STUDIES ON VARIABILITY OF PLANT CHARACTERS IN TWO POPULATIONS OF CHILLI *(Capsicum annum)* cv. PC-1.

Anusha.S[1], Arulnandhy.V[1] and Vijitha.N[1]

ABSTRACT

Chilli cv. PC-1 is popular in Batticaloa district due to its high pungency and resistant to pests and diseases. However, farmers faced problems in marketing due to variation in fruit quality with respect to colour, shape, size, etc. This is due to the unavailability of genetically pure population of chilli cv. PC-1. An investigation was conducted to study the variability and to select promising plants from two populations of chilli cv. PC-1 with Dark green Long fruit and Light yellow Round fruit types. Plants were selected randomly from these populations and were evaluated for quantitative characters such as canopy height, number of primary branches, leaf length, leaf width, fruit length, fruit width, fruit weight, number of fruits per plant and yield. The collected data were statistically analyzed to determine the level of significance.

The correlation studies of the quantitative characters were found. They were canopy height at 100% flowering and canopy height at last harvest; canopy height at 100% flowering and yield per plant; canopy height at last harvest and fruit weight; canopy height at last harvest and fruit length; number of primary branches at 100% flowering and number of primary branches at last harvest; leaf length and leaf width; leaf length and number of fruits per plant; leaf length and yield per plant; leaf width and fruit width; fruit length and fruit weight; fruit width and fruit weight; number of fruits per plant and yield per plant.

It was observed that selected plants of PC-1 cultivar showed a wider variation in several traits. Hence, selection would be positively approached for the characters and use in chilli improvement programme through selection. Genetic improvement in present cultivar and maintenance of genetic purity is a need to encourage production and market potential of chilli cv. PC-1.

Key words : Chilli cv. PC-1, Genetic improvement, Genetic purity, Quantitative Characters

INTRODUCTION

Chilli (Capsicum annum) is considered as one of the major commercial crops of the world. Different varieties of chilli are grown for vegetables, spices, condiments, sauces and pickles (Smith et al., 1987 and Bosland, 1992). Both green and dried chillies are the important components of our routine diet. It will give the required pungency, colour, taste and flavour to our dishes. Hence, there is lot of demand for chilli oleoresin in the world market (Heiser, 1976).

In dry zone and intermediate zone of the Sri Lanka, chilli is cultivated in a large extent. At present, major chilli growing districts are Anuradhapura, Moneragala, Ampara, Vavuniya, Kurunegala, Hambantota and Mahaweli System H. Other chilli growing districts are Batticaloa, Trincomalee and Jaffna. During the Yala season water shortage and late water issues have caused severe moisture stress along with incidence of pest out breaks. This ultimately led to sevear crop losses in these districts (Department of Agriculture, 2001).

Pant C-1 (PC-1), is an advanced generation selection from a cross between NP46 A and a local cultivar resistant to leaf curl mosaic virus disease. The PC-1 plants are erect, 50-60 cm tall and have more primary branches. Fruits are small in size and borne upright in clusters (Ravindar, 2003). First fruiting commences in 60 days and picking commences 100 days after transplanting. Fruits are green when immature and red when ripe. Fruit surface is smooth with blunt apex. Fruits are 6-7 cm long and are highly pungent. Leaf curl and mosaic incidence are very low (Rose and Som, 1986). Due to the higher pungent, it is used for green chilli production only.

Chilli is a selfpollinated crop;however, cross pollination up to 65% leads to heterogeneous population (Purseglove, 1977). This influences on characteristics

[1] Department of Agricultural Biology, Faculty of Agriculture, Eastern University, Sri Lanka. (anush190@yahoo.com)

and such low quality creates problem in export as well as relate to quality grading which is not practiced by farmers. Due to this, price fluctuation is a main problem faced by growing farmers.

