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GENETIC VARIATION AND CHARACTER ASSOCIATION ANALYSIS IN CHILLI. (*CAPSICUM ANNUUM* L.)

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ABSTRACT
The present investigation on genetic variability studies included estimation of mean, genotypic and phenotypic variances, coefficient of variation, heritability, and genetic advance for yield and yield related attributes in segregating population of SCH 8 hybrid of chilli. Most of the characters studied showed the presence of good amount of variability as indicated by the high range of mean and high phenotypic and genotypic co-efficient of variation. Correlation and path coefficient analysis was attempted to understand nature of association of several characters contributing to yield in chilli. Number of fruits per plant (0.9342) and fruit weight (0.6083) were significantly and positively correlated with dry fruit yield per plant. Path analysis also revealed that yield was primarily influenced by number of fruits per plant as it showed maximum direct effect (0.8386) followed by fruit weight (0.3033). These studies revealed that, importance should be given to number of fruits per plant, fruit length, fruit weight and seed weight while formulating selection strategies for yield improvement in chilli.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is one of the most important vegetable-cum-spice crop valued for its aroma, taste, flavour and pungency. Improvement in yield is an uphill task in any breeding programme, as so in chilli too. Yield is a complex quantitative character governed by a large number of genes and is greatly influenced by environmental factors. Hence selection of superior genotypes based on yield alone may not be effective. Indeed the presence of wide range of variability and a knowledge of the nature and magnitude of relationship of the various characters with yield is important in making selection in crops. A comprehensive knowledge of the available variability within the breeding material of a crop species for desired characters enables the breeders to identify most potential genotype. The phenotypic variation is the outcome of genotypic, environmental and interaction between genotypic and environmental variation, but for making effective selections, the heritable unit *i.e.,* the genetic variation is most important. Burton and Devane (1953) suggested that genetic variability along with heritability should be considered for assessing the maximum and accurate effect of selection. Shift in the gene frequency towards desirable combinations under selection procedure is termed as genetic advance and is generally expressed as percentage of mean (genetic mean). Johnson *et al.* (1955) reported that heritability and genetic advance, when computed together, are more useful in predicting the resultant effect of selection. The study of correlation of character will help in simultaneous selection for more than one character. As yield is dependent on many component characters, the total correlation is insufficient to explain the true association between the characters. In order to have more clear picture of yield components for effective selection programme, it would be desirable to consider the relative magnitude of various characters. Keeping this objective in view character association analysis was done. Earlier studies by Vani et al. (2007), Singh and Singh, (2011) and Kadwey et al (2015) observed that fruit yield per plant was significantly and positively correlated with green fruit yield per hectare. Path co-efficient analysis helps for sorting out the total correlations into direct and indirect effects and useful in selecting high yielding genotypes available. Previous studies on path analysis in chilli by Mubarak (2002), Smitha and Basavraj (2007), and Kadwey et al (2015) found that yield was primarily influenced by number of fruits per plant, fruit weight and seed weight. To realize these objectives a field investigation was carried out with a view to study the genetic variability and character association in F_2 population of SCH 8 hybrid of chilli.

MATERIALS AND METHODS

The study was carried out at College of Agriculture, University of Agricultural Sciences, Dharwad during kharif 2013. The experiment site is situated in the Agro-climatic zone-8 (Northern Transitional Zone) of Karnataka state. Geographically, Dharwad is located at 15^0 28′ North latitude, 76^0 27′ East longitude and at altitude of 678 m above mean sea level (MSL). Material for the present study consisted of F_2 population of the single cross hybrid SCH 8 and observations were recorded on plant height, number of primary branches/ plant, number of secondary branches/plant, number of fruits/plant, fruit length, fruit diameter, fruit weight, seed weight/fruit and dry fruit weight/ plant. GCV and PCV were estimated as suggested

by Burton (1952) and heritability in broad sense and expected genetic advance as percentage of mean at 5 % selection intensity were calculated following Burton and De Vane (1953) and Johnson *et al* (1955) respectively. Phenotypic correlations were calculated by using the method described by Singh and Choudhary (1977) and path coefficient analysis was done by following the procedure suggested by Dewey and Lu (1959).

