VARIABILITY IN *CAPSICUM CHINENSE* JACQ.

By

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THESIS

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DECLARATION

I hereby declare that this thesis entitled " **Variability in *Capsicum chinense* Jacq.**"is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, fellowship or other similar title, of other university or society.

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Certified that this thesis entitled **"Variability in *Capsicum chinense* Jacq"** is a record of research work done independently by Mrs. Elizabeth V. Cherian, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, fellowship or associateship to her.

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Elizabeth V. Cherian

Dedicated to my loving
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INTRODUCTION

INTRODUCTION

The chilli is a spice cum vegetable crop of commercial importance. Green chilli, chilli powder, cayenne pepper, tabasco, paprika, sweet or bell pepper, pimentos and serrano pepper are all derived from the berries of *Capsicum spp.* Chilli is unique among all the spice crops, being the only source of capsaicin. The pungent principle, capsaicin has significant physiological action and is used in many pharmaceutical preparations and cosmetics.

Though Kerala is not a major chilli producing state, the variability existing in the crop in the state is tremendous. The diverse climatic and soil conditions prevailing in different parts of the state have helped in the development of different ecotypes in chilli.

Classical genetic and cytogenetical exploitation of *Capsicum Spp.* began in the 1940's and continued throughout the century. Modern taxonomists recognized the cultivated capsicum into five species, *Capsicum annuum*, *C. frutescens*, *C. chinense*, *C. baccatum* and *C. pubescens*. But the modern pepper breeding relied largely upon a relatively narrow gene base within various cultivar groups, despite the morphological genetic diversity apparent both intraspecifically and interspecifically. This may be explained partly by the traditional market demands for specific phenotypes and the use of pure line or back cross breeding within open pollinated or commercial varieties. In order to meet the growing demands for evolving varieties suited for specific purpose widening of genetic base is inevitable.

Capsicum chinense with their perennial nature, ability to yield substantially under shaded condition and tolerance to diseases like bacterial wilt, collar rot etc. is ideal for homestead condition of Kerala. The species is characterized by the presence of typical annular constriction at the junction of calyx and pedicel, two to five flowers per node and variously incurved peduncles. The fruits are highly pungent, deep red coloured and fleshy in nature.

C. chinense, characterized by a typical flavour and pungency, is extensively liked by the Keralites. But its cultivation is mainly limited to the homesteads, especially during the rainy season. The production of the crop in small holdings by individual farmers, in diverse environmental conditions substantially contributed to the vast variability of this crop. Recently the species is gaining popularity in the export sector also. Genotypes with high oleoresin content will be of much use in the industrial sector. But, so far there is no commercial variety available in this species in India. There are only two commercial varieties of *C.chinense* even at the global level. As there is much diversity for this particular species in Kerala, there is good scope for its selection and improvement.

Breeding methodology for crop improvement consist of three stages, a) assembly or creation of a pool of variable germplasm. b) selection of superior individuals from the pool and c) utilization of selected individuals to create superior varieties.

For assessing superiority of genotypes, a sound knowledge of the nature and magnitude of variation in the available material, genetic parameters namely genetic advance, heritability and association of different traits among themselves and with yield become imperative before embarking upon any major selection procedure in *C. chinense*.

The economic and commercial value of chilli are determined not only by yield but also by quality traits like capsaicin, oleoresin, carotenoids and ascorbic acid content. Although the chemical constituents of *C. annuum* have been studied in detail, no comprehensive efforts have been made to assess the chemical composition in *C.chinense*.

Taking into consideration of all the above aspects, the present study was undertaken with the following objectives:

1. To genetically catalogue the germplasm available in *Capsicum chinense*,

2. To identify type(s) with high fruit yield and oleoresin content,

3. To study the genetic parameters in yield and yield attributes.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Capsicum chinense Jacq. is an economically important species characterized by a typical flavour and pungency. This species originated in the New World was named by a French taxonomist who got its seeds from China (Smith and Heiser, 1957). Though considerable efforts have been made for genetic improvement of *Capsicum annuum* little efforts have been made for improvement of *C.chinense.*

The available literature on variability in *Capsicum chinense* and other related *Capsicum spp* are reviewed under the following subheads.

1. Variability
2. Heritability and genetic advance
3. Correlation
4. Path coefficient analysis
5. Selection index
6. Chemical constituents of chilli

2.1 Variability

Variability either natural or created artificially forms the basis for any crop improvement programme. Considerable variability was reported for most of the characters in chillies by Arya and Saini (1976); Elengovan *et al.*(1981) and Kataria *et al.*(1997) .

2.1.1 Morphological Characters

High variability for plant height was pointed out by many workers in *C. annuum* (Legg and Lippert,1966;Ramalingam and Murugarajendran,1977;Singh and Singh,1979;Elengovan *et al.*1981; Gupta and Yadav,1984; Sekhar, 1984; Thangaraj,1984; Jayasankar, 1985;Pawade,1991; Sarma and Roy,1995 and Kataria *et al.*1997).On the other hand Kshirsagar *et al.*(1983); Sunthanthirapandian and Rangaswamy (1983) and Arya and Saini (1986) observed moderate variability for plant height. A low coefficient of variation for plant height was reported by Ramakumar *et al.*(1981) and Vadivel *et al.* (1983). Sheela (1998) observed high variability for plant height and plant spread in *C. frutescens.*

High variability for number of primary branches was reported by Sethupathiramalingam and Murugarajendaran (1977); Bavaji and Murthy (1982);Gupta and Yadav (1984) and Jayasankar (1985) whereas moderate values for this trait were reported by Arya and Saini (1986). In contrast a low phenotypic variance for number of primary branches was reported by Ramakumar *et al.*(1981);

Varalakshmi and Haribabu (1991); Sarma and Roy (1995) and Rani *et al.*(1996).

2.1.2 Economic characters

1. Number of fruits and yield.

Genetic variability for fruit yield in *C.annuum* was reported by Arya and Saini (1976); Singh and Brar (1979); Singh and Singh (1979); Elengovan *et al.*(1981); Bavaji and Murthy (1982); Rajput *et al.*(1982); Amarchandra *et al.*(1983); Suthanthirapandian and Rangasamy (1983); Thangaraj (1984); Ahmed *et al.*(1990); Varalakhsmi and Haribabu (1991); Nandi (1992); Singh *et al.* (1994). Rani *et al.*(1996) reported high genotypic coefficient of variation for number of fruits and yield. Kataria *et al.*(1997) observed high variability for most of the traits and also reported high genotypic coefficient of variation for number of fruits and fresh fruit weight per plant. Singh *et al.*(1998) reported considerable genetic variability for pod yield and other traits. In *C.frutescens*, Sheela (1998) obtained high variabilty and high genotypic coefficient of variation for fruit yield.

2. Fruit characters .

High genotypic coefficient of variation for fruit length, fruit circumference, fresh and dry weight of fruits were reported by

Amarchandra *et al.*(1983). Gupta and Yadav (1984) observed high coefficient of variation for fruit girth. Choudhury *et al.*(1985) reported that fruit weight, length and girth resulted in higher yield and hence these characters should be given due consideration while making selection. Jayasankar (1985) reported low variability for fruit length and girth. High variation for fruit length and girth was observed by Ahmed *et al.*(1990) and Rani (1996a). Kataria *et al.* (1997) obtained a high gcv and pcv for fruit length and fruit girth.

In *Capsicum frutescens,* Sheela (1998) reported high variability for fruit size and fruit weight. Fruit length and fruit girth also differed significantly among the accessions. Fatima (1999) reported high gcv for fruit length and fruit weight in *C.annuum*.

2.2 Heritability and Genetic Advance

Nandpuri *et al.*(1971) reported that expected genetic advance was high for number of branches per plant. A low heritability for number of branches per plant was reported by Rani *et al.*(1996) while Kataria *et al.*(1997) observed high heritability .

High estimates of heritability for plant height in *C.annuum* were reported by Milkova (1981); Raju *et al.*(1984); Rani *et *al.*(1996) and Kataria *et al.*(1997), whereas moderate heritability for this character reported by Singh *et al.*(1972) and Ahmed *et al.*(1990).

Sheela (1998) obtained a moderate heritability of 86 percent for plant height in *C.frutescens.* Vallejo and Costa (1987) observed a low narrow sense heritability of 2.9 percent for plant height in *C.chinense*.

High heritability coupled with high genetic advance was observed for fruit yield by Singh *et al.*(1972); Hiremath and Mathapati (1977); Bavaji and Murthy (1982); Ahmed *et al.*(1990); Bhagyalaksmi *et al.*(1990); Nandi (1992); Singh *et al.*(1994); Rani *et al.*(1996) and Kataria *et al.*(1997) whereas Gopalakrishnan *et al.*(1984) observed moderate heritability for this trait. High heritability linked with moderate genetic advance for yield was observed by Singh *et al.*(1998).

Low heritability was observed for days to 50 percent flowering in *C.annuum* by Rani *et al.*(1996); Kataria *et al.*(1997) and Singh *et al.* (1998). Vallejo and Costa (1987) observed a narrow sense heritability of 10.6 percent for days to flowering and 47 percent for days to maturity in *C.chinense*.

High heritability coupled with high genetic advance were reported by Awasthi *et al.*(1974); Amarchandra *et al.*(1983); Choudhury *et al.*(1985); Natarajan *et al.*(1993); Pitchaimuthu and Pappiah (1995); Ghildiyal *et al.*(1996); Rani and Singh(1996) and Kataria *et al.*(1997). Low heritability has been reported for the trait by Rani *et al.*(1996).

Choudhury *et al.*(1985); Ahmed *et al.*(1990); Pitchaimuthu and Pappiah (1995); Bhatt *et al.*(1996) and Ghildiyal *et al.*(1996) realised high heritability estimates in *C.annuum* for fruit girth. Sheela (1998) observed high heritability for fruit size in *C.frutescens.*

High heritability coupled with high genetic advance was observed for average fruit weight in *C.annuum* by Ahmed *et al.*(1990); Bhatt *et al.*(1996); Ghildiyal *et al.*(1996); Rani *et al.*(1996) and Kataria *et al.*(1997). Fatima, 1999 observed high heritability for all the characters viz. plant height, fruit girth, pedicel length, number of fruits per plant, average fruit weight, fruit yield and driage .

2.3 Correlation

A positive correlation between number of fruits and primary branches with yield was reported by Legg and Lippert (1966); Hiremath and Mathapati (1977); Sethupathiramalingam (1979); Nair *et al.*(1984); Bhagyalakshmi *et al.*(1990) and Aliyu *et al.*(1991).

Padda *et al.*(1970) observed that yield in chillies is governed by fruit size, since fruit size (length x breadth) was positively correlated with fruit length and yield .They had further suggested that selection for fruit size is likely to result in increased yield. Suthanthirapandian *et al.(1979)* in a study of *125 accessions in* *C.annuum* obtained a positive correlation of plant height with yield.

Factor analysis of chilli by Rao *et al.*(1981) indicated that fruit yield per plant had high significant and positive correlation with fruits per plant, plant spread and height. They further reported that harvest index, fruit yield per plant and fruits per plant exhibited high positive direct effect on dry chilli yield per plant.

Bhagyalakshmi *et al.*(1990) observed a negative correlation between fruit length and fruit diameter. In a correlation study for chilli varieties indicated that there was a positive and highly significant relationship between fruit yield and fruit number, plant height, leaf number and branch number. Fruit length was negatively correlated with fruit number. Khurana *et al.*(1993) in a study of ten accessions in chilli observed a significant positive correlation of fruit yield with mean fruit weight, number of fruits, fruit length, leaf area and number of branches. They further reported that fruit weight had the highest direct effect followed by number of fruits.

Sarma and Roy (1995) observed a positive association of fruit weight with fruit diameter and fruit length which indicated that selection for any of these traits would lead to increase in fruit size. The correlation was negative and significant for days to 50 percent flowering and days taken from fruit set to maturity.

Ahmed *et al.*(1997) observed positive and highly significant correlation of fruit yield with number of fruits per plant, average fruit weight, plant height, plant spread, and fruit length and a negative significant correlation between days to maturity. Character association analysis in sweet pepper by Deka and Shadeque (1997) indicated that the number of branches per plant had strong positive association with yield per plant.

In *C.frutescens* Sheela (1998) observed a significant positive association of plant height, primary branches per plant and plant spread with yield. Economic characters like number of harvests, fruit girth, fruit length, pedicel length, mean fruit weight and fruit size also exhibited significant correlation with yield.

2.4 Path coefficient analysis

The path coefficient analysis here provides an effective measure of untangling direct and indirect causes of association and permits a critical examination of specific causes acting to produce a given correlation and measures the relative importance of each factor.

Gill *et al.*(1977) found that the number of fruits have direct effect on total yield. Nair *et al.*(1984) recorded high direct effect due to number of fruits on yield. Singh and Rajput (1992) reported high direct effect of fruit length, fruit girth, fruit weight on yield. Plant height, fruit length, time taken for fruit set to maturity for ripe chillies and number of fruits per plant were observed to give negative effects.

In a study on character association in hot pepper Ahmed *et al.* (1997) observed that among the different yield components fruit number per plant exhibited highest positive direct effect on fruit yield and also showed indirect effect through branch number and plant height. Average fruit weight had a positive direct effect of desirable magnitude towards fruit yield but its indirect effect via number of fruits per plant was negative with higher magnitude.

