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Genetic Divergence for Yield and its Component Traits in Chilli (*Capsicum frutescens*L) Accecessions of Kerala

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Abstract: ***A Study on genetic diversity was conducted with 78 chilli (Capsicum frutescensL.) genotypes which were collected from different parts of Kerala. Fifteen quantitative characters and one qualitative characterwere taken into consideration.Mahalanobis D^2 statistics was employed to study genetic divergence among 78 genotypes and they were grouped into nine clusters on the basis of relative magnitude of D^2 values using Euclidean^2 method. Cluster II accommodated maximum number (24) of genotypes and minimumwith cluster III (1 genotype).The inter cluster distances (D values) ranged between 3.90 to12.68. Minimum inter cluster distance was between cluster II and IV (3.90) and maximum inter cluster distance was observed between cluster VII and VIII (12.68). The intra cluster divergence varied from 3.32 to 5.45. Maximum intra cluster distance was achieved in cluster VIII (5.45) and minimum divergence was observed in cluster V (3.32). Cluster III was showed zero intra cluster distance as it contains only one genotype.The maximum relative contribution to the total divergence was made by fruit yield per plant (61.07 %) and cluster VIII and cluster IX may be taken into consideration as better parents for an efficient hybridization programme of chilli.***

Keywords: Chilli, *Capsicum frutescens*, Genetic diversity, Resistance and Cluster

1. Introduction

Chilli is a widely used vegetable or spice crop cultivated throughout India. It is consumed both in unripe (green) and ripe (red) forms. Chilli is a rich source of vitamin C. It also contains vitamin A, vitamin B and minerals [13]. India is the leading country in the production of chillies contributing 41.11 per cent of the world's production. Bird chilli (*Capsicum frutescens*L.) or bird's eye chilli is a stimulating herb renowned for aroma, taste, flavour and pungency. Pungency in chilli is due to presence of an alkaloid "capsaicin" contained in the pericarp and placenta of fruits [12]. In Indiachilli is cultivated in7. 94 lakhs ha, production is 1304 million tonnes and its productivity is 1.6 million tonnes per ha[7].India is the only country which is rich in many chilli varieties with different quality factors. A wide variability in chilli fruit morphology, pungency, bearing habit and crop duration is found throughout India [4].Leaf curl is considered to be one of the major limiting factors in chilli production.Collection and evaluation of genotypes for high yield and resistance to biotic stress are important in crop improvement.

Genetic divergence existing in the population helps in selection of suitable parents for any crop breeding programme, leading to reduction in the number of crosses. Selection of parents depends on specific objective of the research programme and their performance. Various statistical analyses are available to select suitable parents. Mohalanobis D^2statistic of multivariate analysis is recognized as a powerful tool in quantifying the degree of genetic divergence among the populations. The information on the nature and degree of genetic divergence is essential for the breeder to choose the right type of parents for purposeful hybridization in heteros is breeding [2], [6]. In order to benefit transgressive segregation, the knowledge of genetic distance between parents is necessary [6].Therefore, the present study was undertaken to assess the genetic diversity in 78 genotypes of chilli and to identify suitable donors for a successful breeding program in this crop.

2. Materials and Methods

Seventy eight chilli (*Capsicum frutescens*L.) genotypes were collected from different part of Kerala and cultivated in the experimental field at Department of Plant Breeding and Genetics, College of Agriculture, Vellayani,during September-February, 2013-14.The four weeks old seedlings were transplanted in a spacing of 50cm × 50cmbetween rows and 75cm × 75cm between plants. Timely management practices as per the package of practices recommendations of Kerala Agricultural University [5] were carried out. The observations were recorded on five randomly selected plants of each genotypeon number of days to first flowering, number of primary branches, number of secondary branches, number of fruits per plant, average fruit length (cm), average fruit width (cm), individual fruit weight (g), fruit yield per plant(g), number of seeds per fruit, plant height (cm), incidence of leaf curl disease, number of white flies per plant, number of aphids per plant, number of thrips per leaf, number of mites per leaf andleaf pubescence.

Vulnerability index is calculated on the basis of leaf curl virus disease scoring0 to 4 scale. Leaf pubescence was observed on the youngest mature leaves and it was classified assparse(3), intermediate (5) and dense (7).Mahanalobis D^2 statistics [11] was used for assessing the genetic divergence between the groups. The grouping of the population was done by using squared Euclidean distance [9].