From the farmers point of view the major problem faced was the market price fluctuation. Farmers are cheated by traders or other purchasing members by the reason of low purity level of chilli revealed from the Population variation in phenotypic characters, mainly fruit quality. Because the main reason size variation lies in the fruit is length and width of the fruit. So we aim at uniform size of the fruits from the crop improvement programme.

Main objective of this research is to synthesis homogeneous population of chilli variety which has all the favorable features of PC-1 in a uniform manner with superior production potential and market quality to suit the local and export markets.

(i) Compare the two types of populations for their quantitative traits.

(ii) Select plants from the two types of populations to achieve promising strains in term of production potential, marketing potential, resistant or tolerance to biotic and abiotic stresses

MATERIALS AND METHODS

This experiment was conducted during the period of 28th April to 13th December of 2008 at the Agronomy Farm, Eastern University, Vantharumoolai, Chenkalady located in Batticaloa district. Batticaloa district comes under the agro ecological zone of low country dry zone (DL2).

Annual rainfall varies from 864 mm to 3081 mm and most of the rain is being received during the month of October to January. Rainfall is both inter-monsoon and north-east monsoon types. There are two distinct cultivation seasons in the Batticaloa district namely Maha and Yala. The Maha season commences in September to February. Yala season commences in March to August. The experiment was conducted in Yala season.

Relative humidity shows much variation and is related to the rainfall pattern and temperature variation. Temperature ranges from 25° C to 36° C. Soil type of experimental site is classified as sandy regosols.

Experimental variety

PC-1 variety of chilli was used in this experiment. This variety is not pure in the Batticaloa district. Two types of populations from the local chilli PC-1 were planted in separate plots in isolation. The populations are Dark Green Long Fruits (DGLF) denoted by Black and Light Yellow Round Fruits (LYRF) denoted by White. In order to differentiate there populations were named Black and White.

Chilli plants selection for data collection

In each population 10% of the plants were selected. In White 21 plants were selected and in Black 16 plants were selected. Random selection method was only used for plant selection before flowering.

Measurement and Observation

After transplanting data collection was commenced and measurements were taken.

The following parameters were measured from each population in randomly selected plants.

Seed collection

Promising plants were selected based on the selection criteria and all the fruits were removed (1st harvest). Then covered by insect proof nets to prevent the cross pollination. At the end of the experiment the Ripen chilli pods were harvested from the individual plants from the two types of population. Seeds were collected from selected plants separately. These pods were dried and extracted seeds were packed in polyethylene bags on individual plant basis for further experiment in future.

Statistical analysis

Collected data was subjected to statistical analysis of variance using SPSS (Statistical Package of Social Science) and the collected data was analyzed by Micro Soft Excel computer package. Also cross tabulation of data was done to obtain relationship among variables.

RESULTS AND DISCUSSION

The objective of this research to study the variability and to select promising plant from local chilli PC-1 populations with Light Yellow Round Fruits and Dark Green Long Fruits raised in the Agronomy Farm, Eastern University of Sri Lanka. The main focus was on the quantitative characters of randomly selected chilli plants.

Table 1: Correlation matrix of the important Agronomic characters of PC-1 chilli variety studied

	CH-100% F	CH-LH	NOB-100% F	NOB-LH	LL	LW	FL	FW	FWt	NOF/Pt	YD/Pt
CH-100% F											
CH-LH	0.642**										
NOB-100% F	-0.197	-0.011									
NOB-LH	-0.049	0.043	0.673**								
LL	0.037	0.260	0.031	-0.131							
LW	0.067	0.260	-0.152	-0.190	0.852**						
FL	0.109	0.499**	0.303	0.306	0.047	0.019					
FW	- 0.001	0.200	-0.100	0.076	0.199	0.362*	0.156				
FWt	0.287	0.520**	0.030	0.161	0.007	0.011	0.516**	0.572**			
NOF/Pt	0.316	0.198	-0.112	-0257	0.367*	0.142	- 0.005	- 0.128	-0.049		
YD/Pt	0.342*	0.290	-0.070	-0.159	0.331*	0.090	0.175	0.033	0.189	0.930**	

* * Significant at 1% (p =0.01) level

* Significant at 5% (p =0.05) level

Canopy height

The growth curve varied from population to population. The plant height of each randomly selected plants were analyzed by using Excel and SPSS packages (Release 14.0). The variation in mean height of plants at different growth stages in the populations are shown in Table 2.