RESULTS AND DISCUSSION

The present investigation revealed that considerable amount of variation was present for all the characters studied (Table 1) as indicated by the high range of mean and high phenotypic and genotypic co-efficients of variation. Such wide variation indicated the scope for improving the population for these characters as suggested earlier by Cherian (2000).

High coefficients of phenotypic (PCV) and genotypic (GCV) variation were observed for several characters, the highest being for fruits per plant followed by dry fruit yield per plant. The high PCV and GCV observed are evident from their high variability that in turn offers good scope for selection. The lowest PCV and GCV was for plant height and fruit diameter, similar results were also obtained by Acharya *et al*. (2002) and Kulkarni *et al*. (2010). The GCV was close to PCV for most of the characters, indicating a highly significant effect of genotype on phenotypic expression with very little effect of environment

Heritability estimates observed for most of the characters ranged from 30.15 (fruit length) to 65.69 (fruit weight). Higher magnitude of heritability resulting from high GCV was also registered for fruit weight, number of fruits per plant and fruit diameter as earlier reported by Munshi *et al*. (2010). High heritability estimates indicate the presence of large number of fixable additive factors and hence these traits may be improved by selection. The effectiveness of selection depends upon genetic advance of the character selected along with heritability. High genetic advance over mean was recorded for fruits/plant while for the characters like number of primary and secondary branches, fruit diameter, fruit weight and seed weight moderate GAM was recorded indicating that these traits could be improved by simple selection procedures because of preponderance of additive gene action. Similar results were also reported by Singh, D. K. and Singh, A. (2011) and Janaki *et al*. (2015).

Correlation coefficients for yield and yield attributing traits are presented in table 2. Yield is a very complex character, Griffing (1956) even opined that there are no genes as such governing yield. Therefore for improving yield breeders often try to select on the basis of component characters which are less complex as compared to yield. Correlation analysis helps the breeder to take decision on the choice of the character as selection criterion. The Correlation studies indicated highly significant positive association of dry fruit yield with most of the traits. Krishnakumar *et al*. (2003) also observed such significant positive association. In the present investigation magnitude of association of yield was high with number of fruits per plant (0.9342), fruit weight (0.6083) and fruit length (0.5568). These characters can therefore, be used to the advantage of the breeder for selecting productive genotypes. Similar correlations between these characters were reported by Yadwad *et al*. (2008).

Sink number and sink size are the two most important traits in any species. In chilli, number of fruits per plant and average fruit weight are the corresponding characters. Review of correlation pattern in any species reveal that sink number is more often positively associated with potentiality than sink size. In the present study also number of fruits per plant showed significant positive association with yield in all the populations.

Table 1: Genetic variability parameters for different quantitative traits in F_2 population of chilli hybrid SCH 8

Character	Mean	Range	PV	GV	PCV	GCV	h^2	GA	GAM
Plant height	73.53	37.2-104	40.00	16.73	8.60	5.56	41.83	5.45	7.41
Number of primary branches	2.99	1-4	0.267	0.084	17.28	9.69	31.44	0.335	11.19
Number of secondary branches	6.195	3-14	1.39	0.55	19.03	11.97	39.52	0.959	15.492
Number of fruits per plant	56.41	17-118	202.29	118.81	25.21	19.32	58.74	17.21	30.51
Fruit length	8.88	4.8-12.8	1.16	0.35	12.12	6.67	30.15	0.669	7.535
Fruit weight	1.01	0.68-1.46	0.014	0.0095	11.72	9.65	65.69	0.163	16.08
Fruit diameter	1.009	0.65-1.32	0.0088	0.005	9.29	7.00	57.39	0.11	10.98
Seed weight	0.32	0.22-0.54	0.0015	0.00079	12.10	8.78	54.54	0.042	13.30
Dry fruit yield per plant	55.98	21.2-131.88	142.29	48.69	21.30	12.46	34.18	8.39	15.00

Table 2: Phenotypic correlations among different quantitative traits in F_2 population of SCH 8 hybrid of chilli

