Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(1): 1105-1108

Received: 16-11-2018
Accepted: 20-12-2018

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Studies on association between yield attributing traits in Chilli (*Capsicum annuum* L.)

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Abstract
Understanding the direction and magnitude of the correlation between fruit yield and its attributing traits in Chilli (*Capsicum annuum* L.) is a prerequisite for the identification of such characters whose selection would prove beneficial in any breeding program. The correlation coefficient analysis measures the mutual relationship between various characters and it determines the component traits on which selection can be relied upon the effect of improvement. The correlation coefficient analysis was studied in sixteen genotypes in chilli for different characters under randomized complete block design with three replications at Indira Gandhi Krishi Vishwavidayalaya (IGKV), Raipur during *rabi* season of 2016-17. Significant and positive correlation of total fruit yield, both at genotypic and phenotypic levels was recorded with fruit yield per plant, fruit length, and number of seeds per fruit, number of fruits per plant, and number of primary branches. Thus, direct selection for the above traits will be helpful in improving total fruit yield of chilli affect the growth, development and ultimately fruit yield.

Keywords: Chilli, correlation, yield determinants, fruit yield

Introduction
Chilli (*Capsicum annuum* L.) is an important vegetable as well as condiment crop, widely grown throughout India. Chilli, also known as hot pepper, was introduced into India from Brazil during 1584 by the Portuguese. As India has the highest area under chilli, a lot of natural variability exists in this crop. Chilli is an often cross pollinated crop with high natural cross pollination and this also contributes to its variability. Before going to breeding programme through selection it is essential to know the importance and inter association of various components and their association with yield. The correlation coefficient analysis measures the mutual relationship between various characters and it determines the component traits on which selection can be relied upon the effect of improvement (Shau *et al*. 2016) [8]. By keeping this objective in view the present investigation was undertaken for sixteen genotypes of chilli for seventeen quantitative traits out in order to find the characters that influenced the yield.

Materials and Methods
The present experiment was conducted at Indira Gandhi Krishi Viswavidayalaya (IGKV), Raipur during *rabi* season of 2016-17 in order to evaluate the performance of sixteen genotypes of chilli for various yield and its component traits under field condition with three replications of each genotype. Each plot measuring 4.2 x 3.5 m2 had six rows spaced at 60 cm apart with intra- row spacing of 50 cm. The chilli seeds were planted during the second week of September, 2016. The recommended dose of fertilizer *i.e.* nitrogen 150 Kg, phosphorus 75 Kg and potassium 60 Kg per hectare was applied. Half nitrogen was applied at the time of planting and remaining was applied in two splits *i.e.*, at 30 and 60 DAP. Crop was visited regularly throughout the growing season and intercultural operations such as weeding, irrigation and plant protection measures were performed as and when necessary. For each character under study, data were recorded on five randomly taken plants from each plot and expressed on plant basis. The mean of five plants was used for statistical analysis. Observation on important characters *viz*., days to first flowering, days to 50% flowering, plant height, number of primary branches, stem girth, days to first picking, fruit length, fruit girth, stalk length, number of seeds per fruit, number of fruits per plant, fresh weight of fruits, dry weight of fruits, dry matter% of fruits, fruit yield per plant, fruit yield per plot and number of pickings were recorded.

To estimate the association between two variables, correlation coefficient at phenotypic and genotypic levels, was worked out in all possible combination. The phenotypic and genotypic correlations between all possible characters were calculated according to Miller *et al*. (1958) [1].