3. Results and Discussion

The computations from distance matrix gave non-hierarchical clustering among 78bird chili genotypes and they were grouped into nine clusters (Table 1). Cluster II was the largest one comprising of twenty four genotypes

followed by cluster IV with 13 genotypes, cluster I with 11 genotypes, cluster V with 9 genotypes, cluster IX with 8 genotypes, cluster VI with 7 genotypes, cluster VII with 3 genotypes, cluster VIII with 2 genotypes and cluster III with 1 genotype, indicating high degree of heterogeneity among the genotypes. This was supported by [14] in a Study of genetic diversity in 30 chilli genotypes and they were grouped into 6 clusters.[3]studied54 chilli genotypes which were fallen into seven clusters. The selection of genotypes for hybridization should be based on genetic divergence rather than geographical diversity.

Intra and inter cluster distances (D values) are shown in Table 2. The inter-cluster distances were larger than the intra-cluster distances. The inter cluster D^2 values were found to range between 3.90 to12.68. The inter-cluster distance was maximum between cluster VII and VIII (12.68) indicating wide genetic diversity between these two clusters [8] the hybrids of genotypes with maximum distance resulted in high yield. Thus the cross between the genotypes from cluster VII and VIII can be used in chilli breeding to achieve maximum heteros is. Genotypes from these two clusters if involved in hybridization, may result in a wide spectrum of segregating populations as genetic diversity is very distinct among the groups. The selection of diverge genotypes from a cluster would produce a broad spectrum of variability for morphological and quality traits studied which may enable further selection and improvement. Minimum inter cluster distance between cluster II and IV (3.90) indicated that the genotypes were genetically close to each other. The intra cluster divergence varied from 3.32 to 5.45. Maximum intra cluster distance was achieved in cluster VIII (5.45) which comprised two genotypes while minimum divergence was observed in cluster V (3.32). Cluster III showed zero intra cluster distance due to containing only one genotype.Similar findings were reported by [14], [3].

Difference in cluster means existed for almost all the characters studied and are presented in Table 4.Cluster VIII had Highest mean values for different characters viz fruit yield per plant (g) followed by number of fruits per plant, plant height (cm), number of days to first flowering, number of secondary branches, number of primary branches, average fruit length (cm), average fruit width (cm) and individual fruit weight (g). Therefore the genotype fallen in cluster VIII having the genetic potentiality to contribute better for yield maximization of chilli genotypes. The genotypes in cluster V exhibited lowest number of days to first flowering while those in cluster VIII exhibited highest. Maximum number of primary branches per plant was observed in cluster VIII and minimum number was in cluster VI. Highest number of secondary branches per plant was recorded for cluster VIII and lowest for cluster IV. Maximum number of fruits per plant was recorded in cluster VIII and minimum was in cluster IV. Fruit length varied from 7.50 in cluster VIII to 3.00 in cluster III. Maximum fruit width was observed in cluster VIII and minimum was in cluster IV. Highest individual fruit weight was observed for cluster VIII and it was lowest in cluster V. Maximum fruit yield per plant was reported in cluster VIII while cluster II reported minimum. Maximum number of seeds per fruit was shown by cluster I and minimum by cluster III. Cluster VIII reported maximum plant height while cluster VI exhibited minimum. Highest and lowest incidence of leaf curl disease was recorded for cluster IV and VIII respectively. Cluster VII recorded highest number of white flies per plant while cluster VIII recorded lowest. Cluster VII had highest number of thrips per leaf while those in cluster VIII exhibited lowest. Highest number of mites per leaf was observed for cluster VI and it was found lowest for cluster VIII. The results indicated that selection of genotypes having high values for a particular trait can made and they can be utilised in the hybridization programme for improvement of that particular character [10], [14], [3].

The maximum relative contribution to the total divergence was made by fruits yield per plant (61.07 %), number of fruits per plant (27.11 %), plant height (4.86 %) incidence of leaf curl disease (4.83 %), number of seeds per fruits (1.67 %), number of secondary branches (0.37 %) and number of days to first flowering (0.10 %) (Table 3).

4. Conclusion

The seventy eight genotypes of chilli (*Capsicum frutescens*L.) under study were grouped into nine clusters. Geno typically distant parents are able to afford high heterosis. Therefore, considering group distance, mean performance and variability the inter genotypic crosses between cluster VIII and cluster IX , cluster III and cluster VIII and cluster III and cluster IX maybe suggested to be useful for future hybridization programmes. Superior geno types, Vandithadam-I and Kumarapuram-Ifallen in cluster VIII had shown best results on fruit yield per plant (g), followed by number of fruits per plant, plant height (cm), number of days to first flowering, number of secondary branches, number of primary branches, average fruit length (cm), average fruit width (cm)individual fruit weight (g) and less incidence of leaf curl disease. Hence, these characters should be given prime importance for further crop improvement programmes*i.e* inter specific hybridisation with *Capsicum annuum* to develop the resistant genotypes for leaf curl virus [1].

