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Determination of selection parameters for genetic improvement by evaluating F_7 progenies of green chilli

Paramjeet Singh Negi and Akhilesh Sharma*

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Abstract

The experimental materials comprised of 27 advance breeding lines derived from eight inter-varietal crosses and six varieties including 'Surajmukhi' as standard check. The materials were evaluated in randomized complete block design with three replications during summer 2017. PCV and GCV were high marketable green fruit yield/plant (30.75 and 31.35%, respectively). Similarly, it showed high heritability along with high genetic advance. However, in general, high heritability along with moderate PCV, GCV and genetic advance were observed for majority of the traits. Green fruit yield/plant showed positive and significant correlations with fruit length, fruit girth, fruit width, leaf width, plant height, average green fruit weight, number of marketable green fruits/plant and capsaicin content at both genotypic and phenotypic levels. Marketable green fruits/plant had the maximum positive direct effect on marketable green fruit yield per plant followed by average green fruit weight while leaf length, plant height and secondary branches/plant also contributed directly to a limited extent at both phenotypic and genotypic levels. Further, marketable green fruits/plant followed by average green fruit weight had the maximum indirect contribution to the total positive association. Thus, selection for these traits should be taken as a criterion for yield improvement in chilli.

Key words: Genotypes, PCV, GCV, Heritability, Correlation, Path coefficient

Introduction

Chilli (*Capsicum annuum* var. *annuum* L) is one of the common and remunerative cash crops grown for its green and dry red fruits especially as spice in Indian subcontinent. Today, India has emerged as the major producer, consumer and exporter of chilli. Indian chilli exports nowadays, is facing severe competition in the international market from other chilli growing countries along with high domestic consumption. On the other hand, the average yield is low due to various constraints such as non-availability of suitable cultivars, biotic and abiotic stresses and genetic drift in the age-old popular cultivars. Thus, there is a pressing demand to develop high yielding varieties or hybrids with good quality attributes to enhance the productivity.

The initial and cheapest input to enhance the productivity of any crop is to make available high yielding and well adapted varieties by initiating a strong breeding programme. Genetic variability in germplasm decides the extent of improvement to be achieved ingermplasm through selection (Eze and Nwofia 2016) and provides the possibility to improve the yield and quality through strategic breeding programme. This indicates that genetic diversity serves as a reservoir for identifying superior alleles controlling key agronomic and quality traits (Sharma et al. 2018). Crop improvement with heritable characters, estimation of genetic parameters and their association is of prime importance in breeding (Bozokalfa et al. 2010) and are dependable indicators for improvement of characters in a genetic material through selection.

Yield is a complex polygenically inherited character resulting from multiplicative interaction of its contributing characters and is highly influenced by the environment. Hence, selection based on yield alone may limit the improvement. On the other hand, the yield component traits are comparatively less complex in inheritance and are influenced to lesser extent by the environment. Thus, effective improvement in yield may be brought about through selection for yield component characters (Alkuddsi et al. 2013). Yield component characters show association among themselves and also with yield. Favourable associations between desirable attributes will help improvement in a joint manner whereas, unfavorable associations between the desirable attributes under selection may limit genetic advance. Hence, knowledge

Department of Vegetable Science and Floriculture, CSK Himachal Pradesh Krishi Vishvavidyalaya, Palampur, 176062, HP
*Corresponding author, Email: assharmaakhil1@gmail.com

of associations between the yield components and among themselves is essential for planning a sound breeding programme. Knowledge of correlation alone is often misleading as the correlation observed may not be always true. Simple correlation analysis that relates yield to a single variable may not provide a complete understanding of the importance of each component in determining fruit yield (Okuyama et al. 2004). Portioning of total correlation into direct and indirect effects provide actual information on contribution of characters and thus form the basis for selection to improve the yield. In other words, it allows separating the direct effect and their indirect effects through other attributes by apportioning the correlations for better interpretation of cause and effect relationship. Thus, selection based on the detailed knowledge of magnitude and direction of association between yield and its attributes is very important in identifying the key characters, which can be exploited for crop improvement through suitable breeding programme.