Table 2: Mean height of plants at different stages of growth in the populations

Different stages	White	Black
	17.55 ± 3.50 cm	15.03 ± 5.48 cm
50% Flowering	(10.8-23.3 cm)	(7-26.5cm)
	35.76 ± 6.33 cm	33.16 ± 9.62 cm
100% Flowering	(26-47.5cm)	(17.5-52 cm)
	51.24 ± 9.15 cm	44.00 ± 11.16 cm
First Harvest	(34-68.5 cm)	(23-62 cm)
	80.43 ± 14.58 cm	65.47 ± 15.52 cm
Last Harvest	(53-112.5 cm)	(44-94 cm)

The growth curves of randomly selected plants in the populations are shown in Figure 4.1. The growth curve of White was at higher level than Black. The highest mean height at last harvest of plants in White was 80.43 ± 14.58 cm and ranged from 53-112.5 cm.The lowest mean last harvest height 65.47 ± 15.52 cm was observed in the Black (Table 2).

Variation in canopy height within the plot may be attributed to genotypic variation or gene and environmental interaction. Environment includes soil fertility, soil moisture, soil compaction, etc. That would possibly vary within the plot.

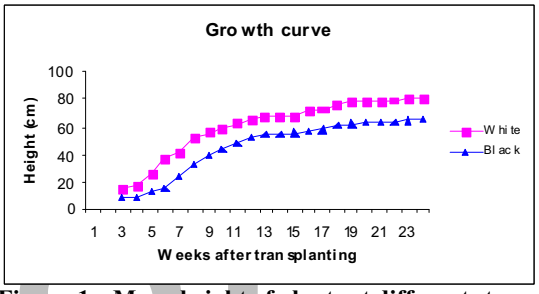


Figure 1: Mean height of plants at different stages in the populations

PRIMARY BRANCH NUMBER

Primary branch developed from the main stem of the plant. The number of primary branches of chilli variety PC-1 varied from population to population.

The mean number of primary branches at third harvest in population Black was15.2 ± 3.19 higher than the population White14.1 ± 2.74. The total number of primary branches per plant at third harvest in the population Black ranged from 9-20 and population White from 7-18 (Table 3). In White after 4th harvest and in Black after 3rd harvest the total number of primary branches per plant remained same until last harvest in the populations. The Black showed flowering and fruiting 2 weeks later than White.

Table 3: Mean number of primary branches at different stages of growth in the populations

Different stages	White	Black
	6.48 ± 2.84	6.63 ± 2.55
50% Flowering	(2-12)	(2-11)
	9.29 ± 2.59	10.1 ± 2.5
100% Flowering	(5-14)	(5-16)
	11.1 ± 2.59	12.4 ± 2.78
First Harvest	(5-16)	(7-18)
	14.1 ± 2.74	15.2 ± 3.19
Third Harvest	(7-18)	(9-20)

The higher average number of primary branches per plant was noticed in population Black than population White at different stages which may be attributed to vigorous and short plants in a Black population. White plants were less vigorous and more tall than Black. At the start of transplanting the White population had leaf curl complex disease so the number of primary branches may be slightly less in White at a different stages. Then the disease reduced and the number of primary branches increased.

The branching mainly depends on cultivar, soil fertility, soil moisture and season. High branching is preferred in chilli for easy picking of fruits and for effective inter cultivation and to prevent rotting of fruits (Millawithanachchi, 2002).

Fruit length and Fruit width

The variation in length of fruits was observed from population to population. The mean length of fruits in population White 4.64 ± 0.72 cm was higher than the population Black 4.1 ± 0.97 cm (Table 4).