Deka and Shadeque (1997) conducted path coefficient analysis in sweet pepper and observed that branches per plant, fruits per plant and fruit size had high magnitudes of positive direct effects on yield. Fruits per plant, fruit size also had positive indirect effects via branches per plant.

2.5 Selection index

Singh and Singh (1976) observed from a study of eight cultivars and their F_1 and F_2 generations, that the use of selection indices will increase the efficiency of selection. In the F_2 a selection index based on seven yield components gave a predicted yield of 16 percent higher value than that of predicted for straight selection. Days to flowering, fruit length and number of fruits per plant were considered to be the major yield components. Based on discriminant function analysis Singh and Rajput (1992) reported negative discriminant values for average fruit weight, number of fruits per plant and yield per plant while it was positive for days taken for 50 percent flowering, fruit length and dry matter.

2.6 Chemical constituents of chilli

The quality of chilli is decided by its pungency, colour, aroma and nutritive value. The chemical constituents of *C.annuum* has been well studied, while information on constituents of *C.chinense* is very little.

2.6.1 Oleoresin

Chilli oleoresin represents the total flavour extracts of ground chilli. It contains both pungency and colour fractions of chilli. Mathew *et al.*(1971) analysed the oleoresin yield (%) of some major chillies in the world which included three varieties from India, four from Africa, two from Japan and one from Bahamas. The yield varied from 8.7 to 16.5 percent. Lewis (1972) observed distinct difference in quality and yield of oleoresin in varieties of chillies. Raina and Teotia (1986) evaluated chillies of Jammu and Kashmir and observed variability in oleoresin recovery.

Pradeepkumar (1990) analysed the oleoresin content of different *Capsicum spp* and their interspecific hybrids. The oleoresin content ranged from 18.7 percent in *C.annuum* to 31.7 percent in *C.chinense*. The F_1 hybrids with high oleoresin content were *C.frutescens X C.chinense*(35.37%) and *C.annuum X C.chinense* (34.4%).

Lakshmanachar (1993) reported that varieties with low seed content and free of stock and calyx were suited for chilli oleoresin production. Pruthi (1993) presented chemical quality attributes of fifteen chilli varieties grown in different regions of India. Oleoresin content of these varieties varied from 6.2 to 12.4 percent on moisture free basis. Indira (1994) evaluated twenty five chilli accessions belonging to *C.annuum, C.chinense and C.baccatum* and reported the oleoresin range from 14 to 28 percent. In an evaluation of nine genotypes of *C. annuum,* Mini (1997) observed a range of 13.33 to 30.40 percent.

2.6.2 Capsaicin

Pungency in chilli is due to a mixture of various amides commonly designated as capsaicinoids and capsaicin is the most important among these. Capsaicin ($C_{18}H_{27}O_3$) is a condensation product of 3-hyroxy 4-methoxybenzylamine and decyclemic acid.

Berry and Samways (1937) reported that the pungency factor varied among fruits of the cultivars of the same species. Heiser and

Smith (1953) reported that the small, thin skinned chilli peppers had the highest capsaicin content.

Reddy and Murthy(1988) reported that the chillies can be classified based on capsaicin content as follows, high (1 to 1.5%), medium high (0.75 to 1.25%), medium low(0.5 to 0.75%) and low(0.11 to 1.25%).In a study conducted by Ribeiro *et al.*(1990) on the inheritance of capsaicin content in *Capsicum chinense*, the character showed predominance of additive gene effects and the magnitude of narrow sense heritability indicated that the capsaicin content can be effectively improved by simple selection.

Wide variation in capsaicin content of *C.annuum* genotypes were reported by many workers which are summarized below.

Number of varieties tested	Range of capsaicin (%)	Reported by
4	0.0075-0.08	Ananthasamy *et al.*(1960)
12	0.272-1.497	Deb *et al.* (1963)
5	0.45-1.84	Kamalam and Rajamani (1965)
12	0.272-1.498	Ramanujam and Tirumalachar (1966)
10	0.0024-0.0044	Gorde (1969)
20	0.33-0.49	Sooch *et al.*(1977)
25	0.03-0.15	Bajaj *et al.*(1978)
5	0.732-4.2	Luhadiya and Kulkarni (1978)
14	0.12-0.53	Sankarikutty *et al.*(1978)
24	0.15-0.925	Bajaj *et al.*(1980)

19	0.09-0.59	Theymoli *et al.*(1982)
7	0.0027-0.0033	Maurya *et al.*(1984)
12	0.048-0.098	Teotia and Raina (1986)
47	0.013-0.199	Teotia and Raina (1987)
1	0.6-0.7	Tewari(1990)
12	0.243-0.0474	Rajput *et al.*(1991)
8	0.24-0.420	Amarchandra *et al.*(1992)
12	0.42-0.72	Narayanankutty *et al*(1992)
73	0.056-1.810	Rani (1996b)

Sheela (1998) also observed a range of 0.43-1.7 percent for capsaicin in a collection of 16 accessions of *C. frutescens.*

2.6.3 Colour value

Natural fruit colour is one of the most important attributes of chilli *(Capsicum spp)* used in processed food in place of synthetic colours. Colour of chilli is due to carotenoid pigments. The principle colouring matter is the carotenoid pigment capsanthin, the other pigment being βcarotene, capsorubin, zeaxanthin, cryptoxanthin and violaxanthin. Vinkler (1971) determined the total carotenoids, capsanthin and capsorubin in fruits of *C.annuum var annuum*. He found that capsanthin formed 45 to 80 percent of the total carotenoid and capsorubin ranged from 6 to 19 percent. Capsanthin and capsorubin increases proportionally with advanced stages of ripening; with capsanthin being the more stable of the two. Grubben (1977) reported that the carotene content in hot and sweet pepper was 6.6 mg per 100 gram and 1.80 mg per 100 gram respectively.

Bajaj *et al.* (1980) evaluated the varietal variation for capsanthin content in 24 chilli accessions and found it to range from 22.3 to 118.63 ASTA units.

Govindarajan (1985) reported that the greatest effect on final colour retained was the cultivar grown, its intrinsic composition of the colour complex and concentration of the components that contributed the red component. Chalukova *et al.*(1987) estimated carotenoid composition of ripe fruits of eight pepper varieties and observed that *C.frutescens* had the highest level of βcarotene.

Pradeep kumar (1990) reported that the hybrid *C.annuum* x *C.chinense* was the most promising inter specific hybrid with high values of colour. Improving specific market types for pigment quality should be feasible through breeding, since the proportion of colour pigment varied considerably among pepper varieties (Almela *et al.*,1991)

Narayanankutty *et al.*(1992) reported high extractable colour (90 to 136.36 ASTA units) in eleven varieties of *C.annuum* studied. Papalkar *et al.*(1992) in a study of extractable colour in six varieties of chilli found it to range between 7119 to 8556 ASTA units.

Bosland (1993) reported that more than 20 carotenoids contribute to colour in chillies and capsanthin .the major carotenoid in ripe fruits contributes upto 60 percent of the total carotenoids and imparts the major red colour and is present as its dilaurate.

Biosynthesis and transformation of carotenoid pigments during ripening of fruits from two Spanish Capsicum varieties, "Bola" and "Agridulce" were studied by Minguez-Mosquera and Mendez (1994). Rani (1996b) analysed 73 accessions of *C.annuum* for capsanthin content and found it varying from 0.126 to 0.407 percent with an overall average of 0.245 percent.

Mini (1997) observed a range of 333.5 to 1687.67 Nesslerimetric colour value in the full ripe fruits of *C.annuum* genotypes. Sheela (1998) reported a range of 0.26 to 0.69 per cent for total carotenoids content in red ripe fruits of *C. frutescens.*

Sunil and Ahmed (1998) observed a range of 10.26-110.34 ASTA units for total extractable colour in an analysis on the five cultivated species of capsicum. *C.chinense* observed to have the highest total extractable colour.

MATERIALS AND METHODS

3. MATERIALS AND METHODS

The study was conducted in the Vegetable Research Farm of the Department of Olericulture and Biochemistry Laboratory of College of Horticulture, Kerala Agricultural University , Vellanikkara which is located at an altitude of 23m above MSL and between 10° 82" and 76°16" east longitude. The experiment was conducted in two seasons, October 97-June 98 and September 98 - April 99

The studies comprised of the following experiments:

3.1 Genetic cataloguing of *Capsicum chinense*

3.2 Evaluation of variability in *Capsicum chinense*

3.1 Genetic cataloguing of *Capsicum chinense*

Twenty eight accessions of *C.chinense* were collected from different parts of Kerala. Details of the sources are given in Tables 1 and 2. The accessions were genetically catalogued based on the descriptor developed for capsicum (IBPGR,1995)(Table 3)

3.2 Evaluation of variability in *Capsicum chinense*

3.2.1 Experimental materials

Twenty five diverse accessions of *Capsicum chinense* were used for the study during two seasons. Since there are no released varieties of this

Table 1. Genotypes used during the first season

Sl. no	Accession number	Source
1	CC 1	Karunagappally
2	CC 2	Karunagappally
3	CC 3	Karunagappally
4	CC 5	Karunagappally
5	CC 6	Karunagappally
6	CC 8	Alappuzha
7	CC 9	Kottayam
8	CC 10	Alappuzha
9	CC 11	Alappuzha
10	CC 14	Wayanad
11	CC 15	Kottayam
12	CC 16	Mavelikara
13	CC 17	Wayanad
14	CC 18	Thrissur
15	CC 20	Muvattupuzha
16	CC 21	Muvattupuzha
17	CC 22	Kottayam
18	CC 23	Thiruvananthapuram
19	CC 25	Thiruvananthapuram
20	CC 26	Thrissur
21	CC 28	Thrissur
22	CC 30	Wayanad
23	CC 32	Thrissur
24	CC 37	Thrissur
25	CC 38	Ernakulam

Table 2. Genotypes used during the second season

Sl no	Accession number	Source
1.	CC2	Karunagappally
2.	CC5	Karunagappally
3.	CC6	Karunagappally
4.	CC8	Alappuzha
5.	CC9	Kottayam
6.	CC10	Alappuzzha
7.	CC14	Wayanad
8.	CC15	Kottayam
9.	CC16	Mavelikara
10.	CC17	Wayanad
11.	CC18	Thrissur
12.	CC20	Muvattupuzha
13.	CC21	Muvattupuzha
14.	CC22	Kottayam
15.	CC23	Thiruvananthapuram
16.	CC25	Thrivananthapuram
17.	CC26	Thrissur
18.	CC28	Thrissur
19.	CC30	Wayanad
20.	CC32	Thrissur
21.	CC37	Thrissur
22.	CC38	Ernakulam
23.	CC42	Thrissur
24.	CC46	Thrissur
25	CC51	Kayamkulam

Table 3. Genetic cataloguing of *Capsicum chinense*

1.	**Vegetative characters**	
1.1	Plant growth habit	- Prostrate/ Intermediate/Erect.
2.	Stem colour	- Green/Green with purple stripes/Purple
3.	Stem pubescence	- Sparse/Intermediate/Dense
4.	Nodal anthocyanin	- Green/light purple/Purple/Dark purple
5.	Branching Habit	- Sparse/Intermediate/Dense
6.	Leaf colour	- Light Green/Green/Dark green/Light. purple/PurpleVariegated
7.	Leaf Pubescence	- Sparse/Intermediate/Dense
8.	Leaf shape	- Deltoid/ Ovate/ Lanceolate
9.	Lamina margin	- Entire/Undulate/Ciliate
2.	**Inflorescence and Fruit characters**	
2.1.	Number of flowers per axil	-One/Two/Three or more
2.	Flower position	- Pendant/Intermediate/Erect.
3.	Corolla colour	-White/Light yellow/Yellow/Yellowgreen
4.	Calyx pigmentation	- Absent/ Present.
5.	Calyx annular constriction	- Absent/ Present.
6.	Anthocyanin spots or stripes on fruit	-Absent/Present.
7.	Fruit colour at initial stage	-White/Yellow/Green/Orange/Purple/Deep purple
8.	Fruit colour at mature stage	-White/Lemon yellow/Pale orange yellow/Orange yellow/ Orange/ Red
9.	Fruit shape	Elongate/ Round/ Triangular/ Companulate/ Blocky
10.	Fruit shape at blossom end	-Pointed/Blunt/Sunken/Sunken and pointed
11.	Fruit cross sectional corrugation	-Slightly corrugated/ Intermediate/ corrugated.
12.	Fruit surface	-Smooth/Semi-wrinkled/Wrinkled.

particular species in the country, all the accessions in the study belonged to local collections.

3.2.2 Experimental methods

The experiment was laid out in randomized block design with two replications. Each replication consisted of twenty five plots and there were fifteen plants per plot per replication. The crops were raised in two seasons, during October 97 to June 98 and September 98 to April 99. The crops were raised as per the package of practices recommendations of the Kerala Agricultural University 1996.