Materials and Methods

The present investigation was undertaken at the Experimental Farm of Department of Vegetable Science and Floriculture, Chaudhary Sarwan Kumar Himachal Pradesh Krishi Vishvavidyalaya, Palampur (1, 290.8 m above mean sea level with 32^0 6^2 N latitude and 76^0 32 E longitudes) during summer 2017. The experimental materials comprised of 27 F_7 progenies derived from eight inter-varietal crosses, five entries from AICRP on Vegetable Crops and recommended variety 'Surajmukhi' as the standard check were sown on 14thMarch 2017 in the nursery bed and transplanting was done on 7th May 2017 in randomized complete block design with three replications. Each genotype was planted in two rows of length 2.25 m consisting of ten plants in each replication with inter and intra row spacing of 45 cm × 45 cm, respectively. The other recommended practices were followed for raising the crop successfully. The observations were recorded on five competitive plants taken at random in each entry over the replications on days to flowering, days to first harvest, pedicel length (cm), fruit length (cm), fruit girth (cm), fruit width (cm), leaf length (cm), leaf width (cm), primary branches/plant, secondary branches/ plant, plant Height (cm), average green fruit weight (g), marketable green fruits/ plant, harvest duration, ascorbic acid (mg/100g) and capsaicin content (%). The data collected were subjected to analysis of variance and parameters of variability, heritability in broad sense and genetic advance (GA) resulting from selection of top 5% of individuals, phenotypic and genotypic coefficients of correlation and path coefficient analysis was done as per standard procedures. The genotypic and phenotypic correlations were calculated as per Al- Jibouri et al. (1958) and Path coefficient as per procedure elaborated by Dewey and Lu (1959).

Results and Discussion

A critical insight of the magnitude of genetic variability provides the basis for effective selection and possibility to improve the yield and quality through strategic breeding programme (Singh et al. 2009). The knowledge of phenotypic coefficient of variation (PCV) and genotypic coefficient of variation (GCV) is helpful in predicting the amount of variation present in the given genetic stock which in turn helps in formulating an efficient breeding programme.PCV and GCV were high for marketable green fruit yield/plant (30.75 and 31.35%, respectively) indicating substantial variability ensuring

Table 1: Estimates of parameters of variability for various traits in chilli

Traits	Ranges	Population mean	ECV (%)	GCV (%)	PCV (%)	h^2_{bs}(%)	GA (%)
Days to flowering	33.33-42.67	38.01	6.92	4.16	8.08	26.56	4.42
Days to first harvest	58.67-73.33	62.83	4.43	6.79	8.11	70.16	11.71
Pedicel length (cm)	2.24-4.17	3.34	7.64	14.71	16.57	78.83	26.90
Fruit Length (cm)	5.01-10.67	7.51	4.84	17.28	17.94	92.72	34.27
Fruit girth (cm)	2.72-4.09	3.50	5.27	10.29	11.54	79.45	18.89
Fruit width (cm)	0.78-1.19	1.01	7.65	8.97	11.60	59.82	14.30
Leaf length (cm)	6.14-9.98	8.14	3.20	14.51	14.86	95.33	29.18
Leaf width (cm)	2.58-4.55	3.58	6.05	14.56	15.77	85.27	27.69
Primary branches/plant	3.60-6.40	4.96	8.89	14.12	16.68	71.61	24.61
Secondary branches/plant	9.67-20.40	14.69	10.42	16.99	19.93	72.67	29.83
Plant height (cm)	43.53-80.27	59.69	5.61	13.80	14.90	85.81	26.33
Average green fruit weight (g)	2.17-3.69	2.89	4.90	13.84	14.67	89.07	26.91
Marketable green fruits/ plant	41.59-119.52	78.04	5.63	24.20	24.85	94.86	48.56
Marketable green fruit yield/plant (g)	93.91-354.86	227.83	6.11	30.75	31.35	96.20	62.13
Harvest duration	46.00-61.00	57.43	4.88	7.08	8.60	67.74	12.00
Ascorbic acid (mg/100g)	31.61-76.68	53.13	7.84	22.04	23.39	88.78	42.78
Capsaicin content (%)	0.97-2.57	1.86	8.33	23.00	24.47	88.33	44.52

PCV and GCV represent phenotypic and genotypic coefficients of variation, respectively; h^2_{bs}: Heritability in broad sense; GA (%): Genetic advance as per cent of mean

ample scope for its improvement through selection (Sharma et al. 2018). In general, moderate estimates of PCV and GCV (magnitude of 10-30%) were observed for most of the characters suggesting that selection for these traits for improvement of genotypes should be taken up with cautions (Pandiyaraj et al. 2017).

