (Davies *et al*., 1985; Bressani and Elias, 1988) a quantitative measure which provides information about the correspondence between genotypic variance is heritability. This term was originally proposed by Lush (1949) to describe the ratio of variance due to hereditary differences to the total phenotypic variance. Heritability is a property not only of the characters being studied, but also the population being sampled and the environmental circumstances to which individuals have been subjected.

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Populations which are genetically more uniform are expected to show lower heritability than the genetically variable population. More variable environmental conditions reduce the magnitude of heritability and more uniform conditions increase it. Correlation coefficient is the statistical measure which is used to find out the degree of relationship between two or more variable. At genetic level, positive correlation arise due to coupling phase of linkage of genes controlling two different traits (Al Jibouri *et al*., 1958).

MATERIALS AND METHODS

The experiment was conducted during Rabi 2012-2013 at Field Experimentation Centre of the Department of Genetics and Plant Breeding, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Science, Deemed-to-be–University, Allahabad. The genotype was obtained from the Department of Genetic and Plant Breeding. The observation was recorded as Days to 50% flowering, Plant height, Number of pods per plant, Days to maturity, Pod length, Number of seeds per pod, Seed index, Seed yield per plant. The data were analyzed by using ANOVA (Panse and Sukhatme, 1967) and the genetic parameters such as PCV and GCV were calculated by the formula given by Burton (1952), heritability broad sense (h2) by Burton and De

Vane (1953), and genetic advance in percent of mean (genetic gain) were work out as suggested by Johnson *et al*. (1955).Correlation by Dewey and Lu (1959)

RESULTS AND DISCUSSION

The analysis of variance for different characters. The mean sum of squares due to genotypes showed significant differences for most of the characters under study at 1% level and 5% level of significance, indicating the presence of substantial amount of genetic variability among the field pea genotypes. The highest significant differences observed for plant height (647.57**). In other words, the performance of the genotypes with respect to these characters was statistically different, suggesting scope for yield improvement in field pea.

Wide range of genotypic coefficient of variation (GCV) was observed for character ranging from 1.96 for days to maturity to 16.35 for number of pods per plant high magnitude of GCV were recorded for number of pods per plant followed by seed yield per plant (12.29), plant height (8.52) seed per pods (7.10), where as low estimates were observed for days to 50% flowering (6.72), seed index (4.83), pod length (3.47) and days to maturity (1.96). Wide range of phenotypic coefficient of variation (PCV) was observed for the characters ranging from 2.66 for days to maturity to 25.74 for seed yield per plant. High magnitude of PCV were recorded for seed yield per plant (25.74) followed by number of pods per plant (17.61), seed per pod (10.04), plant height (8.73) and days to 50% flowering (7.40), whereas low estimates were observed for pod length (6.59), seed index (6.36) and days to maturity (2.66). High genetic variability for different quantitative traits in pea was also reported by Singh *et al*. (1996), Tyagi *et al*. (1997), Tiwari *et al*. (2001), Sharma *et al*. (2003), Kumar *et al*. (2003) and Jitendra *et al*. (2010).

The magnitudinal differences were medium to low in GCV and PCV for plant height, number of seeds per pod, days to 50% flowering, pod length and days to maturity, suggesting the little role of environment in the expression of these characters. These findings are in agreement with the findings of Mulugeta and Assefa (1999), Sonali *et al*. (2009) and Jitendra *et al*. (2010) with respect to number of pods per plant and seed yield per plant.

The heritability estimate were found to be high more than 60%) for plant height (95%) followed by number of pods per plant (86%) and days to 50% flowering (82%) the characters seed per pod (50%) and seed yield per plant showed the among heritability where as pod length (40%) recorded lower heritability. In the present investigation Table 2 highest genetic advance were observed for plant height (29.29) and moderate genetic advance exhibited by days to 50% flowering (10.59).

The estimates of heritability in broad sense were computed, which includes additive gene effects. High value of heritability in broad sense indicates that the character is least influenced by environmental effects. The genetic advance as percent of mean for various characters are represented in Table 2 and noticed that high genetic advance as percent of mean recorded for number of pods per plant (31.28%) and moderate genetic advance as percent of mean recorded for seed yield per plant (21.24%), plant height (17.14%), days to 50% flowering (12.56%).