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Table 1: Distribution of 78 Chili genotypes in different clusters

Cluster No	No of genotypes	Cluster members
I	11	A1, A51, A16, A72, A12, A43, A23, A37, A39, A11, A40
II	24	A2, A25, A27, A8, A6, A64, A9, A58, A5, A54, A68, A33, A60, A19, A46, A47, A61, A17, A44, A18, A59, A65, A20, A35
III	1	A13
IV	13	A3, A35, A78, A66, A73, A49, A63, A69, A48, A14, A56, A21, A36,
V	9	A15, A22, A74, A77, A76, A53, A67, A10, A71
VI	7	A30, A31, A7, A41, A32, A73, A42
VII	3	A26, A38, A75
VIII	2	A4, A50
IX	8	A24, A28, A34, A52, A55, A57, A62, A70

Table 2: Intra and inter cluster distances (D^2) for 78 chili genotypes (D values given in parenthesis)

Clusters	I	II	III	IV	V	VI	VII	VIII	IX
I	18.08 (4.25)	23.45 (4.84)	37.06 (6.09)	21.50 (4.64)	26.85 (5.18)	27.39 (5.23)	51.31 (7.16)	115.37 (10.74)	44.90 (6.70)
II		11.44 (3.38)	30.57 (5.53)	15.23 (3.90)	17.29 (4.16)	19.88 (4.46)	49.38 (7.03)	136.99 (11.70)	48.71 (6.98)
III			0.00 (0.00)	39.61 (6.29)	35.82 (5.98)	35.29 (5.94)	61.03 (7.81)	82.35 (9.07)	36.25 (6.02)
IV				12.29 (3.51)	16.29 (4.04)	19.89 (4.46)	48.06 (6.93)	136.19 (11.67)	50.30 (7.09)
V					11.03 (3.32)	21.20 (4.60)	44.99 (6.71)	154.04 (12.41)	56.85 (7.54)
VI						15.15 (3.89)	54.65 (7.39)	138.26 (11.76)	51.44 (7.17)
VII							21.36 (4.62)	160.72 (12.68)	78.85 (8.88)
VIII								29.72 (5.45)	52.20 (7.23)
IX									12.73 (3.57)

Table 3: Percent contribution of sixteen characters towards diversity in bird chilli

Character	Times Ranked first	Contribution %
Number of days to first flowering	3	0.10
Number of primary branches	0	0.00
Number of secondary branches	11	0.37
Number of fruits per plant	814	27.11
Average fruit length (cm)	0	0.00
Average fruit width (cm)	0	0.00
Individual fruit weight (g)	0	0.00
Fruit yield per plant (g)	1834	61.07
Number of seeds per fruit	50	1.67
Plant height (cm)	146	4.86
Leaf pubescence	0	0.00
Incidence of leaf curl disease (V.I)	145	4.83
Number of white flies per plant	0	0.00
Number of aphids per plant	0	0.00
Number of thrips per leaf	0	0.00
Number of mites per leaf	0	0.00

Table 4: Cluster mean values of 16 different characters of 78 birds Chili genotypes

Cluster means	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16
Cluster -I	107.27	10.62	27.05	124.20	5.65	2.39	1.67	206.78	32.41	58.06	3	63.50	1.23	3.09	3.51	0.00
Cluster -II	108.25	11.05	29.08	108.09	4.64	2.22	1.03	106.01	17.72	52.15	3	62.52	0.41	3.10	3.40	0.00
Cluster -III	114.40	14.60	32.80	255.50	3.00	3.00	1.20	302.90	10.80	49.20	3	12.50	0.75	3.47	2.86	0.00
Cluster -IV	107.58	8.28	20.17	105.55	4.98	2.12	1.32	136.33	20.38	57.98	3	71.41	0.52	2.68	2.89	0.00
Cluster -V	103.30	7.80	20.90	147.80	4.19	2.21	0.83	114.13	14.18	52.14	3	60.56	1.26	3.06	2.96	0.00
Cluster -VI	109.50	7.50	21.54	162.51	4.37	2.17	0.91	144.54	31.81	46.77	3	37.70	0.34	2.78	4.22	0.00
Cluster -VII	109.50	9.00	24.23	147.43	4.33	2.70	1.03	134.83	26.57	61.50	5	67.77	1.56	3.60	1.83	0.00
Cluster -VIII	121.90	15.45	43.15	324.05	7.50	3.75	2.00	645.60	28.00	121.95	3	3.10	0.15	0.16	1.15	0.00
Cluster -IX	104.63	12.50	38.40	246.53	6.70	2.91	1.30	316.79	29.80	93.01	3	10.89	0.16	1.09	1.38	0.00

