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GENETIC VARIABILITY, HERITABILITY AND GENETIC ADVANCE ANALYSIS IN *CAPSICUM ANNUUM* L. GENOTYPES

Ritu Rani Minz *et al.,*

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RITU RANI MINZ*[1], VIVEK KUMAR KURREY[1], PUSHPENDRA PAINKRA[2] AND NISHA CHANDEL[1]
[1]Department of Vegetable Science,
Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh 492012, India
[2]Department of Horticulture,
Institute of Agriculture Sciences, Banaras Hindu University, Varanasi - 221 005, INDIA
e-mail: rituminz1@gmail.com

ABSTRACT

Study on genetic diversity was conducted with 15 chilli (*Capsicum annuum* L.) genotypes at the Vegetable Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh) during 2014-2015. On the basis of fifteen genotypes studied, for different characters genotype KA-2(C) (22.01q) was found superior in terms of fruit yield per hectare followed by 12CHIV AR-2 (17.72q) and LCA-334(C) (13.37q). The phenotypic coefficient of variation (PCV) was higher than genotypic coefficient of variation (GCV) for all the traits. Genetic advance was found high for plant height, no. of seed per fruit, no. of fruits per plant, seeds per fruit, weight of seed per fruit, average fruit weight, days of first anthesis, ascorbic acid and fruit yield per plant (g). Where as high heritability and high genetic advance (as % of mean) were recorded for all the trials except than no. of branches per plant, plant spread, days to 50 % flowering, days of first harvest. Large amount of variability was observed in the experimental for selection. Therefore, these characters should be given priority during selection.

***Corresponding author**

INTRODUCTION

Chilli *(Capsicum annuum* L.) is one of the most important spice cum vegetable crop grown in India with great export potential. The genus *Capsicum* originated in the American tropics. Five species of capsicum were cultivated in different parts of the World (Pickergill, 1997). It is probably introduced by Portuguese into Southern parts of India and cultivation spread out throughout India by the end of 19th century. Due to long history of cultivation, selection and popularity of crops sufficient genetic variability has been generated. The critical assessment of nature and magnitude of variability in the germplasm stock is one of the important pre-requisites for formulating effective breeding methods as the genetic improvement of any crop depends on magnitude of genetic variability and the extent of heritability of economically important characters, though the part played by environment in the expression of such character also needs to be taken into account. Rich variability in morphological traits in hot pepper occurs through out India particularly in south peninsular region, North Eastern foot hills of Himalayas and Gangetic plains (Pradheep and Veeraragavathatham, 2006). Collection and maintenance of the genetic diversity in capsicum are important to avoid genetic erosion. Besides the identification of species, the characterization and evaluation of genotypes maintained in gene banks are of fundamental importance (Sudre *et al.,* 2006). Characterization and evaluation of germplasm are prerequisite for the utilization of the available diversity in the chilli improvement programme. For planning and execution of a successful breeding program, the most essential pre-requite is the availability of substantial desirable genetic variability for important characters in the germplasm and the extent to which the desirable characters are heritable Dhanwani *et al*. (2013). It is necessary to assess the genetic variability present in the indigenous genotypes for yield and its components. Parameter of genotypic and phenotypic coefficient of variations is useful in detecting the amount of variability present in the germplasm. Heritability and genetic advance helps in determining the influence of environment in expression of the characters and the extent to which improvement is possible after selection. Hence, the genotypes were characterized to assess the variability and identification of promising genotypes which can be used in further breeding programme. Therefore, an attempt was made in the present investigation to estimate the extent of genetic variability, heritability and genetic advance analysis in 15 diverse genotypes of chillies for various compositional and yield attributes for identifying superior genotypes for involvement in future breeding programme.

MATERIALS AND METHODS

The experimental material for the study comprised of 15 genotypes collected from IIVR Varanasi, are laid in randomized block design (RBD) with three replications at the Vegetable Research Farm, Department of Horticulture, Allahabad School of Agriculture, Sam Higginbottom Institute of Agriculture, Technology and Sciences, Allahabad (Uttar Pradesh) during 2014-2015. lies at an elevation of 78 meters