Correlation studies showed that the length of fruit had a highly significant positive correlation with fruit weight (r=0.516, p=0.01) and significant positive correlation with canopy height at last harvest (r=0.499, p=0.01) (Table 1). Therefore, selection of plants for heavier fruits may be based on the length of fruit.

Balakrishnan, (1980) reported that the fruit length was positively associated with fruit girth. However, a significant association between fruit length and width was not indicated in this study.

Rose and Som, (1986) reported that fruit length was positively associated with fruit width.

It was reported by Korla and Rastogi, (1977) that fruit length had a negative effect on yield, but in this study the relationship between fruit length and yield did not appear to be a stronger one.

The variation in width of fruits was observed between the there two populations. The variations in the mean width of fruits in the populations are shown in the Figure 4.4. The mean width of fruits in population White 1.77 ± 0.27 cm was higher than the population Black 1.48 ± 0.24 cm (Table 4).

Correlation analysis showed that a highly significant positive correlation with fruit weight (r=0.572, p=0.05) and significant positive correlation with leaf width (r=0.362, p=0.05) (Table 1) were observed from this study. These data revealed that increase of leaf width could increase the width of fruit and the plants with large fruit width could produce high fruit weight. So if it is useful to select plants with high fruit weight, this would be possible by selecting plants with fruit of large width.

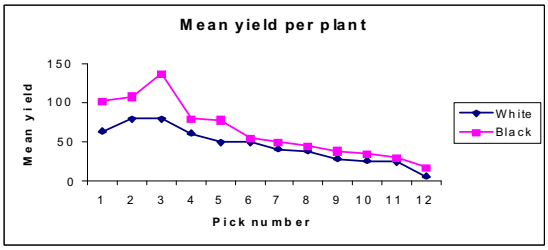
Earlier studies in chilli indicated that the fruit width had direct and indirect effects through plant height, fruit number per plant and fruit length, and this might have resulted in a negative correlation with yield (Korla and Rastogi, 1977), but in this study the relationship between fruit width and yield did not appear to be a stronger one.

Table 4: Mean and range of length and width of fruits in the populations

	Fruit length(cm)		Fruit width(cm)	
	White	Black	White	Black
Mean	4.64	4.1	1.77	1.48
SD	0.72	0.97	0.27	0.24
Max	6	6.1	2.1	2
Min	3	2.3	1.2	1.1

Mean yield per plant

The mean yield per plant at each harvest in the populations are shown in Figure 1. According to the yield curve, the yield increase was upto third harvest and then showed a declining trend until last harvest.



Yield per plant was highly significant positively correlated with number of fruits per plant (r=0.093, p=0.01), positively correlated with canopy height at 100% flowering (r=0.342, p=0.05) and leaf length (r=0.331, p=0.05) (Table 1).

It was reported earlier that yield of fruits in chilli was positively correlated with height of canopy and number

of primary branches whereas a negative correlation was formed with earliness existed (Jamal Hussain, 1977).

CONCLUSION

The variety PC-1 populations showed variation in quantitative characters. The study on agronomic important traits of quantitative characters of PC-1 variety showed variation in canopy height and number of primary branches at different stages of growth, length and width of leaves, length and width of fruits, fruit weight, number of fruits per plant and yield per plant among the populations and within the populations. The variation among the populations may be due to the genetic and environmental interaction.

The yield per plant has significant positive correlation with canopy height at 100% flowering. So the yield per plant is determined by canopy heightat 100% flowering.

Considering the result as a whole, it can be suggested that the chilli populations of PC-1 variety cultivated in the Agronomy Farm is in heterogeneous and showed variation in mopho-agronimic characteristics. However, farmers get good profit from the chilli crop of PC-1 variety and they wish to continue with the same variety in the future. It is suggested that there is needed to improve this variety with desirable characters as this variety is adapted to the environment and growing conditions.

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