Result and Discussion

Yield, being a complex quantitative trait, is dependent on a number of component characters; therefore, knowledge association of different components, together with relative contributions, has immense value in selection. In general, the genotypic correlations were observed to be higher than the corresponding phenotypic which might be due to modifying or masking the effect of environment in the expression of these characters under study as explained by Nandpuri *et al*., (1973). Johnson *et al.* (1955) also reported that higher genotypic correlation than phenotypic correlation indicated an inherent association between various characters. The phenotypic and genotypic coefficient of variance was calculated for all the seventeen characters (Table-1). The result obtained showed that phenotypic coefficient of variance was in general higher than the genotypic coefficient of variance for all the characters. The character fruit yield per hectare had a highly significant and positive correlation with fruit yield per plant both at genotypic (0.954) and phenotypic (0.907) levels indicating that increase in fruit yield per plant will simultaneously increase the fruit yield per hectare. Similar result showing correlation between fruit yield per plant and fruit yield per hectare was also reported by Reddy *et al.* (2008) [6] and Patel *et al.* (2009) [5]. The fruit yield per hectare exhibited the positive and significant association, both at genotypic and phenotypic level with fruit length (0.495 and 0.389), number of seeds per fruit (0.415 and 0.325, respectively), number of fruits per plant (0.361 and 0.338, respectively) and number of primary branches (0.334 and 0.298) indicates that the plant types possessing more fruit length, more number of seeds per fruit and more number of fruits per plant will show better performance in terms of fruit yield per hectare. The association of fruit length with total fruit yield was also reported by Sharma *et al.* (2010) [9]. and correlation of number of fruits per plant with fruit yield per hectare was reported by Datta and Jana (2010) [2], Sandeep (2007) [7]. Similarly, the increase in number of primary branches will lead to proportionate increase in fruit yield per hectare simultaneously due to positive and significant association between these characters. The results showing correlation of the number of primary branches with fruit yield per hectare is supported by the findings of Sandeep (2007) [7] and Patel *et al.* (2009) [5]. Fruit yield per plant exhibited significant and positive correlation both at genotypic and phenotypic levels with fruit length (0.538 and 0.428, respectively), and number of seeds per fruit (0.442 and 0.327, respectively), whereas number of fruits per plant (0.428) and number of primary branches (0.326) had positive and significant association with fruit yield per plant at genotypic level only. Dry matter% of fruits exhibited significant and positive correlation both at genotypic and phenotypic levels with dry weight of fruits (0.734 and 0.727, respectively) and plant height. Thus, it can be concluded that genotypes with more plant height and producing fruits with higher dry weight will result in more dry matter% of fruits. Number of pickings had significant and positive correlation only at genotypic level with number of fruits per plant (0.519) and plant height (0.298). The above findings suggest that the plant types with higher plant height and producing more number of fruits per plant with more fruit late flowering are expected to give more number of pickings. Stalk length showed significant and positive correlation, both at genotypic and phenotypic level with fruit length (0.588 and 0.507, respectively) and stem girth (0.326 and 0.310, respectively). Above findings are in agreements with the findings of Smitha *et al.* (2006) [10] and Khader *et al.* (2006) [4]. Fruit girth had significant and positive correlation both at genotypic (0.633) and phenotypic (0.547) level with stem girth. Days to first picking exhibited significantly positive association, both at genotypic and phenotypic level with days to 50% flowering (0.719 and 0.566, respectively) and days to first flowering (0.641 and 0.469, respectively) indicate that the genotypes in which flowering starts early would lead to early fruit setting and maturity. Stem girth had significant and positive association with days to first flowering at genotypic (0.293) level. Days to 50% flowering had highly significant and positive correlation with days to first flowering both at genotypic (0.991) and phenotypic (0.687) level indicating that genotypes which start flowering early would also attain the 50% flowering stage early. Thus, direct selection for above traits will be helpful in improving fruit yield per hectare in chilli. Similar findings are reported by Vani *et al.* (2007) [11], Farhad *et al.* (2008) [3] and Shau *et al* (2016) [8].

Table 1: Phenotypic (PCV) and genotypic (GCV) coefficient of correlation for fruit yield and its attributing traits in chilli