3.2.3 Observations

For taking observations on the quantitative characters five plants per genotype per replication were randomly selected . Five fruits were selected at random for recording observations on fruit characters of each accession per replication.

a) Plant height (cm)

Measured from the ground level to the tip of the plant before the first harvest.

b) Number of primary branches

Number of branches arising from main stem were counted.

c) Days to first flowering

Number of days from sowing to first flowering was observed.

d) Days to harvestable maturity

Number of days from sowing to first harvest was observed.

e) Pedicel length(cm)

Distance between point of attachment of stem and fruit.

f) Fruit length(cm)

Distance between pedicel attachment and fruit apex

g) Fruit girth(cm)

Measured using twine and scale at its maximum width.

h) Fruit weight (g)

Average of ten fruits weight

i) Number of seeds per fruit

Seed per fruit were counted in five fruits and average was taken.

j) Number of fruits per plant

Total number of fruits per plant was observed.

k) Yield per plant(g)

Weight of fruits harvested from each plant was recorded

l) Driage percent

Initial weight of ten fruits was taken. Then the fruits were oven dried and took the final weight.

$$\text{Driage \%} = \frac{\text{final weight x 100}}{\text{initial weight}}$$

m) Bacterial wilt incidence (%)

The number of plants affected by bacterial wilt per plot per replication was observed and expressed as percentage.

n) Capsaicin (%)

Capsaicin content of *C. chinense* accessions were determined by Folin Dennis method. The pungent principle reacts with Folin-Dennis reagent to give a blue coloured complex which is estimated colorimetrically (Mathew *et al.*, 1971)

Reagents

Folin-Dennis reagent

Preparation of Folin-Dennis reagent : Refluxed 750 ml distilled water, 100 g sodium tungstate, 20 g phosphomolybdic acid and 50 ml phosphoric acid for two hours. Cooled and diluted to 1000 ml with distilled water

25 percent aqueous sodium carbonate solution

Acetone

Procedure

Red ripe fruits were dried in a hot air oven at 50 °C and powdered finely. One gram each of the sample was weighed into test tubes, added 10 ml acetone and kept overnight. Aliquots of 1 ml were pipetted into 100 ml conical flasks, added 25 ml of Folin Dennis Reagent and allowed to stand for 30 minutes. Added 25 ml of freshly prepared sodium carbonate solution and shook vigorously. The volume was made up to 100 ml with distilled water and the optical density was determined after 30 minutes at 725 nm against reagent blank (1 ml acetone + 25 ml Folin-Dennis Reagent + 25 ml aqueous sodium carbonate solution) using a UV spectrophotometer.

To determine the EI percent value for pure capsaicin, a stock solution of standard capsaicin (200 micro gram per mililitre) was prepared by dissolving five milligram in 25 ml acetone. From this, a series of solutions of concentrations 400 micro gram, 600 micro gram, 800 micro gram and 1000 micro gram were prepared and their optical density measured at 725 nm. Standard graph was prepared and calculated the content of capsaicin in the samples.

n) Oleoresin (%)

Oleoresin in chilli was extracted in a Soxhlet's apparatus using solvent acetone

Procedure

Red ripe fruits harvested were dried in a hot air oven at 50 degree celsius, powdered to pass through a 100 mesh sieve. Two gram chilli powder was weighed, packed in filter paper and placed in a Soxhlet's apparatus. Two hundred ml of acetone was taken in the round bottom flask of the apparatus and heated in a water bath. The temperature was maintained at the boiling point of the solvent. After complete extraction (7-8 hours), the solvent was evaporated to dryness under vacuum.

Yield of oleoresin on dry weight basis was calculated using formula

$$\text{Oleoresin \%} = \frac{\text{weight of oleoresin}}{\text{weight of sample}} \times 100$$

o) Colour value

Colour value of the *C.chinense* accessions was determined as per EOA (1975). One gram sample was weighed accurately and dissolved in 100 ml of acetone. Of this stock solution, 1 ml was diluted to 100 ml in a volumetric flask with acetone. Using tungsten lamp source and acetone as blank, the absorbance of this 0.01% solution was taken at 458 nm using a spectrophotometer. The absorbance value was multiplied by 61000(an empirical factor worked out to relate the data from the colour matching method) to obtain the Nesslerimetric colour value.

3.2.4. Statistical analysis

The mean of the values observed on five plants were taken for statistical analysis. Data on different characters were subjected to statistical analysis at the computer centre, Department of Agricultural Statistics, Kerala Agricultural University. The analysis technique suggested by Fisher (1954) was employed for estimation of various genetic parameters. Selection index was also worked out.

3.2.4.1 Phenotypic, genotypic and environmental variance

The variance components were estimated using formula suggested by Burton (1952).

Phenotypic variance (Vp) =Vg + Ve

where,

Vg = Genotypic variance

Ve = Environmental variance

Genotypic variance (Vg) = (V_T- V_E)/N

where,

V_T = mean sum of squares due to treatments

V_E = mean sum of squares due to error

N = number of replication

Environmental variance (Ve) = V_E

3.2.4.2 Phenotypic and genotypic coefficient of variation

The phenotypic and genotypic coefficient of variation were calculated by the formula suggested by Burton and Devane (1953).

Phenotypic coefficient of variation (pcv) = ($Vp^{1/2}$ / $\bar{X}$) x 100 where,

Vp = phenotypic variance

$\bar{X}$ = mean of character under study

Genotypic coefficient of variation (gcv) =($Vg^{1/2}$ / $\bar{X}$)x100

where,

Vg = genotypic variance

$\bar{X}$ = mean of character under study

3.2.4.3 Heritability

Heritability in the broad sense was estimated by the formula suggested by Burton and Devane (1953).

Heritability in the broad sense H^2 = (Vg/ Vp) x 100

where,

Vg = genotypic variance

Vp = phenotypic variance

The range of heritability was categorized as suggested by Robinson *et al.* (1949) as,

0 - 30 per cent	- low
31- 60 per cent	- moderate
61 per cent and above	- high

3.2.4.4 Expected Genetic Advance

The genetic advance expected for the genotypes at five per cent selection pressure was calculated using the formula suggested by Lush

(1949) and Johnson *et al.* (1955) with value of the constant K as 2.06 as given by Allard (1960).

Expected genetic advance GA = (Vg / Vp $^{1/2}$) x 2.06

where,

Vg = genotypic variance

Vp = phenotypic variance

3.2.4.5 Genetic Gain

Genetic advance (GA) calculated by the above method was used for the estimation of genetic gain.

Genetic gain, GG = (GA/ $\overline{X}$) x 100

where

GA = Genetic Advance

$\overline{X}$ = mean of characters under study

The genetic gain was classified according to Johnson *et al.* (1955) as follows.

1 - 10 per cent	- low
11 - 20 per cent	- moderate
21 per cent and above	- high

3.2.4.6 Phenotypic and genotypic correlation coefficients

The phenotypic and genotypic correlation coefficients were worked out to study the extent of association between the characters. The phenotypic and genotypic covariance were worked out in the same way as the variances were calculated. Mean product expectations of the covariance analysis are analogous to the mean square expectations of the analysis of variances. The different covariance estimates were calculated by the method suggested by Fisher (1954).

Phenotypic covariance between two characters 1 and 2

COVp12 = COVg12 +COVe12

where,

COVg12 = genotypic covariance between characters 1and 2

COVe12 = environmental covariance between characters 1and 2

Genotypic covariance between character 1 and 2

COVg12 = (M_t 12 - M_e 12)/N

where,

M_t12 = Treatment mean sum of product of characters 1 and 2

M_e12 = Error mean sum of product of characters 1 and 2

N = Number of replications

The phenotypic and genotypic correlation coefficients among the various characters were worked out in all possible combinations according to the formula suggested by Johnson *et al.* (1955). Phenotypic correlation coefficient between two characters 1 and 2.

$$(rp12) = COVp12 / (Vp1.Vp2)^{1/2}$$

where ,

Vp 1 = phenotypic variance of character 1

Vp2 = phenotypic variance of character 2

Genotypic correlation coefficient between two character 1and 2 was calculated by the formula

$$(rg12) = COVg12/(Vg1.Vg2)^{1/2}$$

where,

Vg 1 = Genotypic variance of character 1

Vg2 = Gecnotypic variance of character 2

3.2.4.7 Path coefficient analysis

In the path coefficient analysis the correlation between a particular cause and the effect is partitioned into direct and indirect effects of the various causal factors on the effect factor. The principles and techniques suggested by Wright (1921) and Li (1955) for the analysis using the formula given by Dewey and Lu (1959).

3.2.4.8 Selection index

Discriminant function analysis developed by Fisher (1936) and first applied by Smith (1936) for plant improvement was used for formulating selection index.

RESULTS

4. RESULTS

The results obtained from the present investigation are presented under the following heads:

4.1 Genetic cataloguing in *Capsicum chinense*

4.2 Evaluation of variability in *Capsicum chinense*

4.1 Genetic cataloguing in *Capsicum chinense*

Twenty eight accessions of *C.chinense* were genetically catalogued based on the descriptor. Morphological characters like vegetative (Table 4), floral and fruit traits (Table 5) were recorded and accessions were catalogued.

Plant growth habit varied from prostrate to erect with sparse to dense branching habit. Stem colour varied between green to green with purple stripes. Most of the accessions were found with sparse stem and leaf pubescence. Leaf colour varied from light green to dark green. Most of the accessions had deltoid leaf shape and entire leaf margin.

The accessions had either two or three or more flowers per axil. Flower position varied from erect to pendant. All the collected accessions had white corolla with no calyx pigmentation. The accessions showed annular constriction at the junction of calyx and pedicel. Fruit colour and fruit shape showed distinct variations among the accessions.

Table 4 Vegetative characters in *C. chinense* accessions

Accession number	Plant growth habit	Stem colour	Stem pubescence	Nodal anthocyanin	Branching habit	Leaf colour	Leaf pubescence
CC1	Intermediate	Green	Intermediate	Light purple	Intermediate	Green	Intermediate
CC2	Erect	Green	Sparse	Purple	Intermediate	Green	Sparse
CC3	Intermediate	Green	Sparse	Light purple	Intermediate	Green	Sparse
CC5	Erect	Green	Sparse	Purple	Intermediate	Green	Sparse
CC6	Erect	Green with purple stripes	Sparse	Purple	Sparse	Green	Sparse
CC8	Intermediate	Green	Sparse	Light purple	Intermediate	Green	Sparse
CC9	Erect	Green	Sparse	Light purple	Sparse	Dark green	Sparse
CC10	Intermediate	Green with purple stripes	Sparse	Purple	Intermediate	Green	Sparse
CC11	Intermediate	Green	Sparse	Light purple	Intermediate	Green	Sparse
CC14	Intermediate	Green	Intermediate	Light purple	Intermediate	Green	Intermediate
CC15	Intermediate	Green	Intermediate	Purple	Intermediate	Green	Intermediate
CC16	Erect	Green	Sparse	Green	Intermediate	Green	Sparse
CC17	Intermediate	Green	Sparse	Green	Intermediate	Light green	Sparse
CC18	Intermediate	Green with purple stripes	Sparse	Light purple	Intermediate	Green	Sparse
CC20	Erect	Green with purple stripes	Sparse	Purple	Dense	Green	Sparse
CC21	Intermediate	Green with purple stripes	Intermediate	Light purple	Intermediate	Green	Sparse
CC22	Intermediate	Green	Sparse	Purple	Intermediate	Green	Sparse
CC23	Intermediate	Green	Intermediate	Green	Intermediate	Green	Intermediate
CC25	Intermediate	Green	Sparse	Green	Intermediate	Green	Sparse
CC26	Erect	Green with purple stripes	Sparse	Dark purple	intermediate	Dark green	Sparse
CC28	Intermediate	Green	Intermediate	Light purple	Intermediate	Light green	Intermediate
CC30	Prostrate	Green	Sparse	Green	Intermediate	Green	Sparse
CC32	Erect	Green	Sparse	Green	Intermediate	Light green	Sparse
CC37	Erect	Green	Sparse	Green	Dense	Dark green	Sparse
CC38	Intermediate	Green	Intermediate	Green	Intermediate	Green	Sparse
CC42	Erect	Green	Sparse	Green	Intermediate	Green	Sparse
CC46	Intermediate	Green	Sparse	Green	Intermediate	Light green	Sparse
CC51	Intermediate	Green	Sparse	Green	Intermediate	Light green	Sparse

Table 5. Inflorescence and fruit characters in *C. chinense* accessions

Acc. No.	No. of flowers per axil	Flower position	Anthocyanin spots on fruit	Fruit colour at initial stage	Fruit colour at mature stage	Fruit shape	Fruit shape at blossom end	Fruit cross sectional corrugation	Fruit surface
CC1	2	Intermediate	Absent	White	Light red	Companulate	Pointed	Corrugated	Smooth
CC2	3 or more	Pendant	Absent	Green	Red	Blocky	Sunken and pointed	Intermediate	Semi-wrinkled
CC3	2	Erect	Absent	White	Light red	Companulate	Sunken	Intermediate	Smooth
CC5	2	Intermediate	Absent	Green	Red	Blocky	Sunken and pointed	Intermediate	Semi-wrinkled
CC6	3 or more	Pendant	Absent	Green	Dark red	Blocky	Blunt	Intermediate	Semi-wrinkled
CC8	2	Intermediate	Absent	White	Light red	Companulate	Pointed	Corrugated	Semi-wrinkled
CC9	2	Pendant	Absent	Green	Dark red	Blocky	Pointed	Intermediate	Semi-wrinkled
CC10	2	Erect	Present	White	Red	Companulate	Pointed	Intermediate	Semi-wrinkled
CC11	2	Erect	Absent	White	Red	Companulate	Sunken	Intermediate	Semi wrinkled
CC14	2	Intermediate	Present	White	Red	Companulate	Blunt	Intermediate	Semi-wrinkled
CC15	2	Erect	Absent	White	Red	Companulate	Sunken	Intermediate	Semi-wrinkled
CC16	2	Erect	Absent	White	Light red	Companulate	Sunken	Slightly corrugated	Semi-wrinkled
CC17	2	Pendant	Absent	Light green	Orange	Triangular	Pointed	Slightly corrugated	Smooth
CC18	2	Intermediate	Present	White	Orange	Round	Blunt	Slightly corrugated	Smooth