The knowledge of heritability influences the choice of breeding procedures to predict gain from selection and to determine the relative importance of genetic effects (Kashiani et al. 2010). High heritability estimates (>80%) were observed for fruit length, leaf length, leaf width, plant height, average green fruit weight, marketable green fruits/plant, marketable green fruit yield/ plant, ascorbic acid and capsaicin content, indicating lesser influence of environment and greater role of genetic components of variation. Thus, focus should be given to such traits for effective selection. However, the high heritability does not necessarily mean high genetic gain and is insufficient alone to make improvement through simple phenotypic selection. It is therefore, useful to study genetic advance along with heritability. Keeping this in view, high heritability along with high genetic advance was observed for marketable green fruit yield/plant (96.20 and 62.13%, respectively) which indicated the presence of additive gene action in the inheritance of these traits and hence, is likely to respond better to selection (Sharma et al. 2018). However, in general, high heritability along with moderate genetic advance was observed for majority of the traits namely, fruit length, leaf length, leaf width, plant height, average green fruit weight, marketable green fruits/plant, ascorbic acid and capsaicin content indicating the importance of both additive and non-additive gene action. Earlier research workers have also reported such estimates for many of these traits in their respective studies (Pujar et al. 2017; Nahak et al. 2018).

Selection for yield may not be effective unless other yield components influencing it directly or indirectly are taken into consideration. Therefore, it is also important to gather information on association of yield with other characters and among themselves, and their basis to identify characters for increasing the efficiency of both direct and indirect selection and thereby, defining an ideal plant type. In general, the genotypic correlation coefficients were higher in magnitude than the corresponding phenotypic ones (Table 2) which revealed that though there is a strong inherent association between various characters, the phenotypic expression of the correlation gets reduced under the influence of environment (Pandit and Adhikari 2014).

In the present investigation, marketable green fruit yield/ plant showed positive and significant correlations with fruit length, fruit girth, fruit width, leaf width, plant height, average green fruit weight, marketable green fruits/plant and capsaicin content at both genotypic and

Table 2: Estimates of phenotypic and genotypic correlation coefficients among different traits in green chilli