Expected genetic advance as percent of mean indicates the mode of gene action in the expression of traits, which helps in choosing an appropriate breeding method. In the present study, plant height, number of pods per plant and seed yield showed high estimates of heritability along with high estimates of genetic advance as percent of mean.

Table 1. Analysis of variance for eight quantitative characters in field pea

S.No.	Characters	Mean sum of squares		
		Replications df=2	Treatments df=17	Error df=34
1.	Days to 50% flowering	4.96	101.479**	6.76
2.	Plant height	13.35	647.57**	10.57
3.	No. of pods/plant	2.05	63.64**	3.21
4.	Days to maturity	4.79	22.15**	4.79
5.	Pod length	0.50	0.23*	0.11
6.	Seeds/ pod	0.12	0.51**	0.12
7.	Seed index	1.13	2.59**	0.50
8.	Seed yield/ plant	2.00	66.64**	22.17

** Significant at 1% level of significance
* Significant at 5% level of significance

Table 2. Estimates of components of variance and genetic parameters for seed yield and other yield component characters in field pea

S. No.	Characters	Genotypic variance	Phenotypic variance	Coefficients of Variation		Heritability (bs) (%)	Genetic Advance	Genetic Advance as per cent of mean
				GCV	PCV			
1	Days to 50% flowering	31.56	38.33	6.72	7.40	82	10.50	12.56
2	Plant height	212.33	222.91	8.52	8.73	95	29.29	17.14
3	No. of pods/plant	20.14	23.35	16.35	17.61	86	8.58	31.28
4	Days to maturity	5.78	10.58	1.96	2.66	54	3.66	2.99
5	Pod length	0.042	0.15	3.47	6.59	27	0.22	3.76
6	seeds/ pod	0.128	0.25	7.10	10.04	50	0.52	10.36
7	Seed index	0.69	1.20	4.83	6.36	57	1.30	7.57
8	Seed yield/ plant	14.82	36.99	16.29	25.74	40	5.02	21.24

GCV = Genotypic coefficient of variation
PCV = Phenotypic coefficient of variation
GA = Genetic advance
h^2 = Heritability

Table 3.1 Estimates of Genotypic correlation coefficients of yield component characters with seed yield in field pea

S.No	Character	Days to 50% flowering	plant height cm	Pods/ Plant	Days to maturity	seeds/ Pod	Pod length cm	Seed index	seed yield
1	Days to 50% flowering	1.0000	0.0792	0.3892**	-0.0879	-0.1302	0.3928**	-0.1589	0.0392
2	plant height		1.0000	0.3218*	0.0956	-0.1744	-0.2985*	-0.0198	0.3083*
3	Pods/ Plant			1.0000	-0.1019	-0.2376*	0.0237	0.1098	-0.1644
4	Days to maturity				1.0000	0.0633	0.4668**	0.1738	-0.0493
5	seeds/ Pod					1.0000	0.3620*	0.2871*	-0.9251**
6	Pod length cm						1.0000	0.0395	-0.3129*
7	Seed index							1.0000	0.0784
8	seed yield								1.0000

* and ** significant at 5% and 1% level of significance respectively

Table 3.2. Estimates of phenotypic correlation coefficients of yield component characters with seed yield in field pea

S.No	Character	Plant height cm	Pods/ plant	Days to maturity	seeds/ Pod	Pod length	Seed index	seed yield
1	Days to 50% flowering	0.0848	0.3678**	-0.0479	-0.1708	0.1624	-0.1368	0.0699
2	Plant height	1.0000	0.2716*	0.0657	-0.1160	-0.1577	-0.0299	0.1516
3	Pods/ plant		1.0000	-0.1075	-0.2091	0.0440	0.1707	-0.1292
4	Days to maturity			1.0000	0.1506	0.3388*	0.0616	0.0161
5	Seeds/ pod				1.0000	0.0673	-0.0242	-0.4199**
6	Pod length cm					1.0000	0.0134	-0.2483
7	Seed index						1.0000	-0.1778
8	Seed yield							1.0000