above sea level at 25.87 degree North latitude and 81.15 degree E longitude**.** Mechanical composition of soil are Sand 59.60 %, Silt **%,** Clay %, Organic carbon (0.480%), Organic matter (0.637%), Nitrogen (280 kg/ha), Phosphorus (12.3kg/ha), Potash (150 kg/ha), pH (7.2) was observed in the site of experiment. The seeds were sown in 60cm apart between rows and 45cm within the row. Standard agronomic practices and plant protection measures were taken as per schedule. Observations were recorded on five randomly selected plants per replication for Plant height 90 DAT(cm), Plant height 120 DAT(cm), Plant height 150 DAT(cm), Number of branches per plant 90 DAT, Number of branches per plant 120 DAT, Number of branches per plant 150 DAT, Plant spread 90 DAT, Plant spread 120 DAT, Plant spread 150 DAT, Days to flower anthesis, Days to 50% Flowering, Days of first harvest, Fruit length, Fruit diameter (cm), Average fruit weight (g), Number of seeds per fruits, Weight of seeds per fruits, Number of Fruits/Plant, Yield/Plant, Yield/ha, Vitamin 'C' (mg/100g and Estimation of capsaicin (°Brix) were recorded periodically. Data were analyzed as per Panse and Sukhatme (1984) for analysis of variance. Phenotypic and genotypic coefficients of variation (PCV and GCV), heritability in broad-sense and genetic advance as percent of mean were calculated as per procedures given by Burton and De Vane (1953) and Johnson *et al*. (1955).

RESULTS AND DISCUSSION

The extent of variability present in the genotypes were measured in terms of ranges, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability in broad sense and Genetic advance as percentage of mean is presented in Table 1. The analysis of variance revealed highly significant differences for all the characters studied which indicates the genotypes differ significantly for all the characters. Wide range of variation was observed in all the characters. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) are categorized as low (less than 10%), Moderate (10-20%) and high (more than 20%) as suggested by Sivasubramanian and Madhavamenon (1973).

High magnitude of genotypic as well as phenotypic coefficient of variations were recorded for traits *viz*., Number of seeds per fruits (52.81 and 53.43), Average fruit weight (g) (46.01and 49.99), Fruit length (cm) (24.16 and 27.92), Weight of Seeds /fruits (mg) (23.35and 25.75), Number of fruits/plant (22.76 and 25.68), Ascorbic acid (mg/100g) (21.39and 23.94), Estimation of capsaicin (°Brix) (20.71and 25.67), suggested the substantial improvement on chilli through selection for these traits. These results are in conformity with Sahoo *et al*. (1989). Moderate GCV and PCV were recorded for Fruit yield per plant (g) (19.52and 26.91), Fruit diameter (cm) (18.92and 23.11), Days to 50% flowering (16.96 and 23.64), Plant spread (13.46 and 18.24), Day to first harvest (13.08 and 17.57), Plant height (cm) (11.68 and 12.56), Days to first anthesis (11.49 and 13.50). Characters like Yield per hectare (q) (9.73and 14.53) and Number of branches per plant (4.73 and 8.45) had low genotypic and phenotypic coefficient of variation. Phenotypic coefficient of variation genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that a character showing high heritability will also exhibit high PCV was higher than the genotypic coefficient of variation (GCV) for all the traits indicates that the variation for these traits is not only by genotypes but also due to environment. Selection based on phenotypes may miss lead as their expression depends more on genetically factors. Similar observations were reported in chilli by Sha *et al*. (1986) and Shirsat (1994).

Heritability estimate along genetic advance are normally more useful in predicting the gain under selection than that of heritability alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al*. 1955). An attempt has been made in present investigation to estimate heritability in broad sense and categorized as low (< 50%), moderate (50%-70%) and high (> 70%) as suggested by Robinson (1966).

Table 1: Coefficient of variations, heritability and genetic advance for 15 traits in chilli Genotypes.