Traits		Days to first harvest	Pedicel length (cm)	Fruit Length (cm)	Fruit girth (cm)	Fruit width (cm)	Leaf length (cm)	Leaf width (cm)	Primary branches/ plant	Secondary branches/ plant	Plant height (cm)	Average green fruit weight (g)	Marketable green fruits/plant	Harvest duration	Ascorbic acid (mg/100g)	Capsaicin content (%)	Marketable green fruit yield/plant (g)
Days to flowering	P	0.362*	0.179	0.084	-0.018	0.092	-0.041	0.181	-0.040	-0.052	-0.036	-0.135	-0.141	-0.428*	-0.021	-0.273*	-0.180
	G	0.767*	0.184	0.065	-0.087	0.145	-0.046	0.295*	-0.073	-0.262*	-0.017	-0.206*	-0.279*	-0.643*	-0.054	-0.511*	-0.328*
Days to first harvest	P		0.077	0.220*	-0.233*	-0.204*	0.208*	0.219*	0.043	-0.244*	0.011	-0.102	-0.217*	-0.809*	0.172	-0.113	-0.224*
	G		0.098	0.259*	-0.318*	-0.393*	0.247*	0.276*	0.054	-0.211*	0.030	-0.103	-0.264*	-0.949*	0.202*	-0.215*	-0.262*
Pedicel length (cm)	P			0.430*	-0.036	-0.114	0.006	-0.119	-0.019	-0.210*	0.328*	-0.007	-0.228*	-0.045	-0.217*	-0.196*	-0.177
	G			0.467*	-0.055	-0.241*	0.015	-0.185	-0.014	-0.228*	0.406*	0.012	-0.258*	0.025	-0.219*	-0.230*	-0.185
Fruit Length (cm)	P				0.303*	0.211*	0.176	-0.059	-0.305*	0.087	0.476*	0.545*	0.105	-0.210*	0.002	-0.162	0.309*
	G				0.300*	0.164	0.198*	-0.059	-0.331*	0.089	0.518*	0.589*	0.107	-0.255*	-0.005	-0.188	0.320*
Fruit girth (cm)	P					0.636*	0.232*	0.204*	-0.094	-0.069	0.397*	0.582*	0.170	0.136	0.157	0.244*	0.362*
	G					0.813*	0.283*	0.269*	-0.102	-0.085	0.437*	0.655*	0.181	0.197*	0.173	0.268*	0.388*
Fruit width (cm)	P						-0.034	0.047	-0.201*	0.115	0.164	0.497*	0.319*	0.136	-0.020	0.080	0.436*
	G						-0.002	0.151	-0.254*	0.170	0.176	0.639*	0.415*	0.274*	-0.021	0.108	0.554*
Leaf length (cm)	P							0.637*	0.196	-0.291*	-0.004	0.165	0.106	-0.174	0.500*	0.440*	0.170
	G							0.677*	0.232*	-0.315*	0.018	0.170	0.118	-0.214*	0.545*	0.472*	0.177
Leaf width (cm)	P								0.025	-0.372*	-0.061	0.114	0.221*	-0.334*	0.603*	0.391*	0.214*
	G								0.031	-0.399*	0.003	0.136	0.253*	-0.362*	0.668*	0.453*	0.242*
Primary branches/plant	P									-0.046	-0.268*	-0.417*	-0.141	-0.054	-0.027	0.098	-0.291*
	G									-0.016	-0.336*	-0.498*	-0.181	-0.021	-0.029	0.138	-0.350*
Secondary branches/ plant	P										-0.015	-0.061	0.202*	0.205*	-0.228*	-0.135	0.128
	G										-0.088	-0.074	0.192	0.214*	-0.268*	-0.107	0.117
Plant Height (cm)	P											0.536*	0.172	0.026	0.020	0.113	0.364*
	G											0.628*	0.159	-0.002	0.024	0.107	0.382*
Average green fruit weight (g)	P												0.325*	0.078	0.159	0.202*	0.683*
	G												0.380*	0.055	0.184	0.249*	0.705*
Marketable green fruits/ plant	P													0.052	-0.000	0.209*	0.906*
	G													0.055	0.004	0.240*	0.919*
Harvest duration	P														-0.129	0.122	0.098
	G														-0.167	0.215*	0.098
Ascorbic acid (mg/100g)	P															0.520*	0.062
	G															0.571*	0.073
Capsaicin content (%)	P																0.252*
	G																0.292*

* Significant at $P \leq 0.05$

phenotypic levels (Table 2). Selection based on these traits might leads to higher yield. Earlier reports of many research workers have also revealed such association in their respective studies (Pujar et al. 2017; Sharma et al. 2018; Vidya et al. 2018) through the evaluation of variable breeding materials at their respective locations. Therefore, these traits need to be given special focus for the improvement of fruit yield. Besides, marketable green fruit yield/plant showed negative and significant correlation with days to first harvest and primary branches/plant at both genotypic and phenotypic levels which indicate that early maturing genotypes had low yield potential. Such negative correlationwas also reported by Kumar et al. (2014) and Maurya et al. (2017) among these traits. Correlation coefficient between other pairs of traits revealed that fruit length, fruit girth, plant height and average green fruit weight had positive association among themselves. Kumar et al. (2014) and Sharma et al. (2014) have also reported positive association of these characters with each other. Similarly, leaf length, leaf width, ascorbic acid and capsaicin content had significant and positive association among themselves.