Characters	Number of primary branches	Number of secondary branches	Fruit length	Fruit diameter	Fruit weight	Seed weight	Number of fruits per plant	Plant height	Dry fruit yield per plant
Number of primary branches	1	0.6507 **	0.3045 **	0.2756 **	0.2160 **	0.1598 *	0.1257	0.0739	0.1732*
Number of secondary branches		1	0.3584 **	0.3341 **	0.2978 **	0.2164 **	0.2175 **	0.2442 **	0.2737**
Fruit length			1	0.7959 **	0.9176 **	0.7036 **	0.3634 **	0.2442 **	0.5568**
Fruit diameter				1	0.7704 **	0.6306 **	0.3146 **	0.2132 **	0.4662**
Fruit weight					1	0.7032 **	0.3961 **	0.3025 **	0.6083**
Seed weight						1	0.4123 **	0.3614 **	0.5542**
Number of fruits per plant							1	0.6092 **	0.9342**
Plant height								1	0.5654**
Dry fruit yield per plant									1

Table 3: Direct and indirect effect of different quantitative traits on dry chilli yield in F_2 population of SCH 8 hybrid in chilli

Characters	Number of primary branches	Number of secondary branches	Fruit length	Fruit diameter	Fruit weight	Seed weight	Number of fruits per plant	Plant height	Dry fruit yield per plant (r)
Number of primary branches	0.0018	0.0012	0.0005	0.0005	0.0004	0.0003	0.0002	0.0001	0.1732*
Number of secondary branches	0.0152	0.0234	0.0084	0.0078	0.007	0.0051	0.0051	0.0057	0.2737*
Fruit length	-0.0089	-0.0105	-0.0292	-0.0233	-0.0268	0.0206	0.0106	-0.0071	0.5568**
Fruit diameter	-0.0107	-0.013	-0.031	-0.039	-0.03	0.0246	0.0123	-0.0083	0.4662**
Fruit weight	0.0655	0.0903	0.2783	0.2337	0.3033	0.2133	0.1201	0.0918	0.6083**
Seed weight	0.0082	0.0112	0.0363	0.0325	0.0363	0.0516	0.0213	0.0187	0.5542**
Number of fruits per plant	0.1054	0.1824	0.3048	0.2638	0.3322	0.3458	0.8386	0.5109	0.9342**
Plant height	-0.0034	-0.0113	-0.0113	-0.0099	-0.014	-0.0168	-0.0282	-0.0464	0.5654**

Residual : 0.2396; *, ** indicates significant at 5 per cent and 1 per cent level of probability, respectively

Fruit length is another important criterion in chilli which decides consumer preference. Yadwad *et al*. (2008) and Sood *et al*. (2007) reported positive association of fruit length with yield. In the present study also fruit length showed positive significant association with yield. Other fruit characters like fruit diameter and seed weight also showed positive significant association with yield and also among themselves indicating that selection for the trait will help in improving associated trait in turn leading to high productivity.

The correlation values decide only the nature and degree of association existing between pairs of characters. A character like plant yield is dependent on several mutually associated component characters. The knowledge of correlation alone, however is often misleading as the correlation observed may not reflect true nature of association, since two characters may show correlation just because they are correlated with a common third one (Jaiswal and Gupta, 1967). In such cases it becomes necessary to study a method which takes into account the causal relationship. One such method is path analysis that informs us about the direct and indirect effect of different characters on the dependent character.

Results obtained from the path analysis (Table 3) revealed that yield was primarily influenced by number of fruits per plant as it showed maximum direct effect (0.8386) on yield per plant. Hence, it would be rewarding to lay emphasis on fruits per plant while developing selection strategies in these populations. The results are in confirmity with earlier reports of Munshi and Behera (2000), Smitha and Basavraj (2007) and Surya kumari *et al*. (2011). Fruit weight is also an important trait as indicated by its high positive direct effect and indirect effect through fruit length and seed weight on yield. Yadwad *et al*. (2008) and Kadwey et al. (2015) obtained similar results and inferred to lay emphasis on fruit weight also while making selection.

Though very low direct effect of plant height, number of primary branches and number of secondary branches was observed on yield, these traits contributed indirectly via fruits per plant in all the populations. Hiremath (1997), Mubarak (2002) and Smitha and Basavraj (2007) also obtained such results suggesting that while practicing selection one should not neglect the above traits. On the basis of present study it is evident that characters *viz*., number of fruits per plant, fruit length, fruit weight and seed weight deserve due weightage while formulating selection strategies for yield improvement in chilli.

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