Table 5. Continued

1	2	3	4	5	6	7	8	9	10
CC20	2	Erect	Present	White	Red	Round	Blunt	Slightly corrugated	Smooth
CC21	2	Erect	Absent	White	Red	Blocky	Sunken	Intermediate	Smooth
CC22	2	Pendant	Absent	White	Orange	Companulate	Sunken	Intermediate	Semi-wrinkled
CC23	3 or more	Erect	Present	White	Light red	Round	Sunken	Corrugated	Smooth
CC25	2	Erect	Absent	White	Red	Companulate	Pointed	Intermediate	Smooth
CC26	3 or more	Pendant	Absent	Green	Dark red	Blocky	Blunt	Intermediate	Smooth
CC28	3 or more	Erect	Presnt	White	Red	Round	Sunken	Intermediate	Smooth
CC30	3 or more	Pendant	Absent	Light green	Red	Triangular	Pointed	Corrugated	Wrinkled
CC32	2	Intermediate	Absent	Green	Orange	Round	Sunken	Intermediate	Smooth
CC37	2	Pendant	Absent	Green	Dark red	Triangular	Pointed	Slightly corrugated	Smooth
CC38	3 or more	Erect	Present	Green	Red	Triangular	Pointed	Slightly corrugated	Smooth
CC42	2	Erect	Absent	Green	Red	Blocky	Sunken	Intermediate	Smooth
CC46	3 or more	Intermediate	Absent	Green	Red	Round	Sunken	Corrugated	Semi-wrinkled
CC51	2	Pendant	Absent	Green	Orange yellow	Companulate	Sunken and pointed	Corrugated	Wrinkled

Table 6. General analysis of variance for 15 characters in selected accessions of *C.chinense*

Source of variation	df	Mean squares															
		Plant height	Primary branches per plant	Days to first flowering	Days to harvestable maturity	Pedicel length	Fruit length	Fruit girth	Seed no per fruit	Fruit weight	Fruit no per plant	Yield per plant	Driage	Bacterial wilt incidence	Oleoresin	Colour value	Capsaicin
Genotypes																	
S_1	24	73.121**	4.815**	50.270**	61.947**	1.340**	4.740**	2.787**	31.471**	5.698**	1054.16**	324.29**	2.601**	4.750**	36.6827**	94438.8**	0.1776**
S_2	24	84.053**	6.2673**	46.406**	111.854**	1.509**	4.471**	5.587**	63.794**	6.786**	488.40**	3185.46**	3.438**	5.469**	44.49**	138315.5**	0.1520**
Error																	
S_1	25	8.328	0.153	6.906	6.916	0.0279	0.015	0.533	3.961	0.0367	2.72	22.03	0.100	0.780	0.3026	5196.3	0.01416
S_2	25	24.819	0.294	4.752	6.583	0.0558	0.249	0.0712	26.571	0.02542	6.736	32.28	0.0603	1.263	0.415	5376.33	0.0092

**significant at 1% level

Table 7. Mean value of bio-metric characters during season - I

Acc. No.	Plant height (cm)	No. of primary branches	Days to first flowering	Days to harvestable maturity	Pedicel length (cm)	Fruit length (cm)	Fruit girth (cm)	Seed number per fruit	Fruit weight (g)	Number of fruits per plant	Yield (g)	Driage (%)	Bacterial wilt incidence (%)	Oleoresin (%)	Colour value	Capsaicin (%)
CC1	39.00	3.70	116.50	156.00	4.05	3.90	6.85	29.00	2.60	9.50	23.50	22.60	46	8.50	671.00	1.51
CC2	42.50	4.00	118.50	155.00	4.00	3.85	8.50	36.00	5.75	4.00	22.00	24.65	18	17.50	1067.57	1.85
CC3	40.00	4.00	115.50	154.50	3.50	5.50	5.25	32.50	4.75	7.50	26.00	21.60	46	12.25	945.50	1.75
CC5	45.00	3.40	119.00	153.00	2.55	4.60	6.20	29.00	5.50	10.00	48.00	23.20	18	11.75	945.53	1.85
CC6	46.00	3.10	121.00	157.00	3.45	4.95	6.75	31.50	5.25	4.50	20.00	22.50	23	13.50	1159.00	1.55
CC8	50.50	4.60	114.50	156.50	3.95	5.90	6.15	32.50	5.65	16.00	75.50	22.50	23	12.50	1189.33	1.13
CC9	46.50	3.50	116.00	154.00	3.55	5.80	5.90	33.00	5.70	6.00	28.00	22.00	41	22.25	1006.53	1.57
CC10	47.00	4.90	107.00	150.50	3.20	4.95	6.05	33.00	5.15	7.00	26.50	24.85	00	15.75	1006.50	1.12
CC11	47.50	3.50	121.00	157.00	3.85	4.05	6.45	28.00	3.80	9.50	25.00	24.30	14	11.75	1098.00	1.52
CC14	42.50	4.80	120.00	162.50	2.55	2.50	7.30	29.50	2.05	9.50	16.50	21.00	23	12.75	945.50	1.65
CC15	39.50	4.70	116.00	152.00	4.20	3.65	6.25	31.00	3.30	8.50	28.00	21.55	27	14.50	854.10	1.07
CC16	45.50	3.30	108.50	150.00	3.80	4.45	6.70	32.50	3.90	5.00	17.50	24.05	27	13.00	854.10	1.24
CC17	51.00	4.20	119.50	172.00	2.65	6.20	5.60	28.50	6.60	4.50	25.50	22.95	46	25.75	1067.50	1.53
CC18	48.00	4.20	115.50	154.00	2.90	1.35	6.55	34.50	2.70	9.00	18.00	21.60	32	9.00	1037.33	1.47
CC20	50.50	5.70	110.00	155.00	2.30	0.90	3.45	33.00	0.90	12.50	13.10	23.45	09	10.25	762.50	0.82
CC21	35.50	4.80	114.00	155.50	4.25	3.65	5.80	32.50	3.40	6.00	16.70	22.40	14	13.00	854.00	1.00
CC22	42.00	3.90	113.50	156.00	3.80	4.55	5.55	32.50	2.90	8.00	19.80	20.75	32	9.50	764.00	1.30
CC23	46.00	5.20	106.50	147.00	3.30	2.40	7.10	36.50	3.10	10.00	25.50	22.20	09	14.25	640.50	1.20
CC25	44.50	3.50	112.00	153.50	3.95	4.15	6.60	31.50	3.15	9.50	23.50	24.10	14	16.75	579.57	1.25
CC26	51.50	2.80	117.00	159.50	3.00	4.95	5.95	30.50	4.90	6.50	27.10	22.40	18	17.25	1006.50	1.80
CC28	45.50	3.80	104.50	152.00	2.40	2.50	7.60	32.00	3.35	11.00	32.50	23.25	05	14.00	1372.33	1.25
CC30	32.50	3.30	121.50	165.00	3.40	4.15	7.70	30.00	6.75	6.00	36.50	22.90	41	21.75	1037.00	1.40
CC32	46.50	3.50	111.00	162.50	1.40	1.35	5.40	22.50	1.85	11.00	19.00	22.65	00	20.50	1250.00	1.75
CC37	32.50	10.80	120.00	165.00	3.40	1.50	5.50	22.00	1.30	32.50	38.00	22.65	14	11.50	1433.50	1.45
CC38	29.00	3.00	119.00	161.50	1.35	1.45	3.05	20.50	1.05	12.50	11.90	20.75	09	14.75	1250.00	1.65

Table 8. Mean value of bio-metric characters during season –2

Acc. Number	Plant height (cm)	Number of primary branches	Days to first flowering	Days to harvestable maturity	Pedicel length (cm)	Fruit length (cm)	Fruit girth (cm)	Seed number per fruit	Fruit weight (g)	Number of fruits per plant	Yield (g)	Driage %	Bacterial wilt incidence %	Oleoresin %	Colour Value	Capsaicin %
CC2	47.00	3.50	112.50	148.00	4.05	4.10	8.95	53.00	6.20	8.00	44.00	24.50	21	18.50	1189.50	1.60
CC5	45.00	3.35	104.00	151.00	2.90	4.70	6.40	40.00	6.00	11.00	56.00	21.00	08	11.25	976.67	1.75
CC6	45.50	3.70	110.50	148.50	3.70	4.15	6.35	41.00	5.60	8.00	42.00	22.40	25	13.25	1057.33	1.44
CC8	55.00	4.50	105.50	148.50	4.00	4.85	6.00	36.00	3.25	63.50	185.00	22.50	12	7.75	1037.67	0.96
CC9	46.00	3.50	106.00	149.00	3.35	5.45	5.70	41.00	5.75	5.00	21.00	21.35	46	22.05	945.50	1.42
CC10	51.50	5.00	101.50	138.00	3.45	5.25	6.70	40.50	4.75	32.50	101.00	24.65	04	15.50	1067.50	1.05
CC14	46.50	5.00	111.50	154.00	2.75	2.55	7.85	39.00	2.50	11.50	22.50	20.45	16	12.50	854.10	1.36
CC15	43.50	5.50	101.00	141.50	4.35	3.80	6.40	39.0	3.60	9.00	33.50	21.30	42	16.50	945.33	1.24
CC16	48.00	4.10	100.50	141.50	3.95	4.40	7.05	39.50	4.25	9.50	32.00	23.40	50	12.50	732.57	1.22
CC17	55.50	4.60	122.00	170.00	2.55	6.15	5.65	38.00	7.20	9.00	53.50	22.75	37	24.00	1281.67	1.63
CC18	51.00	4.60	106.50	148.00	3.35	1.50	7.55	38.50	2.20	11.00	20.50	21.55	25	9.25	1067.50	1.48
CC20	57.00	6.10	109.50	153.50	2.55	0.95	3.55	36.00	0.90	21.00	20.50	22.05	08	10.75	579.57	0.88
CC21	41.00	5.40	108.00	156.00	4.35	3.65	6.15	37.50	3.65	7.00	22.50	23.45	29	12.50	854.00	1.45
CC22	50.50	4.50	109.50	154.50	3.90	4.40	6.05	41.00	3.20	9.50	24.00	20.75	33	8.75	762.83	1.37
CC23	51.00	5.95	100.00	143.50	3.75	2.50	7.85	42.00	3.20	62.00	167.00	21.15	08	13.50	579.50	1.66
CC25	50.50	4.50	107.00	148.00	4.20	4.10	6.65	39.50	3.90	7.00	21.50	24.20	21	16.75	549.00	1.05
CC26	46.50	2.70	111.50	160.50	2.75	4.95	6.05	33.50	5.45	5.50	33.00	22.50	21	16.75	1037.00	1.65
CC28	48.00	5.30	101.50	139.00	2.90	2.40	7.75	36.00	2.75	13.50	31.50	20.50	00	14.00	1403.00	1.23
CC30	35.50	3.00	106.50	146.50	3.45	4.80	8.20	30.00	6.95	14.50	88.50	23.65	21	22.25	945.57	1.34
CC32	52.00	3.40	109.00	141.50	1.60	1.35	5.50	29.50	1.90	15.50	18.00	21.45	12	20.75	1189.50	1.66
CC37	42.50	11.80	113.00	144.50	1.95	2.20	3.00	31.00	1.15	36.00	38.00	23.00	12	12.75	1433.00	1.34
CC38	35.00	3.00	107.00	151.50	1.40	1.40	3.00	28.50	1.15	12.50	14.00	20.30	21	16.25	1281.10	1.72
CC42	52.00	3.60	106.00	141.00	2.50	2.10	2.50	30.00	2.30	13.50	26.00	21.65	04	23.50	1159.00	1.65
CC46	44.50	4.20	109.50	143.00	3.00	1.70	7.05	29.50	3.10	13.00	33.50	23.40	16	20.75	1067.50	1.55
CC51	46.50	3.80	105.00	138.50	1.75	2.90	4.90	29.50	1.95	14.50	30.00	21.10	12	19.50	1555.50	1.70

Table 9. Range, mean, phenotypic coefficient of variation and genotypic coefficient of variation of different characters in *C. chinense* during first season

Character	Range	Mean± SE	PCV	GCV
Plant height (cm)	29-51.5	43.46 ± 2.88	14.68	13.10
Number of primary branches	2.8-10.8	4.24 ± 0.39	37.10	35.94
Days to first flowering	104.5-121.5	114.8 ± 2.62	4.66	4.05
Days to harvestable maturity	147-172.0	156.66 ± 2.62	3.75	3.35
Pedicel length (cm)	1.35-4.25	3.19 ± 0.16	25.93	25.39
Fruit length(cm)	0.90-6.20	3.71 ± 0.12	41.52	41.38
Fruit girth(cm)	3.05-7.70	6.16 ± 0.73	20.89	17.21
Number of seeds per fruit	20.5-36.50	30.56 ± 1.99	13.77	12.14
Fruit weight (g)	1.05-6.60	3.84 ± 0.19	44.08	43.79
Number of fruits per plant	4.00-32.50	10.3 ± 1.64	60.52	58.22
Yield (g)	11.90-75.50	25.54 ± 4.69	50.53	47.23
Driage (%)	20.75-24.85	22.67 ± 0.31	5.13	4.93
Bacterial wilt incidence %	0 - 46	22.08 ± 0.88	69.28	58.70
Oleoresin (%)	9.0-25.75	14.53 ± 0.55	29.59	29.34
Colour value	579.57-1433.50	991.86 ± 72.08	22.50	21.30
Capsaicin (%)	0.82-1.85	1.44 ± 0.11	21.45	19.80

Table 10. Range mean, phenotypic coefficient of variation and genotypic coefficient of variation of different characters in *C. chinense* during second season.