Yield is a complex character with polygenic inheritance and depends upon series of processes *viz.,* phenological, canopy development, biomass production etc. that are driven by environment influences. The performance of a genotype is ultimately determined by the integrated effect of genotype and environment. The path coefficient analysis allows partitioning of correlation coefficients into direct and indirect effects of various traits towards dependent variable. It plays an important role in determining the degree of relationship between yield and its component effects and also permits critical examination of specific factors that provide a given correlation. The present study revealed that the direct effects obtained at genotypic level were markedly different from those at phenotypic level (Table 3). These differences might be due to varying degree of influence of environment on various traits studied. In few cases, the direct effects were observed to be of opposite sign (positive to negative and vice-versa) at corresponding phenotypic and genotypic levels like in days to flowering, fruit width, leaf width, primary branches/plant and harvest duration. Such a change in direction and magnitude of direct and indirect effects might be due to environmental factors influencing various traits. Therefore, path analysis at phenotypic level may not provide true picture of direct and indirect causes and it would be advisable to understand the contribution of different traits towards the fresh fruit yield/plant at genotypic level.

Marketable green fruits/plant had the maximum positive direct effect on marketable fruit yield/plant at both phenotypic and genotypic levels followed by average fruit weight while leaf length, plant height and secondary branches/plant also contributed directly to a limited extent toward fruit yield at both levels. The earlier research workers have also reported direct and positive effect of number of marketable fruits/plant (Ullah et al. 2011). A

Table 3: Estimates of direct and indirect effects of different traits on green fruit yield/plant at phenotypic (P) and genotypic (G) levels in chilli