* & ** significant at 5% and 1% level of significance respectively

On the other hand, character like days to maturity showed moderate heritability along with low genetic advance as percent of mean. This indicates that these characters showed intermediate expression for both the additive and dominance gene effect. Similar findings have been also reported by Chaudhari and Sharma (2003), Kumar *et al*. (2004) and Jitendra *et al*. (2010). High heritability associated with moderate genetic advance was observed for number of pods per plant and seed yield per plant, suggesting greater role of non-additive gene action in their inheritance. Heterosis breeding could be used to improve these characters.

Correlation coefficient analysis Correlation coefficient showed in Table 3.1 & 3.2 positive significant association with plant height (0.3083*) whereas significant and negative association was observed with seed per pod (-0.9251**) and pod length (-0.3129*). For characters days to 50% flowering (0.8392) and seed index (0.0784), seed yield per plant showed the positive and non significant association. Days to 50% flowering showed significant and positive association with pods length (0.3928**) and pods per plant (0.3892**). Plant height showed positive and significant association pods per plant (0.3218*) and seed yield per plant (0.3083*). Number of pods per plant showed positive and non significant association with pods length (0.02376) and seed index (0.1098). Days to maturity showed significant and positive association with pod length (0.4668**) and positive non significant association with seed per pod (0.0633) and seed index (0.1738). Number of seed per pods showed positive and non significant association with days to maturity (0.0633). Seed index showed positive and significant association with number of seeds per pod (0.2871*). Correlation coefficient analysis revealed that seed yield per plant showed positive non significant association with days to 50% flowering (0.0699), plant height (0.1516) and days to maturity (0.016). Days to 50% flowering showed positive and significant association with number of pods per plant (0.3678**). Number of pod per plant showed positive and significant association with days to 50% flowering (0.3678**) and plant height (0.2716*). Days to maturity showed positive and significant association pod per length (0.3388*). Number of seed per pod showed the positive and non significant association with days to maturity (.1506 and pod length (0.0673). Seed index showed positive and non significant association with number of pods per plant (0.1707), days to maturity (0.0616) and pod length (0.0134).

The association of character interpreted above can be compiled as characters, number of pods per plant exhibited significant and positive association with seed yield per plant. Pod length, followed by number of pods per plant, number of seeds per pod and seed index were found to be most important characters determining seed yield per plant through correlation studies. The correlation study showed that number of pods per plant serve as the most important indices of grain yield.Usmani *et al*. (2006), Kaur *et al*. (2007), Nawab *et al*. (2008), Ghobary (2010) and Jitendra *et al*. (2010) reported similar findings i.e., number of pods per plant exhibited significant and positive association with seed yield per plant.

Character association studies could be highly useful to know the suitability of various characters for selection, because selection of any particular character may effect desirable or undesirable changes in other related characters. Further, direct selection for seed yield may not be effective, because yield is a complex entity. High genotypic and environmental interactions are likely to restrict the improvement, if selection is based mainly on yield alone by considering it as a simple character. Therefore, the character association between yield and yield components are of considerable importance in selection programmes.

Simultaneous expression of characters may be either due to pleiotropic or genetic linkage. If the relationship is due to manifold effects of gene or genes, it is difficult to separate those effects by selecting a particular character. The degree of correlations observable among attributes depend on the

developmental relations between them and on genes which contribute to variations. Positive correlations occur due to changes of genes supplying precursors. On the other hand, negative correlation arises due to competition among the characters for a common precursor, which is in restricted supply. In the present study, genotypic and phenotypic correlation coefficients were worked out. In general genotypic correlations were higher in magnitude than the phenotypic correlation coefficients. This indicates that these characters are positively governed by additive of gene action and are useful for improvement.

From the character association results in the present investigation, it was apparent that yielding ability in field pea might be improved by selecting plant with higher number of pods per plant and more number of seeds per pod. So priority should be given for these characters while performing selection.

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