Character	Range	Mean ± SE	PCV	GCV
Plant height (cm)	35 - 57	46.88 ± 4.98	15.74	11.61
No of primary branches	2.8-11.8	4.58 ± 0.54	39.51	37.70
Days to first flowering	100 - 122	107.34 ± 2.18	4.71	4.25
Days to harvestable maturity	138 - 170	147.98 ± 2.56	5.20	4.90
Pedicel length (cm)	1.40 - 4.35	3.13 ± 0.23	28.19	27.17
Fruit length (cm)	0.95 - 6.15	3.45 ± 0.49	44.51	42.09
Fruit girth (cm)	2.50 - 8.95	6.11 ± 0.26	27.52	27.17
No of seeds per fruit	28.5 -53.0	36.78 ± 5.15	18.28	11.73
Fruit weight (g)	0.9 - 7.2	3.71 ± 0.15	49.69	49.51
No of fruits per plant	5 - 63.5	16.92 ± 2.59	92.99	91.72
Yield (g)	14 - 185	46.36 ± 5.68	92.69	90.68
Driage (%)	20.3 - 24.65	22.20 ± 0.24	5.96	5.85
Bacterial wilt incidence %	0 - 50	19.83 ± 1.12	77.09	60.94
Oleoresin (%)	9.25 - 24.0	15.61 ± 0.64	30.51	30.23
Colour value	579.50 -1555.5	1022.36 ± 73.32	26.22	25.22
Capsaicin (%)	0.88 - 1.75	1.38 ± 0.09	20.54	19.34

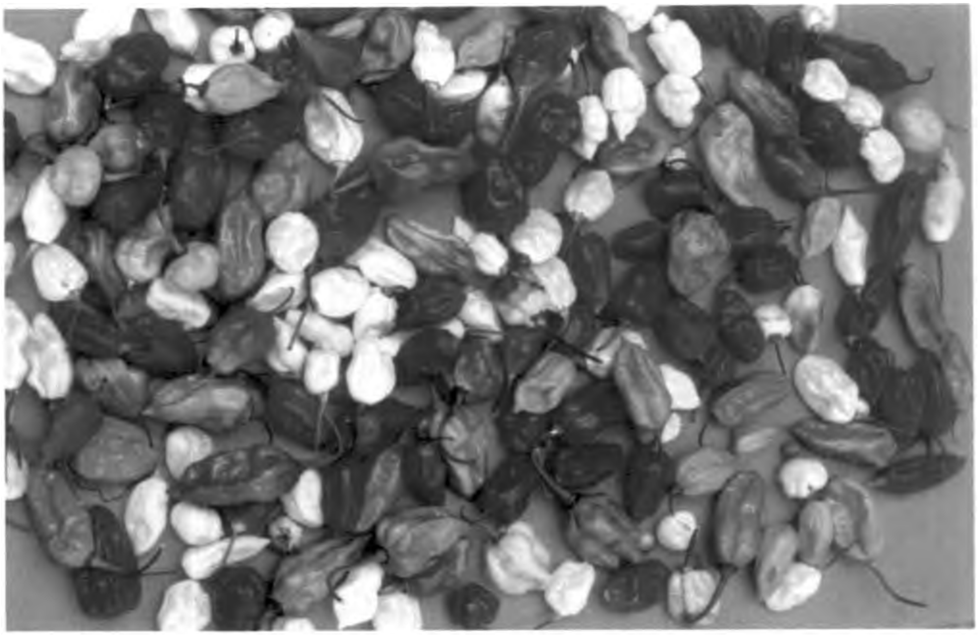

Plate 1. Variability in *Capsicum chinense* Jacq.

Plate 2. Variability in fruit shape and colour

4.2 Evaluation of variability in *Capsicum chinense*

4.2.1 Variability

The results of analysis of variation of the accessions of *Capsicum chinense* showed significant difference for all the 16 characters observed during the first and second seasons (Table 6). Mean performance during the two seasons is given in Tables 7 and 8. The population mean, genotypic coefficient of variation (gcv) and phenotypic coefficient of variation (pcv) are given in Table 9 and 10.

a) Plant height

The height ranged from 29 cm to 52 cm during the first season and from 35 cm to 57 cm during the second season. CC26 was the tallest genotype during the first season and CC20 was the tallest during the second season. CC38 has got the minimum height during both the seasons. The pcv and gcv were 14.68 and 13.10 respectively in the first season and 15.71 and 11.61 respectively in the second season.

b) Number of primary branches

In the first season the number of primary branches ranged from 2.8 (CC26) to 10.8 (CC37) and in the second season it ranged from 2.7 (CC26) to 11.8 (CC37). The pcv and gcv were

37.10 and 35.94 in the first season and 39.51 and 37.70 in the second season.

c) Days to first flowering

In the first season CC28 was the earliest to flower (104.5 days) and CC30 was the latest (121.5). But in the second season CC16 and CC23 were the early flowering accessions and CC17 was the late flowering accession. The pcv and gcv were 4.66 and 4.05 respectively in the first season and 4.71 and 4.25 respectively in the second season.

d) Days to harvestable maturity

CC23 was the earliest to attain harvestable maturity (147 days) during the first season while CC10 (138) was the earliest during the second season. CC17 was the latest during both first (172) and second (170) seasons. The pcv and gcv were 3.75 and 3.35 respectively during the first season and 5.20 and 4.90 respectively during the second season.

e) Pedicel length

Pedicel length varied from 1.35 cm (CC38) to 4.25 cm (CC21) during the first season and from 1.40 cm (CC38) to 4.35 cm (CC 21, CC15) during the second season. The pcv was 25.93

Plate 3. CC17 - accession with maximum fruit length, fruit weight, days for fruit maturity and oleoresin content

Plate 4. CC 8 - accession selected as an elite type based on selection model with maximum number of fruits per plant and maximum yield per plant

Plate 5. CC 5 - accession with maximum capsai cin percent and also selected as an elite type based on selection model

and gcv was 25.39 for the first season and the pcv was 28.19 and the gcv was 27.17 for the second season.

f) Fruit length

Fruit length varied from 0.9 cm to 6.2cm in the first season and from 0.95 cm to 6.15 cm in the second season. CC17 has got the longest fruit and CC20 has got the shortest during both the seasons. The gcv and pcv were 41.38 and 41.52 in the first season and 42.09 and 44.59 in the second season respectively.

g) Fruit girth

Fruit girth ranged from 3.05 cm (CC38) to 8.5 cm (CC2)in the first season and from 3.00 cm (CC37,CC38) to 8.9 cm (CC2) in the second season. The gcv and pcv for the first season were 17.21 and 20.89 respectively and for the second season were 27.17 and 27.52 respectively.

h) Number of seeds per fruit

Number of seeds per fruit ranged from 20.5 (CC38) to 36.5(CC23) during the first season and from 28.9 (CC38) to 53 (CC2) during the second season. The gcv and pcv were 12.14 and 13.77 for the first season and 11.73 and 18.28 for the second season respectively.

i) Fruit weight

Average fruit weight ranged from 0.9 to 6.6 g and 0.9 to 7.2 g respectively during the first and second season. Fruit weight was highest in CC17 and lowest in CC20. In the first season pcv and gcv were 44.08 and 43.79 and in the second season were 49.69 and 49.5 respectively.

j) Number of fruits per plant

The number of fruits per plant ranged from 4 (CC2) to 52.5 (CC37) during the first season and from 5 (CC9) to 63.5 (CC8) during the second season. The gcv and pcv were 58.22 and 60.52 in the first season and 91.72 and 92.99 in the second season.

k) Yield per plant

During the first season yield per plant ranged from 12g (CC38) to 75.5g(CC8) and the gcv and pcv were 46.96 and 49.89 respectively. During the second season yield varied from 14g (CC38) to 185g (CC8). The gcv and pcv were 90.59 and 92.69 respectively.

l) Driage

The driage per cent varied from 20.75 to 24.85 during the first season and from 20.3 to 24.6 during the second season. The gcv and pcv were 4.93 and 5.13 in the first season and 5.85 and 5.96 in the second season.

m) Bacterial wilt incidence

Among the pests and diseases of *Capsicum chinense* bacterial wilt caused by *Ralstonia solanacearum* was observed more serious. During the first season incidence of wilt ranged from zero (CC32) to 46 percent (CC1, CC3, CC17) and from zero (CC28) to fifty percent (CC16) in the second season.

n) oleoresin

The oleoresin content ranged from 8.55 percent to 25.65 percent during the first season and from 8.8 percent to 24.05 percent during the second season. CC17 has got the highest oleoresin content .The pcv and gcv were 29.59 and 29.34 during the first season and 30.51 and 30.23 during the second season

o) Colour value

Nesslerimetric colour value ranged from 579.50 (CC25) to 1433.5 (CC37) in the first season and from 549 (CC25) to 1555.5 (CC51) in the second season. The pcv and gcv were 22.50 and 21.30 during the first season and 26.22 and 25.22 during the second season.

p) Capsaicin

Capsaicin content of the accessions ranged from 0.80 per cent (CC20) to 1.85 per cent (CC2,CC5) during the first season and from 0.80 per cent (CC20) to 1.75 per cent (CC5) during the second season. The gcv and pcv were 19.80 and 21.45 in the first season and 19.34 and 20.54 in the second season.

4.2.2 Heritability, genetic advance and genetic gain

Heritability, genetic advance and genetic gain for different characters for the two seasons are presented in the Tables 11 and 12.

During the first season the highest heritability was observed for the character fruit length (0.993) followed by fruit weight (0.987), oleoresin (0.984), pedicel length (0.959), number of primary branches per plant (0.938), driage (0.926), number of fruits per plant (0.925). The other characters also exhibited high range of heritability.

.During the second season the highest heritability was observed for the character fruit weight (0.993) followed by oleoresin content (0.982), fruit girth (0.975), number of fruits per plant (0.973), yield (0.957), pedicel length (0.929), colour value (0.925).The other characters except plant height (0.544)

Table 11. Heritability, genetic advance and genetic gain of different characters in *C. chinense* during season –1

Characters	Heritability	Genetic advance	Genetic gain (%)
Plant height	0.795	10.46	24.07
Number of primary branches per plant	0.938	3.05	71.79
Days to first flowering	0.758	8.35	7.27
Days to harvestable maturity	0.799	9.66	6.166
Pedicel length	0.959	1.63	51.09
Fruit length	0.993	3.16	85.08
Fruit girth	0.679	1.80	29.18
Number of seeds per fruit	0.776	6.73	22.02
Fruit weight	0.987	3.44	88.91
Number of fruits per plant	0.925	10.89	115.36
Yield	0.874	24.16	91.06
Driage	0.926	2.22	9.79
Bacterial wilt incidence	0.718	2.46	102.50
Oleoresin	0.984	8.71	59.94
Colour value	0.896	411.83	41.52
Capsaicin	0.852	0.54	37.50

Table 12. Heritability, genetic advance and genetic gain of different characters in *C.chinense* during season -2

Character	Heritability	Genetic advance	Genetic gain
Plant height	0.544	8.27	17.62
Number of primary branches per plant	0.910	3.40	74.17
Days to first flowering	0.814	8.48	7.90
Days to harvestable maturity	0.889	14.09	9.52
Pedicel length	0.929	1.69	53.85
Fruit length	0.894	2.83	81.98
Fruit girth	0.975	3.38	55.30
No of seeds per fruit	0.412	5.70	15.49
Fruit weight	0.993	3.77	101.5
Number of fruits per plant	0.973	31.53	186.35
Yield	0.957	85.50	182.39
Driage	0.965	2.63	11.84
Bacterial wilt incidence	0.625	2.36	99.15
Oleoresin	0.982	9.64	61.73
Colour value	0.925	510.84	49.96
Capsaicin	0.886	0.52	37.62

and number of seeds per fruit (0.412) also exhibited high heritability.

Genetic advance was the highest for colour value (411.83 during the first season and 510.84 during the second season) and the lowest for capsaicin (0.54 during the first season and 0.52 during second season).

During the first season genetic gain was the highest for the character number of fruits per plant (115.36%) followed by bacterial wilt incidence (102.5%), yield (91.06%), fruit weight (88.91%), fruit length (85.08%), number of primary branches per plant (71.79%), oleoresin (59.94%), pedicel length (51.09%), colour value (41.52%), capsaicin (37.50%), fruit girth(29.18%), plant height (24.07%), number of seeds per fruit (22.02%). Low genetic gain was observed for characters, driage (9.79%), days to first flowering (7.29%) and days to harvestable maturity (6.16%).