Traits		Days to flowering	Days to first harvest	Pedicel length (cm)	Fruit Length (cm)	Fruit girth (cm)	Fruit width (cm)	Leaf length (cm)	Leaf width (cm)	Primary branches per plant	Secondary branches per plant	Plant Height (cm)	Average green fruit weight (g)	Marketable green fruits per plant	Harvest duration	Ascorbic acid (mg/100g)	Capsaicin content (%)	r
Days to flowering	P	0.008	0.000	-0.001	-0.001	0.001	-0.002	-0.002	-0.001	0.000	0.000	0.000	-0.062	-0.107	-0.015	0.001	0.001	-0.180
	G	-0.015	-0.081	-0.005	0.000	0.014	0.009	-0.004	0.007	-0.001	-0.001	-0.001	-0.093	-0.193	0.019	0.001	0.016	-0.328*
Days to first harvest	P	0.003	0.000	-0.001	-0.003	0.008	0.004	0.009	-0.001	0.000	0.000	0.000	-0.047	-0.165	-0.028	-0.004	0.000	-0.224*
	G	-0.012	-0.106	-0.003	-0.001	0.053	-0.026	0.024	0.006	0.000	0.000	0.002	-0.046	-0.183	0.028	-0.005	0.007	-0.262*
Pedicel length (cm)	P	0.001	0.000	-0.007	-0.005	0.001	0.002	0.000	0.000	0.000	0.000	0.003	-0.003	-0.174	-0.002	0.005	0.001	-0.177
	G	-0.003	-0.010	-0.028	-0.002	0.009	-0.016	0.001	-0.004	0.000	0.000	0.029	0.006	-0.179	-0.001	0.005	0.007	-0.185
Fruit Length (cm)	P	0.001	0.000	-0.003	-0.012	-0.010	-0.004	0.008	0.000	0.002	0.000	0.005	0.250	0.080	-0.007	0.000	0.000	0.309*
	G	-0.001	-0.027	-0.013	-0.005	-0.050	0.011	0.019	-0.001	-0.002	0.000	0.037	0.266	0.074	0.008	0.000	0.006	0.320*
Fruit girth (cm)	P	0.000	0.000	0.000	-0.004	-0.034	-0.012	0.010	-0.001	0.001	0.000	0.004	0.267	0.130	0.005	-0.004	-0.001	0.362*
	G	0.001	0.034	0.002	-0.002	-0.167	0.053	0.027	0.006	-0.001	0.000	0.031	0.295	0.126	-0.006	-0.004	-0.008	0.388*
Fruit width (cm)	P	0.001	0.000	0.001	-0.003	-0.021	-0.019	-0.002	0.000	0.002	0.000	0.002	0.228	0.244	0.005	0.000	0.000	0.436*
	G	-0.002	0.042	0.007	-0.001	-0.135	0.065	0.000	0.003	-0.002	0.000	0.013	0.289	0.288	-0.008	0.001	-0.003	0.554*
Leaf length (cm)	P	0.000	0.000	0.000	-0.002	-0.008	0.001	0.045	-0.002	-0.001	0.000	0.000	0.076	0.081	-0.006	-0.011	-0.001	0.169
	G	0.001	-0.026	0.000	-0.001	-0.047	0.000	0.096	0.015	0.002	-0.001	0.001	0.077	0.082	0.006	-0.013	-0.015	0.177
Leaf width (cm)	P	0.002	0.000	0.001	0.001	-0.007	-0.001	0.029	-0.003	0.000	0.000	-0.001	0.052	0.169	-0.012	-0.013	-0.001	0.214*
	G	-0.004	-0.029	0.005	0.000	-0.045	0.010	0.065	0.022	0.000	-0.001	0.000	0.061	0.176	0.011	-0.016	-0.014	0.242*
Primary branches per plant	P	0.000	0.000	0.000	0.004	0.003	0.004	0.009	0.000	-0.007	0.000	-0.003	-0.191	-0.108	-0.002	0.001	0.000	-0.291*
	G	0.001	-0.006	0.000	0.002	0.017	-0.016	0.022	0.001	0.007	0.000	-0.024	-0.225	-0.126	0.001	0.001	-0.004	-0.350*
Secondary branches per plant	P	0.000	0.000	0.001	-0.001	0.002	-0.002	-0.013	0.001	0.000	0.001	0.000	-0.028	0.154	0.007	0.005	0.000	0.128
	G	0.004	0.022	0.006	-0.001	0.014	0.011	-0.030	-0.009	0.000	0.002	-0.006	-0.033	0.133	-0.006	0.006	0.003	0.117
Plant Height (cm)	P	0.000	0.000	-0.002	-0.006	-0.013	-0.003	0.000	0.000	0.002	0.000	0.010	0.246	0.131	0.001	0.000	0.000	0.364*
	G	0.000	-0.003	-0.011	-0.003	-0.073	0.011	0.002	0.000	-0.002	0.000	0.072	0.283	0.110	0.000	-0.001	-0.003	0.383*
Average green fruit weight (g)	P	-0.001	0.000	0.000	-0.007	-0.020	-0.010	0.007	0.000	0.003	0.000	0.005	0.459	0.247	0.003	-0.004	-0.001	0.683*
	G	0.003	0.011	0.000	-0.003	-0.109	0.041	0.016	0.003	-0.003	0.000	0.045	0.451	0.263	-0.002	-0.004	-0.008	0.705*
Marketable green fruits per plant	P	-0.001	0.000	0.002	-0.001	-0.006	-0.006	0.005	-0.001	0.001	0.000	0.002	0.149	0.762	0.002	0.000	-0.001	0.906*
	G	0.004	0.028	0.007	-0.001	-0.030	0.027	0.011	0.006	-0.001	0.000	0.011	0.171	0.694	-0.002	0.000	-0.008	0.919*
Harvest duration	P	-0.004	0.000	0.000	0.003	-0.005	-0.003	-0.008	0.001	0.000	0.000	0.000	0.036	0.039	0.034	0.003	0.000	0.098
	G	0.010	0.100	-0.001	0.001	-0.033	0.018	-0.021	-0.008	0.000	0.000	0.000	0.025	0.038	-0.029	0.004	-0.007	0.098
Ascorbic acid (mg/100g)	P	0.000	0.000	0.001	0.000	-0.005	0.000	0.022	-0.002	0.000	0.000	0.000	0.073	0.000	-0.004	-0.022	-0.001	0.062
	G	0.001	-0.021	0.006	0.000	-0.029	-0.001	0.052	0.015	0.000	-0.001	0.002	0.083	0.003	0.005	-0.024	-0.018	0.072
Capsaicin content (%)	P	-0.002	0.000	0.001	0.002	-0.008	-0.002	0.020	-0.001	-0.001	0.000	0.001	0.093	0.159	0.004	-0.012	-0.003	0.251*
	G	0.008	0.023	0.006	0.001	-0.045	0.007	0.045	0.010	0.001	0.000	0.008	0.112	0.166	-0.006	-0.014	-0.031	0.292*