X_1 Number of days to first flowering X9 Number of seeds per fruit
X2 Number of primary branches X10 Plant height (cm)
X3 Number of secondary branches X11 Leaf pubescence
X4 Number of fruits per plant X12 incidence of leaf curl disease
X5 Average fruit length (cm) X13 Number of white flies per plant
X6 Average fruit width (cm) X14 Number of thrips per leaf
X7 Individual fruit weight (g) X15 Number of mites per leaf
X8 Fruit yield per plant (g) X16 Number of aphids per plant

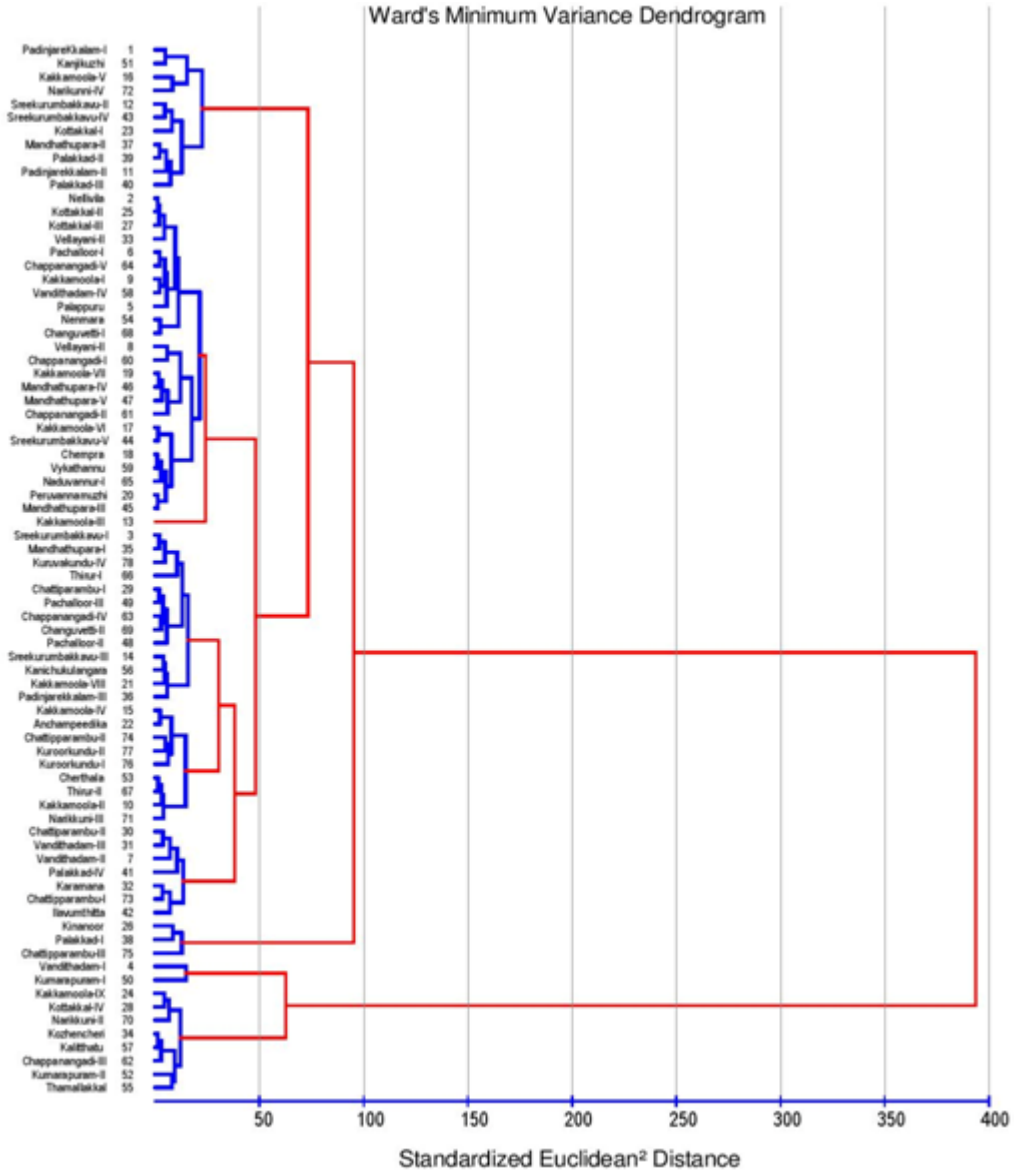

Figure 1: Dendrogram of 78 genotypes of bird chilli