During the second season genetic gain was highest for number of fruits per plant (186.35%) followed by yield (182.39%), fruit weight (101.5%), bacterial wilt incidence (99.15%), fruit length (81.98%), number of primary branches per plant (74.17%), oleoresin (61.73%), fruit girth (55.30%), pedicel length (53.85%), colour value (49.96%) and capsaicin (37.62%). Moderate genetic gain was observed for characters like plant height (17.62%), number of seeds per fruit (15.49%), driage (11.84%). Low values of genetic gain observed for days to harvestable maturity (9.52%) and days to first flowering (7.9%).

4.2.3 Correlation Studies

The genotypic and phenotypic correlation of various yield components with yield were worked out for two seasons. The results are presented in Tables 13 and 14. During the first season the characters such as fruit length and fruit weight had significant positive correlation with yield (rg = 0.42 and 0.461 respectively). During the second season number of fruits per plant had high and significant positive correlation with yield (rg = 0.866). In all the characters studied, genotypic correlation coefficients were found to be high.

Inter correlation among different characters

During the first season plant height had significant positive correlation with seed number (rg = 0.533). Number of primary branches had positive significant correlation with number of fruits per plant and negative significant correlation with fruit weight and fruit length (rg = -0.384, -0.378). Days to first flowering had significant positive correlation with days to harvestable maturity (rg = 0.729) and bacterial wilt incidence (rg = 0.544). Days to harvestable maturity had negative significant

Table 13. Genotypic (G) and Phenotypic (P) correlation coefficients among yield and its components in season I

Character		Plant height	Number of primary branches	Days to first flowering	Days to harvestable maturity	Pedicel length	Fruit length	Fruit girth	Seed number	Fruit weight	Number of fruits per plant	Yield	Driage	Bacterial wilt incidence	oleoresin	Colour value
Number of Primary Branches	G	-0.256														
	P	-0.244														
Days to first flowering	G	-0.280	-0.018													
	P	-0.290	-0.014													
Days to harvestable maturity	G	-0.267	0.179	0.729**												
	P	-0.165	0.143	0.601*												
Pedicel length	G	0.043	-0.131	-0.014	-0.429*											
	P	0.048	-0.125	-0.048	-0.409											
Fruit Length	G	0.283	-0.378*	0.200	-0.428	0.599**										
	P	0.256	-0.365	0.167	-0.050	0.587*										
Fruit girth	G	0.109	-0.195	0.002	-0.191	0.517**	0.292									
	P	0.023	-0.129	0.046	-0.128	0.422	0.228									
Seed number	G	0.533**	-0.222	-0.474*	-0.707**	0.692**	0.361	0.493*								
	P	0.391	-0.178	-0.315	-0.585	0.568*	0.317	0.382								
Fruit weight	G	0.295	-0.384*	0.288	0.075	0.414*	0.832**	0.553**	0.426*							
	P	0.261	-0.379	0.251	0.071	0.405	0.826*	0.450	0.369							
Number of fruits per plant	G	-0.313	0.846**	0.077	0.239	-0.367	-0.462**	-0.334	-0.552**	-0.539**						
	P	-0.279	0.791*	0.042	0.188	-0.340	-0.448	-0.242	-0.488	-0.515						
Yield	G	0.166	0.172	0.122	0.042	0.169	0.429*	0.307	0.040	0.461**	0.347					
	P	0.127	0.153	0.051	-0.014	0.171	0.399	0.178	0.026	0.427	0.359					
Driage	G	0.368	-0.002	-0.181	-0.240	0.220	0.174	0.316	0.250	0.306	-0.131	0.099				
	P	0.289	-0.013	-0.161	-0.165	0.204	0.160	0.281	0.185	0.296	-0.101	0.103				
Bacterial wilt incidence	G	-0.119	-0.212	0.544**	0.322	0.412*	0.534**	0.184	0.212	0.469**	-0.351	-0.054	-0.353			
	P	-0.049	-0.182	0.355	0.230	0.361	0.466	0.160	0.097	0.383	-0.258	-0.069	-0.307			
Oleoresin	G	0.118	-0.251	0.122	0.463**	-0.155	0.308	0.139	-0.105	0.534**	-0.337	0.023	0.195	0.124		
	P	0.129	-0.239	0.088	0.419	-0.146	0.307	0.117	-0.116	0.523	-0.326	0.016	0.184	0.128		
Colour value	G	-0.140	0.236	0.292	0.494**	-0.535**	-0.162	-0.009	-0.558	-0.052	0.424*	0.288	-0.004	-0.304	0.213	
	P	-0.116	0.216	0.255	0.414	-0.493	-0.150	-0.053	-0.484	-0.045	0.399	0.266	-0.012	-0.198	0.194	
Capsaicin	G	0.111	-0.347	0.217	0.118	0.080	0.267	0.465*	0.227	0.292	-0.240	0.003	0.002	0.185	0.080	-0.13
	P	0.115	-0.316	0.196	0.058	0.766	0.245	0.388	0.160	0.282	-0.228	-0.013	-0.012	0.127	0.073	-0.08

* significant at five percent level

** significant at one percent level

Table 14. Genotypic (G) and Phenotypic (P) correlation coefficients among yield and its components in season 2

Character		Plant height	Number of primary branches	Days to first flowering	Days to harvestable maturity	Pedicel length	Fruit length	Fruit girth	Seed number	Fruit weight	Number of fruits per plant	Yield	Driage	Bacterial wilt incidence	oleoresin	Colour value
Number of Primary Branches	G	0.166														
	p	0.087														
Days to first flowering	G	0.213	0.123													
	P	0.120	0.082													
Days to harvestable maturity	G	0.036	-0.100	0.787**												
	P	0.038	-0.122	0.693*												
Pedicel length	G	0.113	-0.059	-0.330	0.025											
	P	0.076	-0.059	-0.270	-0.163											
Fruit Length	G	-0.061	-0.293	0.104	0.363	0.515**										
	P	-0.058	-0.229	0.090	0.332	0.461										
Fruit girth	G	-0.123	-0.278	-0.220	-0.053	0.595**	0.348									
	P	-0.056	-0.256	-0.195	-0.670	0.584*	0.315									
Seed number	G	0.223	-0.075	-0.062	0.158	0.936**	0.522*	0.670**								
	P	0.134	-0.011	-0.020	0.155	0.535*	0.391	0.347								
Fruit weight	G	-0.243	-0.436**	0.199	0.364*	0.449**	0.871**	0.525**	0.594**							
	P	-0.182	-0.410	0.178	0.338	0.431	0.835*	0.513	0.393							
Number of fruits per plant	G	0.359	0.415*	-0.284	-0.253	0.057	-0.090	-0.032	-0.039	-0.258						
	P	0.243	0.402	-0.267	-0.243	0.037	-0.084	-0.029	-0.033	-0.254						
Yield	G	0.239	0.074	-0.296	-0.107	0.321	0.328	0.288	0.214	0.216	0.866**					
	P	0.116	0.066	-0.259	-0.124	0.295	0.304	0.281	0.109	0.212	0.858*					
Driage	G	0.134	0.088	0.165	-0.015	0.420*	0.390*	0.235	0.316	0.430*	0.018	0.186				
	P	0.091	0.071	0.150	-0.0185	0.411	0.370	0.232	0.183	0.425	0.014	0.182				
Bacterial wilt incidence	G	-0.045	-0.125	0.151	0.361	0.551**	0.555**	0.192	0.357	0.446*	-0.479	-0.285	0.130			
	P	-0.109	-0.128	0.098	0.348	0.372	0.429	0.119	0.308	0.360	-0.380	-0.212	0.088			
Oleoresin	G	-0.038	-0.344	0.275	-0.038	-0.322	0.129	-0.101	-0.397	0.330	-0.349	-0.215	0.179	0.060		
	P	-0.040	-0.322	0.246	-0.040	-0.298	0.118	-0.0966	-0.244	0.322	-0.340	-0.210	0.176	0.036		
Colour value	G	-0.234	0.179	0.264	-0.174	-0.617**	-0.127	-0.315	-0.491	-0.102	-0.053	-0.141	-0.124	-0.292	0.311	
	P	-0.138	0.130	0.262	-0.137	-0.568	-0.104	-0.297	-0.313	-0.098	-0.059	-0.133	-0.096	-0.228	0.301	
Capsaicin	G	-0.344	-0.116	0.160	0.147	-0.074	0.131	0.457**	0.329	0.299	-0.270	-0.145	-0.178	0.046	0.134	0.203
	P	-0.200	-0.129	0.158	0.105	-0.045	0.099	0.441	0.104	0.274	-0.256	-0.135	-0.162	0.024	0.122	0.188

* significant at five percent level

** significant at one percent level

correlation with pedicel length (rg = 0.429) and seed number (rg = -0.707).

Fruit length had positive significant correlation with pedicel length (rg =-0.599), fruit girth (rg = 0.517), seed number (rg = 0.692), bacterial wilt incidence (rg = 0.534) and had negative significant correlation with number of fruits per plant (rg =-0.462). Fruit girth had positive significant correlation with fruit weight (rg = 0.553), seed number (rg = 0.493) and pedicel length (rg = 0.517). Fruit weight has positive significant correlation with yield (rg = 0.461), seed number (rg = 0.426), pedicel length (rg = 0.414). Seed number had positive significant correlation with fruit weight, fruit girth and pedicel length. Number of fruits per plant had positive significant correlation with number of primary branches and negative significant correlation with fruit weight, seed number, fruit girth and pedicel length.

In the second season the inter correlation observed among different characters were similar to that in the first season. Number of primary branches were positively correlated with number of fruits per plant (rg = 0.415) and had negative significant correlation with fruit weight (rg = -0.436). Fruit length had significant positive correlation with pedicel length (rg = 0.515), seed number (rg = 0.522), fruit weight (rg = 0.595), driage (rg = 0.390) and bacterial wilt incidence (rg = 0.555). Fruit girth had significant positive correlation with pedicel length (rg = 0.595), seed number (0.670), fruit weight (rg = 0.525). Driage percent had positive correlation with pedicel length (rg = 0.420), fruit girth (rg = 0.390) and fruit weight (rg = 0.430).

4.2.4 Path coefficient analysis

The direct and indirect contribution of the component characters on yield can be found out by partitioning the correlation between yield and component characters in to direct and indirect effects (Tables 15 and 16). Factors having high positive correlation with yield namely-number of primary branches, fruit length, fruit girth, fruit weight and number of fruits per plant were selected for path coefficient analysis.

Season I

The number of fruits per plant exhibited the highest positive direct effect on fruit yield(1.481) followed by fruit weight (0.702), fruit girth (0.224), fruit length (0.204). The direct effect of number of primary branches on yield was negative(0.691), but the positive correlation with yield was due to the indirect effect through number of fruits per plant (1.255). Though the number of fruits per plant has high positive direct

Table 15. Direct and indirect effect of selected yield component on fruit yield in *C. chinense* during season – 1

Character	Number of primary branches	Fruit length	Fruit girth	Fruit weight	Number of fruits per plant	Correlation with yield
Number of primary branches	**-0.691**	-0.077	-0.044	-0.270	1.255	0.172
Fruit length	0.261	**0.204**	0.066	0.584	-0.686	0.429
Fruit girth	0.136	0.060	**0.224**	0.391	-0.499	0.307
Fruit weight	0.266	0.170	0.124	**0.702**	-0.799	0.461
Number of fruits per plant	-0.586	-0.095	-0.075	-0.379	**1.481**	0.347

Residual : 0.1239

Table 16. Direct and indirect effect of selected yield components on fruit yield in *C. chinense* during season - 2

Character	Number of primary branches	Fruit length	Fruit girth	Fruit weight	Number of fruits per plant	Correlation with yield
Number of primary branches	**-0.179**	-0.036	-0.028	-0.106	0.424	0.074
Fruit length	0.053	**0.122**	0.036	0.212	-0.093	0.328
Fruit girth	0.050	0.042	**0.102**	0.127	-0.033	0.288
Fruit weight	0.078	0.106	0.054	**0.243**	-0.264	0.216
Number of fruits per plant	-0.074	-0.011	-0.003	-0.063	**1.018**	0.866

Residual : 0.0082

effect with yield, its indirect effect on yield through number of primary branches(-0.586),fruit length(-0.095), fruit girth(-0.075) and fruit weight (-0.379) were negative. The residual effect due to other factors influencing yield was 0.1239.

Season 2

The number of fruits per plant exhibited the highest positive direct effect on fruit yield (1.018) as in season 1 followed by fruit weight (0.243), fruit length (0.122), fruit girth (0.102). The direct effect of number of primary branches on yield was negative (-0.179) but has positive correlation with yield due to the high positive indirect effect on yield through number of fruits per plant (0.424). The residual effect due to other factors influencing the yield was 0.0082.

4.2.5. Selection index

A discriminant function analysis was carried out for isolating superior genotypes based on the genotypic correlation and direct effect of yield components. Eleven simultaneous model were tried.