Residual effect at phenotypic level (P) =0.0061, and genotypic level (G) = 0.0029 Significant at P ≤ 0.05; bold values indicate direct effects; r correlation coefficient with marketable green fruit yield/plant

critical analysis of path analysis revealed that marketable green fruits/plant followed by average fruit weight had the maximum indirect contribution to the total correlation coefficient of fruit yield/plant with fruit length, fruit girth, leaf width, plant height and capsaicin content. Singh and Singh (2004) have also reported the contribution of these traits towards yield. The low magnitude of unexplained variations at genotypic (0.0029) and phenotypic (0.0061) levels indicated that the traits included in the present investigation accounted for the greater part of the variations present in the dependable variable i.e. green fruit yield.

It can be concluded that selection on the basis of green fruits/plant,optimum fruit length and fruit width, average fruit weight, plant height and secondary branches/ plantwould be a rewarding preposition for evolving high yielding chilli genotypes.

lkjk'k

मिर्च की आठ अन्तर प्रजातिय संकरणों से उत्पन्न उच्चीकृत प्रजनन वंशाक्रमों एवं छः किस्मों सहित ''सूरजमुखी'' को मानक नियंत्रक के रूप में सम्मिलित कर परीक्षण किया गया। सामग्री का मूल्यांकन रैण्डीमाइज्ड कम्पलीट ब्लाक डिजाइन में 3 बार प्रतिकृति कर वर्ष 2017 के ग्रीष्मकाल में किया गया। बाह्यदृश्य गुणांक विविधता एवं आनुवांशिक गुणांक विविधता सबसे अधिक बाजार योग्य हरी फलियों की उपज/पौध (30.75 एवं 31.35 प्रतिशत क्रमशः) पाया गया। इसी प्रकार इनमें उच्च वंशागतित्व के साथ उच्च आनुवांशिक उन्नयन भी पाया गया। जबकि सामान्य रूप से उच्च वंशागतित्व के साथ मध्यम बाह्यदृश्य गुणांक विविधता, आनुवांशिक गुणांक विविधता एवं आनुवांशिक उन्नयन कई प्रमुख घटकों के लिये पाया गया। हरी फली उपज/पौध से धनात्मक एवं सार्थक सह–सम्बन्ध फली की लम्बाई, फली व्यास, फली की चौड़ाई, पत्ती की चौड़ाई, पौध ऊँचाई, औसत हरी फली की भार, बाजार योग्य फलियों की प्रति पौध संख्या एवं कैप्सेजिन की मात्रा दोनों स्तरों–आनुवांशिक एवं बाह्यदृश्य प्रारूप में पाया गया। बाजार योग्य हरी फलियों की उपज प्रति पौध ने अधिकतम सकारात्मक सीधा प्रभाव स्पष्ट किया तथा औसत हरी फली भार इसके बाद पाया गया जबकि पत्ती की लम्बाई पौध ऊँचाई एवं द्वितीयक प्रति पौध ने भी कम स्तर पर सीधे रूप से दोनों स्तरों– बाह्यदृश्य प्रारूप एवं आनुवांशिक ने स्पष्ट किया। इसी प्रकार बाजार योग्य हरी फलियाँ प्रति पौध के उपरान्त औसत हरी फली भार ने परोक्ष रूप में सकारात्मक सम्बन्ध स्पष्ट किया। इस प्रकार मिर्च में इन घटकों के लिये चयन हेतु उपरोक्त मापदण्डों का उपयोग किया जाना चाहिए।

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