Characters	Range Max.	Min.	Mean	GV	PV	CV GCV (%)	PCV (%)	h2 (bs) (%)	GA	GA as percent on mean
Plant height (cm)	81.77	34.28	48.96	150.15	153.54	11.68	12.56	85	30.09	28.69
Number of branches per plant	28.27	13.87	17.40	33.13	32.00	4.73	8.45	33	5.35	6.28
Plant spread	50.58	35.44	42.34	42.20	40.04	13.46	18.24	54	2.89	22.23
Days to . first anthesis	69.93	48.47	56.34	5.64	6.86	11.49	13.50	71	16.76	25.84
Days to 50% flowering	79.52	59.94	66.86	19.23	19.10	16.96	23.64	57	4.73	32.19
Day to first harvest	94.01	74.15	81.95	52.74	53.21	13.08	17.57	55	21.86	26.72
Fruit length	9.07	4.72	6.76	5.34	4.65	24.16	27.92	62	23.46	45.25
Fruit diameter (cm)	1.44	0.49	0.93	4.38	6.27	18.92	23.11	67	13.73	30.88
Average fruit weight (g)	4.67	2.15	3.03	0.95	011	46.01	49.99	75	31.96	111.82
Number of seeds per fruits	46.22	23.05	32.51	298.90	295.39	52.81	53.43	98	36.05	134.81
Weight of Seeds /fruits (mg)	249.08	76.95	153.90	343.11	373.95	23.35	25.75	86	28.65	51.92
Number of fruits /plant	116.03	54.45	75.95	2180.15	2102.08	22.76	25.68	79	20.94	53.24
Fruit yield per plant (g)	621.98	85.52	294.72	20456.78	201.47	19.52	26.91	63	1.69	37.38
Yield per hectare (q)	22.01	3.99	9.70	10.28	12.93	9.73	14.53	65	5.67	17.19
Ascorbic acid (mg/100g)	164.92	121.81	142.31	188.28	190.60	21.39	23.94	80	22.16	50.45
Estimation of capsaicin (°Brix)	0.61	0.23	0.42	0.17	0.11	20.71	25.67	95	639.79	44.11

GV = Genotypic variance, PV = Phenotypic variance, GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, h2 (bs) = Heritability (broad Sense), GA = Genetic advance, GAM = Genetic advance as percent of mean

In the present investigation high magnitude of heritability was recorded for most of characters. The highest heritability was recorded for the characters *viz*., Number of seeds per fruits (98%), Estimation of capsaicin (°Brix) (95 %), Weight of Seeds /fruits (mg) (86 %), Plant height (cm) (85 %), Ascorbic acid (mg/ 100g) (80 %), Number of fruits /plant (79 %), Average fruit weight (g) (75 %), Days to first anthesis (71 %). Moderate heritability was observed for Fruit diameter (cm) (67 %), Yield per hectare (q) (65 %), Fruit yield per plant (g) (63 %), Fruit length (cm) (62 %), Days to 50% flowering (57 %), Day to first harvest (55 %), Plant spread (54 %). Low heritability was observed for Number of branches per plant (33 %). High heritability estimates for rice quality traits were also reportedby Durai *et al*. (2014) and Gampala *et al*. (2015).

The magnitude of genetic advance as percentage of mean easy categorized as high (>20 %), moderate (20-10 %) and low (<10 %) as suggested by Johnson *et al*. (1955). Genetic advance as percentage of mean was observed high for Number of seeds per fruits (134.81 %), Average fruit weight (g) (111.82 %), Number of fruits /plant (53.24 %), Weight of Seeds /fruits (mg) (51.92 %), Ascorbic acid (mg/100g) (50.45 %), Fruit length (cm) (45.25 %), Estimation of capsaicin (°Brix) (44.11 %), Fruit yield per plant (g) (37.38 %), Days to 50% flowering (32.19 %), Fruit diameter (cm) (30.88 %), Plant height (cm) (28.69 %), Day to first harvest (26.72 %), Days to first anthesis (25.84 %), Plant spread (22.23 %), moderate for Yield per hectare (q) (17.19 %) and low for Number of branches per plant (6.28 %).

Heritability estimates along with genetic advance are more useful than the heritability value alone for selecting the best individual. High heritability coupled with high genetic advance was observed for Number of seeds per fruits, Estimation of capsaicin (°Brix), Weight of Seeds /fruits (mg), Plant height (cm), Ascorbic acid (mg/100g), Number of fruits /plant, Average fruit weight (g), Days to first anthesis. Indicating that most likely the heritability is due to additive gene effects and selection may be effective. Therefore, selection based on phenotypic performance of these traits would be effective to select desirable plant type.

High heritability along with high genetic advance is an important factor for predicting the resultant effect for selecting the best individuals. In the present study, high heritability was accompanied with high values of genetic advance for Estimation of capsaicin (°Brix), Number of seeds per fruits, Weight of Seeds /fruits (mg), Plant height (cm) indicating predominance of additive gene component. Thus, there is ample scope for improving these characters based on direct selection. High heritability with moderate genetic advance noticed for Ascorbic acid (mg/100g), Number of fruits /plant, implied equal importance of additive and non additive gene action. These results in agreement with the earlier findings of Rani *et al*. (1996) and Shah et *al*. (1986).

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