Selection index involving characters viz, yield per plant, fruit weight and number of fruits per plant were selected for *Capsicum chinense* to identify superior genotypes. It had an efficiency of 11.85 units while the efficiency of direct selection

Table 17. Discriminant function for different character combination season I

Sl. no.	Combination	Discrimant function	Efficiency
1.	y, x_9	$0.85 y + 0.51 x_9$	11.77
2.	y, x_{10}	$0.87 y + 0.0056 x_{10}$	11.78
3.	y, x_9, x_{10}	$0.75 y + 1.38 x_9 + 0.31 x_{10}$	11.85
4.	y, x_5, x_6, x_7	$0.84 y + 1.10 x_7 + -1.42 x_5 + 0.82 x_6$	11.87
5.	y, x_6, x_7, x_{10}	$0.77y + 1.07x_6 + 1.06 x_7 + 0.27x_{10}$	11.88
6.	y, x_6, x_9, x_{10}	$0.75y + 0.38x_6 + 1.15x_9 + 0.33x_{10}$	11.85
7.	y, x_6, x_7, x_9, x_{10}	$0.74y + 0.74x_6 + 0.91x_7 + 0.62x_9 + 0.34x_{10}$	11.89
8.	$y, x_3, x_6, x_7, x_9, x_{10}$	$0.75y + -0.005x_3 + 0.75x_6 + 0.93x_7 + 0.46x_9 + 0.31x_{10}$	11.89
9.	$y, x_5, x_6, x_7, x_8, x_9, x_{10}$	$0.74y + 0.33x_{10} + -1.84x_5 + 1.69x_6 + 1.37x_7 + -0.12x_8 + -0.09x_9$	11.93
10.	$y, x_2, x_4, x_5, x_6, x_7, x_{10}$	$0.77y + 0.39x_2 + 0.02x_4 + -1.53x_5 + 1.47x_6 + 1.33x_7 + 0.17x_{10}$	11.93
11.	$y, x_1, x_2, x_5, x_6, x_7, x_8, x_9, x_{10}$	$0.76y + 0.07x_1 + 0.37x_2 + -1.71x_5 + 1.64x_6 + 1.43x_7 + 0.02x_8 + -0.12x_9 + 0.22x_{10}$	11.94
	Direct selection		11.77

y = yield per plant

x_1 = plant height

x_2 = number of primary branches

x_3 = days to first flowering

x_4 = days to harvestable maturity

x_{10} = no of fruits per plant

x_5 = pedicel length

x_6 = fruit length

x_7 = fruit girth

x_8 = number of seeds per fruit

x_9 = fruit weight

Table 18. Discriminant function for different character combination season 2

Sl. no	Combination	Discrimant function	Efficiency
1.	y, x_{10}	$0.95\ y + 0.19\ x_9$	41.56
2.	y, x_{10}	$0.91\ y + 0.15\ x_{10}$	41.57
3.	y, x_9, x_{10}	$0.68\ y + 3.26\ x_9 + 0.78\ x_{10}$	41.67
4.	y, x_5, x_6, x_7	$0.95\ y + -0.08\ x_7 + 1.03\ x_5 + 0.17 x_6$	41.57
5.	y, x_6, x_7, x_{10}	$0.72y + 2.41x_6 + 1.39\ x_7 + 0.61x_{10}$	41.66
6.	y, x_6, x_9, x_{10}	$0.68y + 0.46x_6 + 2.93x_9 + 0.78x_{10}$	41.68
7.	y, x_6, x_7, x_9, x_{10}	$0.63y + 1.03x_6 + 1.13x_7 + 2.51x_9 + 0.89x_{10}$	41.70
8.	$y, x_3, x_6, x_7, x_9, x_{10}$	$0.60y + -0.28x_3 + 0.81x_6 + 0.86x_7 + 3.2x_9 + 0.96x_{10}$	41.72
9.	$y, x_5, x_6, x_7, x_8, x_9, x_{10}$	$0.62y + 0.93x_{10} + 1.46x_5 + 0.62x_6 + 0.75x_7 + -0.02x_8 + 2.82x_9$	41.71
10.	$y, x_2, x_4, x_5, x_6, x_7, x_{10}$	$0.53y + -2.22x_2 + 0.16x_4 + 1.75x_5 + 3.13x_6 + 1.63x_7 + 1.19x_{10}$	41.76
11.	$y, x_1, x_2, x_5, x_6, x_7, x_8, x_9, x_{10}$	$0.37y + 0.18x_1 + -2.49x_2 + 2.65x_5 + 1.23x_6 + 0.99x_7 + -0.12x_8 + 4.12x_9 + 1.65x_{10}$	41.84
	Direct selection		41.56

y = yield per plant

x_1 = plant height

x_2 = no of primary branches

x_3 = days to first flowering

x_4 = days to harvestable maturity

X_{10} = no of fruits per plant

x_5 = pedicel length

x_6 = fruit length

x_7 = fruit girth

x_8 = number of seeds per fruit

x_9 = fruit weight

Table 19. Estimation of selection index and ranking of the genotypes for season 1

Serial number	Genotype	Selection index	Rank based on selection index
1	CC1	24.15	16
2	CC2	25.68	14
3	CC3	28.38	10
4	CC5	46.70	02
5	CC6	23.64	17
6	CC8	69.38	01
7	CC9	30.73	06
8	CC10	29.15	08
9	CC11	26.94	12
10	CC14	18.14	23
11	CC15	28.19	11
12	CC16	20.06	21
13	CC17	29.63	07
14	CC18	20.32	19
15	CC20	14.93	24
16	CC21	19.07	22
17	CC22	21.28	18
18	CC23	26.50	13
19	CC25	24.91	15
20	CC26	29.10	09
21	CC28	32.40	05
22	CC30	38.56	04
23	CC32	20.21	20
24	CC37	40.36	03
25	CC38	14.24	25

Table 20. Estimation of selection index and ranking of the genotypes for season 2

Serial number	Genotype	Selection index	Rank based on selection index
1	CC2	56.37	09
2	CC5	66.22	06
3	CC6	53.05	10
4	CC8	185.92	01
5	CC9	36.92	16
6	CC10	109.51	03
7	CC14	32.41	22
8	CC15	41.43	13
9	CC16	43.02	12
10	CC17	66.87	05
11	CC18	29.69	24
12	CC20	33.25	19
13	CC21	32.65	21
14	CC22	34.16	18
15	CC23	172.35	02
16	CC25	32.79	20
17	CC26	44.49	11
18	CC28	40.91	14
19	CC30	94.21	04
20	CC32	30.52	23
21	CC37	57.67	08
22	CC38	23.02	25
23	CC42	35.70	17
24	CC46	63.45	07
25	CC51	38.06	15

is 11.77 during the first season. During the second season the efficiency of the model is 41.67 and that of direct selection is 41.56.

Characters to be considered were selected based on their phenotypic correlations, direct and indirect effects on yield, variability and heritability. The discriminant functions for different character combinations are given in Tables 17 and 18. The selection indices are selected based on efficiency over direct selection and number of characters involved. High efficiency with minimum number of characters is preferred.

Based on selection index (selection index 3), the accession CC 8 was found to be the most superior one during the first and second season. The other genotypes selected for the first season are CC 5, CC 37, CC30 and CC 28 and those selected for the second season are CC 23, CC10, CC30 and CC 5.

DISCUSSION

5. DISCUSSION

Capsicum a "New World genus" known in different names has richness in diversity but their diversity has not received much attention. This crop of much economic importance serves both as spice and vegetable. In contrast to the widely cultivated *Capsicum annuum*, *C.chinense* is perennial in nature, has highly pungent deep red coloured fruits, and its cultivation is mostly restricted to homestead level or kitchen garden.

The *C. chinense* is more suitable than C. *annuum* for cultivation in humid tropical condition as it is resistant to many pathogens such as *Pseudomonas solanacearum*, *Xanthomonas campestris pv vesicatoria*, *Collectotrichum gloeosporioides*, *Erwinia carotovora*, tomato spotted wilt virus and potato Y poty virus which attack *C. annuum* in these areas (Cheng, 1989). The two recognised varieties of *C. chinense* viz, Habanero and Scotch Bonnet are known for their extreme pungency.

High variability existing in this crop has not yet been exploited. The types grown are mostly indigenous ones exhibiting a wide spectrum of variability for plant and fruit characters. Exploration of genetic variability in the available germplasm is a prerequisite to any breeding programme. Further partitioning of this variability into heritable and non heritable components will enable us to know the effectiveness of selection. Hence this project is undertaken with a view to collect, conserve and evaluate the indigenous types of *Capsicum chinense*, to study the variability, heritability, genetic advance and correlation towards yield and its component characters and to identify high yielding types with high ŏleoresin content.

The results of the study are discussed under the following heads

5.1 Genetic cataloguing of *C.chinense*

Twenty eight *Capsicum chinense* accessions collected from different sources were catalogued for morphological characters using the IBPGR descriptor list for *Capsicum*. Success of any breeding programme depends basically on the extent of variability available in the base population . There are reports on high variability for morphological characters in *C.annuum* and *C.frutescens*(Padda *et al.*,1970; Geneif,1984; Amarchandra *et al.*,1992; Mohammed,1994; Olufolaji and Makinde,1994 ; Sheela,1998) and is also observed in *C.chinense* which is evident from the present study.

5.2 Genetic variability

The success of any crop improvement programme depends upon the precise information available on the genetic variability of the crop. The choice of appropriate selection method depends upon the estimates of heritability together with genetic advance (Johnson *et al.*,1955). Wide range of variability in *C.annuum* for biometric characters were reported by many workers (Arya,1979; Sing and Brar, 1979; Ramakumar *et al.*,1981; Nair *et al.*,1984; Narayanankutty *et al.*,1992; Papalkar *et al.*,1992; Sarma and Roy,1995 and Singh *et al.*,1998).

In the present study significant differences exists between the accessions were noted for all the characters studied namely, plant height, number of primary branches per plant, days to first flowering, days to first harvesting, pedicel length, fruit length, fruit girth, number of seeds per fruit, average fruit weight, number of fruits per plant, fruit yield and driage. The existence of considerable variation indicated the scope for improving the population for these characters.

The tallest genotype was CC26 (52cm) recorded during the first season and CC20 (57cm) during the second season. CC37 has got the highest number of branches during both the first and second seasons. Days to harvestable maturity was minimum in CC23 (147 days) in the first season and in CC10 (138 days) in the second season. Pawade *et al.*(1993) in a varietal evaluation in *C.annuum* observed a range of 128 to 157 days for days to first harvest. Kataria *et al.* (1997) observed a range of 94 to 133 days for days to first harvest. In the present study a range of 147 to172 days and 138 to170 days were observed for days to first harvest during the first and second season respectively which proved that accessions of *C.chinense* are late maturing compared to *C.annuum*.

The genotypic coefficient of variation was of high magnitude for fruit length, fruit weight, fruit number per plant, fruit yield per plant during the first and second seasons resulting in high heritability. This indicated that the expression of these characters are least influenced by the environment. High genotypic coefficient of variation reported for number of fruits per plant, length of fruit and fresh fruit weight per plant in *Capsicum annuum* by Ahmed *et al.(*1997). Sheela (1998) observed higher coefficients of variation for fruit size, mean fruit weight, yield per plant and fruit length in the related species *C.frutescens*. High gcv and pcv for the characters suggest very high variability which in turn offers good scope for selection.

Lower values of gcv were observed for days to first flowering, days to harvestable maturity and driage. Similar results were observed in *Capsicum annuum* by Ahmed *et al.* (1990); Rani *et al.*(1996); Kataria *et al.*(1997) and in *C.frutescens* by Sheela(1998).

The gcv was very near to pcv for days to first flowering, days to harvestable maturity, fruit length, fruit weight, number of fruits per plant indicating the highly significant effect of genotype on phenotypic expression. High environmental effects on phenotype for the characters like bacterial wilt incidence, yield and fruit girth were evident from their higher pcv as compared to gcv.

5.3 Heritability

The effectiveness of selection depends upon the heritability and genetic advance of the character selected. In the present study high heritability along with high genetic gain was observed for fruit length, fruit weight, fruit number per plant and fruit yield per plant. This result was in conformity with that of Ahmed *et al.* (1990); Singh *et al.*(1994); Pitchaimuthu and Pappiah(1995); Bhatt *et al.* (1996); Ghildiyal *et al.* (1996); Rani and Singh (1996); Kataria *et al.*(1997) and Singh *et al.*(1998). High heritability combined with high genetic gain is indicative of additive gene action and so these characters can be improved by selection. Driage percent has low genetic gain coupled with high heritability estimates. This signifies that high value of heritability is not always an indication of genetic advance (Johnson *et al.*, 1955). Arya and Saini (1986) also reported low genetic advance for driage percent.

On the basis of the present study fruit length, fruit weight, fruit number per plant, fruit yield per plant and number of primary branches per plant appears to be the characters of major importance and should be given due weightage while formulating selection strategies for improvement of yield in *Capsicum chinense*.

5.4 Correlation studies

A thorough knowledge of the relationship between yield and its component characters makes crop improvement more effective. In this study during the first season fruit length and fruit weight had significant positive correlation with yield and other factors like number of fruits per plant and fruit girth also had high positive correlation with yield. During the second season the number of fruits per plant has high significant positive correlation with yield. Other factors like fruit length, pedicel length, fruit girth had high positive correlation with yield. This is in agreement with the findings of Khurana *et al.* (1993); Ahmed *et al.*(1997) and Sheela(1998). The phenotypic correlation was smaller than genotypic correlation indicating that environment had smaller but similar effect on these characters.

During both the seasons number of fruit per plant had negative significant correlation with fruit length, fruit girth and fruit weight. Thus, the component characters exhibited significant inter relationship among themselves and indicated the likely consequence of selection for simultaneous improvement of desirable characters.