Characters		Days to first flowering	Days to 50% flowering	Plant height (cm)	Number of primary branches	Stem girth (cm)	Days to first picking	Fruit length (cm)	Fruit girth (cm)	Stalk length (cm)	Number of seeds per fruit	Number of fruits per plant	Fresh weight of fruits (gm)	Dry weight of fruits (gm)	Number of pickings	Dry matter% of fruits	Fruit yield per plant (gm)	Fruit yield per ha (q)
Days to first flowering	P	1.000	0.687**	0.084	0.307*	0.197	0.469**	0.110	0.221	0.063	0.179	0.066	0.313*	0.006	0.114	0.324*	0.032	0.027
	G	1.000	0.991**	-0.086	-0.383**	0.293*	0.641**	0.089	0.291*	-0.097	0.219	0.274	0.389**	-0.028	-0.381**	-0.431**	-0.043	0.037
Days to 50% flowering	P			0.202^{NS}	0.384**	0.167^{NS}	0.566**	0.188^{NS}	0.122^{NS}	0.175^{NS}	0.100^{NS}	0.180^{NS}	0.065^{NS}	0.268^{NS}	0.062^{NS}	0.492**	0.108	0.036
	G			-0.206	-0.413**	0.144	0.719**	-0.231	0.140	-0.238	0.144	0.189	0.084	-0.323*	0.091	-0.585**	-0.138	-0.078
Plant height (cm)	P				0.235	0.191	0.082	0.215	0.010	0.213	0.157	0.192	0.053	0.260	0.083	0.488**	0.287*	0.310*
	G				0.267	0.172	-0.128	0.262	0.016	0.272	0.200	-0.417**	-0.070	0.292*	0.298*	0.550**	-0.332*	-0.338*
Number of primary branches	P					0.382**	0.329*	0.165	0.392**	0.118	0.118	0.112	0.264	0.254	0.031	0.001	0.250	0.298*
	G					-0.409**	-0.427**	0.190	-0.411**	-0.134	0.134	0.187	-0.280	-0.285*	0.048	-0.027	0.326*	0.334*
Stem girth (cm)	P						0.126	0.137	0.547**	0.310*	0.009	0.126	0.475**	0.482**	0.410**	0.136	0.380**	0.349*
	G						0.167	0.153	0.633**	0.326*	0.059	-0.413**	0.535**	0.556**	-0.893**	0.144	-0.474**	-0.425**
Days to first picking	P							0.104	0.119^{NS}	0.060^{NS}	0.415**	0.097^{NS}	0.111^{NS}	0.195^{NS}	0.068^{NS}	0.459*	0.170^{N}	0.242
	G							0.108	0.138	-0.062	0.479**	0.149	0.133	-0.240	0.231	-0.559**	0.243	0.283
Fruit length (cm)	P								0.012^{NS}	0.507**	0.361*	0.304*	0.588**	0.470**	0.252^{NS}	0.145^{NS}	0.428**	0.389**
	G								-0.006	0.588**	0.386**	-0.318*	0.626**	0.493**	-0.571**	0.163	0.538**	0.495**
Fruit girth (cm)	P									0.007^{NS}	0.250^{NS}	0.321*	0.581**	0.524**	0.396**	0.228^{NS}	0.390**	0.336*
	G									0.026	0.265	-0.486**	0.611**	0.545**	-0.797**	0.242	-0.431**	-0.385**
Stalk length (cm)	P										0.100^{NS}	0.092^{NS}	0.405**	0.299*	0.015^{NS}	0.017^{NS}	0.166^{NS}	0.186
	G										-0.020	-0.302*	0.536**	0.400**	-0.382**	0.008	0.161	0.187
Number of seeds per fruit	P											0.104^{NS}	0.212^{NS}	0.031^{NS}	0.095^{NS}	0.070^{NS}	0.327*	0.325*
	G											-0.041	0.238	0.059	-0.062	-0.030	0.442**	0.415**
Number of fruits per plant	P												0.357*	0.579**	0.153^{NS}	0.512**	0.263^{NS}	0.338*
	G												-0.587**	-0.923**	0.519**	-0.838**	0.428**	0.361*
Fresh weight of fruits (gm)	P													0.717**	0.446**	0.108^{NS}	0.123^{NS}	0.145^{NS}
	G													0.743**	-0.982**	0.131	0.146	0.179
Dry weight of fruits (gm)	P														0.378**	0.727**	0.195	0.200
	G														-0.666**	0.734**	-0.216	-0.243
Number of pickings	P															0.085	0.032	0.073
	G															-0.040	0.239	0.188
Dry matter% of fruits	P																0.372**	0.417**
	G																-0.440**	-0.542**
Fruit yield per plant (gm)	P																	0.907**
	G																	0.954**
Fruit yield per ha (q)	P																	1.000
	G																	1.000

Conclusion

Correlation coefficient analysis measures the magnitude of the relationship between various plant characters and determines the component character on which selection can be based for improvement in chilli yield. Therefore, present study indicated that fruit yield per plant, fruit length, number of seeds per fruit, number of fruits per plant and number of primary branches were the main components contributing to fruit yield per hectare and therefore, should be given high priority in the selection programme.

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