5.5 Path coefficient analysis

The path coefficient analysis provides an effective measure of untangling direct and indirect cause of association and permits a critical examination of specific causes acting to produce a given correlation and measures the relative importance of each factor. Among different yield components the number of fruits per plant exhibited the highest positive direct effect on yield. Fruit weight also had a direct effect of desirable magnitude towards fruit yield but its indirect effect via number of fruits per plant was negative and of higher magnitude. Similar results were reported by Ahmed *et al.*(1997). In addition to number of fruits per plant and fruit weight, the characters like fruit length and fruit girth having positive correlation with yield and by indirectly contributing to fruit weight should also be considered in the selection programme aimed at improving fruit yield.

5.6 Selection index

A better way to exploit genetic correlation with several traits having high heritability is to construct an index, called selection index, which combines information on all the characters associated with yield. Selection indices involved discriminant function based on the relative importance of various characters. This technique provides information on yield components and thus aids in indirect selection for the improvement of yield. Hence a discriminant function analysis was carried out for isolating superior genotypes based on the genotypic correlation and direct effect of yield components on yield. Eleven simultaneous selection models were tried.

The selection index involving all the yield components namely, plant height, number of primary branches per plant, days to first flowering, days to harvestable maturity, pedicel length, fruit length, fruit girth, number of seeds per fruit, fruit weight and number of fruits per plant was observed to have the maximum efficiency compared to direct selection based on yield. But in order to formulate a selection index with minimum number of easily measurable characters, ten models were also tried. A model with yield per plant, fruit weight and number of fruits per plant was selected for ranking the genotypes for the first and second season. On ranking effected on this model, the first three ranks were obtained by the genotypes viz. CC8, CC5 and CC37 during the first season. During the second season the top ranks were given to CC8, CC23 and CC10.

5.7 Biochemical analysis in *Capsicum chinense*

In chilli apart from yield, quality is also very important. The oleoresin content, colour value, capsaicin content are the three major determinants in evaluating the chilli quality. Highly pungent varieties yield high capsaicinoids which is used for pharmaceutical purposes and hence such varieties have to be identified. Narayanan *et al.*(1980) reported that highly pungent and low coloured chillies are of pharmaceutical use and low pungent and high coloured chillies were used to impart colour to the food products. The use of varieties with high capsanthin contents in enhancing the red colour of other popular varieties has been stressed by Ahmed *et al* (1992).

5.7.1Oleoresin

Oleoresin represents the total flavour extract of ground spices. Chilli extracts are now being extensively used in processed food and also in pharmaceutical products. The advantage of using chilli extract over ground spices are reducing the microbial contamination, imparts uniformity of colour flavour and strength. The oleoresin consists of fixed oil, capsaicin, pigments, sugars and resin (Bajaj *et al.*, 1980).

The oleoresin extracted from highly pungent chillies is referred to as oleoresin capsicum. This oleoresin has very high pungency and used mainly to impart pungency to the manufactured foods and beverages (Purseglove *et al.*,1981.)

In the present study a significant variation was observed between accessions for oleoresin per cent during the first (8.55-25.65%) and the second (8.8-24.05%) seasons. Variation in oleoresin content between *C. annuum* cultivars were reported by many workers (Lewis,1972; Bajaj *et al.*,1980, Teotia and Raina,1986; Narayanankutty *et al*,1992; Mini, 1997). Similar result was observed by Sheela (1998) in *C. frutescens*. Compared to the range of oleoresin content of *C. annuum* reported earlier, *C.chinense* accessions used in the present study was observed to have higher range for oleoresin content. Pradeepkumar (1990) obtained higher oleoresin content in *C.chinense* (31.7%) compared to *C. annuum* and *C. frutescens*. High pungency oleoresin from *C.chinense* can be exploited in the commercial as well as export sector.

Accessons viz, CC17(25.75%), CC9(22.25%), CC30 (21.75%) observed to have higher oleoresin per cent during the first season. During the second season accessions CC17(24%), CC42(23.5%), CC9(22.25%) have higher oleoresin percent. Green fruited accessions have comparatively higher oleoresin than the white fruited accessions. From correlation studies, it is observed that late varieties as well as varieties with high fruit weight has high oleoresin content. The character oleoresin content exhibit high heritability coupled with high genetic gain and hence it can be improved by selection.

5.7.2 Colour value

Colour is a prized quality characteristics of aesthetically rewarding and commercially important. Four different genes (y, c_1, c_2, cl) with epistatic interactions have been reported to control colour in matured fruits (Hurtado-Hernandez and Smith,1985; Shifriss and Pilovsky, 1992). Colour of chilli is due to carotenoid pigment, capsanthin, the other pigments being β carotene, capsorubin, zeaxanthin, cryptoxanthin and violoxanthin. Capsanthin and capsorubin are the major contributors to red colour of chillies.

The range of colour value in *C .chinense* was observed tobe higher when compared to *C.annuum* as reported earlier. Pradeepkumar(1990) also observed the highest extractable colour in *C.chinense* accessions (110.34 ASTA units) when compared with *C.annuum* and *C.frutescens*. He also observed that the hybrid *C. annuum* x *C. chinense* was the most promising inter specific hybrid with high colour value

The Nesslerimetric colour value was higher in the accessions viz, CC37(1433.50) and CC28 (1372.33) during the first season and CC51(1555.5) and CC37(1433.0) during the second season. The characte exhibit high heritability with moderate genetic gain.

5.7.3 Capsaicin

Pungency is considered as the most important quality trait in chillies. Capsaicin, the pungent principle of chillies, is a condensation product of 3-hydroxy 4-methoxy benzylamine and decylenic acid. Significant variation was observed between *C. chinense* accessions for capsaicin percent during the first (0.8-1.85%) and second (0.8-1.75%) season. The pungency is influenced by factors like cultivars, geographic locations, climatic and environmental conditions, harvest maturity and processing procedure (Varghese *et al.*,1992; Bosland, 1993).The degree of pungency varied considerably among varieties. This could probably be due to the presence of gene modifying factors for pungency and the ratio of placental tissue to seed and pericarp. Varietal variation in capsaicin content in *C.annuum* had been reported by many workers. (Ananthasamy *et al.*,1960, Arya and Saini, 1977, Bajaj *et al.*, 1978, Teotia and Raina, 1987; Narayanankutty *et al* .,1992, Rani 1994, Mini 1997). Sheela 1998 observed significant difference in capsaicin content among varieties of *C. frutescens.*

Plate 6. CC2 - accession with maximum fruit girth , maximum seeds per fruit, high capsaicin percent and mimimum number of fruits per plant.

Plate 7. CC 23 - an early maturing accession selected as an elite type based on selection model.

Plate 8. CC 10 - an early maturing accession selected as elite type with maximum driage percent.

On comparing the capsaicin content reported for *C. annuum* with the range obtained in the present study, it is clear that the accessions of *Capsicum chinense* contained higher capsaicin per cent than *C.annuum*. Similar results were reported by Pradeeepkumar(1990) and Mini(1997). Most of the accessions evaluated in the study had high (>1%) capsaicin content indicating their enormous economic potential. The green fruited accessions of *C. chinense* had a higher capsaicin content compared to white fruited accessions. Similar results were reported by Theymoli *et al.*(1982) in *C .annuum* and Sheela (1998) in *C.frutescens*. The higher content of capsaicinoids in green fruited types may be due to the increased rate of photosynthesis and metabolite production. The per cent of capsaicin was highest in CC2(1.85%) and in CC5(1.85%)during the first season and in CC5(1.75%) during the second season. The character capsaicin content exhibited high heritability coupled with moderate genetic gain. Rani and Singh,1996 also reported high heritability for capsaicin content. In the present study fruit girth has got significant positive correlation with capsaicin content during both the seasons.

The present investigation on *C.chinense* has resulted in the estimation of variability, genetic and biometric parameters and the chemical composition of the fruits. *Capsicum chinense* accessions were identified for high yield, fruit size and quality.

Accessions namely CC28 was the earliest to flower, while CC17 has got the maximum fruit length, fruit weight and oleoresin content. CC8 was the highest yielding genotype. Capsaicin content was highest in CC5. These accessions viz, CC8, CC5, CC23, CC17 were found to be promising for high yield and quality attributes and can be recommended as elite types after refinement and testing under multilocations.

SUMMARY

6. SUMMMARY

The present investigation on 'Variability in *Capsicum chinense Jacq.'* was conducted in the Vegetable Research Farm of Department of Olericulture, College of Horticulture, Kerala Agricultural University, Vellanikara during 1997-99.

The programme envisaged cataloguing of available germplasm in *Capsicum chinense*, assessment of genetic variability, assessment of association of different traits with yield including the direct and indirect effects of traits on yield and formulation of a selection index to identify superior genotypes.

The experimental material consisted of 28 accessions of *C. chinense* collected from different parts of Kerala. Field experiment was laid out in two seasons in RBD with two replications each. Observations were recorded from five plants per genotype in each replication. The data were subjected to statistical analysis. The salient findings are summarized below.

Twenty eight accessions of *C.chinense* collected from different parts of Kerala were genetically catalogued based on the descriptor list of Capsicum. Significant difference were observed for all the biometric characters studied viz; plant height, number of primary branches, days to first flowering, days to harvestable maturity, pedicel length, fruit length, fruit girth, fruit weight, number of seeds per plant, number of fruits per plant, yield per plant, driage, bacterial wilt incidence, capsaicin, oleoresin, colour value.

Accession No:CC8 had maximum yield during both the first(75.59g) and second(185g) seasons. Accession No:CC17 had the maximum average fruit weight(6.6g during the first season and 7.2g during the second season). Number of fruits per plant was highest in CC 37(32.5)during the first season and in CC 8(63.5) during the second season. The accession, CC17 had the highest oleoresin content(25.75% during the first season and 24% during the second season). Nesslerimetric colour value was maximum in CC37 (1433.5) during the first season and in CC51 (1555.50) during the second season. Capsaicin content was maximum in CC5 and CC2(1.85%) during the first season and in CC5(1.75%) during the second season.

During the first and second season bacterial wilt incidence has got the highest gcv and pcv followed by number of fruits per plant and yield. Highest pcv and gcv were observed for number of fruits per plant followed by yield and bacterial wilt incidence during the second season.

High heritability was observed for most of the characters studied during both the seasons. Fruit length recorded the highest heritability(0.993) during the first season while it was for the fruit weight(0.993) during the second season.

High values for genetic gain was observed for number of fruits per plant, yield, fruit weight, fruit length, bacterial wilt incidence during the first and second season.

During the first season characters such as fruit length and fruit weight showed significant positive correlation with yield and the number of fruits per plant showed the high and significant positive correlation with yield during the second season.

Results of path coefficient analysis revealed that the number of fruits per plant has got the highest positive direct effect on fruit yield followed by fruit weight during the two seasons. The direct effect of number of primary branches on yield was negative.

A selection model was formulated for *C.chinense* consisting of characters viz; yield per plant, fruit weight and number of fruits per plant.

Comparison of different genotypes based on the index value revealed that the genotypes namely CC8, CC5, CC37 are superior to other genotypes during the first season and the genotypes namely CC8, CC23, CC10 are superior during the second season.

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* Originals not seen

VARIABILITY IN *CAPSICUM CHINENSE* JACQ.

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ABSTRACT OF THE THESIS

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ABSTRACT

The research project 'Variability in *Capsicum chinense* Jacq.' was carried out in the College of Horticulture, Kerala Agricultural University, Vellanikkara, Thrissur during 1997-99. The major objective of the study were to genetically catalogue the available germplasm, to study the genetic variability, heritability, genetic gain and correlation of different characters with yield.

Twenty eight accessions of *C. chinense* were catalogued based on the descriptor list for capsicum. Significant difference were observed for all the biometric characters studied viz, plant height, number of primary branches, days to first flowering, days to harvestable maturity, pedicel length, fruit length, fruit girth, fruit weight, number of seeds per plant, number of fruits per plant, yield per plant, driage, bacterial wilt incidence, capsaicin, oleoresin and colour value.

The accession CC 8 was found to be the highest yielder during both the first(75.5g) and second (185g)season. Accession CC 17 had the maximum average fruit weight(6.6g and 7.2g respectively during the first and second season). Number of fruits per plant was the highest in CC 37 (32.5)during the first season and CC 8 (63.5)during the second season. The accession CC17 had the

high oleoresin per cent during the first (25.75%) and second(24%) season. Accession No. CC5 observed to have the highest capsaicin percent during the first(1.85) and second (1.75%) season.

During the first season bacterial wilt incidence has got the highest genotypic coefficient of variation(69.28) and phenotypic coefficient of variation(58.70) and for number of fruits per plant(gcv-92.99, pcv-91.72) during the second season. Fruit length recorded the highest heritability(0.993) during the first season while it was the fruit weight(0.993) during the second season. High values for genetic gain was observed for number of fruits per plant, yield, fruit weight, fruit length, bacterial wilt incidence during the first and second season. During the first season fruit length and fruit weight showed significant positive correlation with yield and the number of fruits per plant showed the significant positive correlation with yield during the second season.

A selection model was formulated for *C. chinense* consisting of the characters yield per plant, fruit weight and number of fruits per plant.

Genotypes CC8, CC5, CC37 were found to be superior during the first season and the genotypes CC8, CC23, CC10 during the second season.