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RESEARCH

MORPHOLOGICAL EVALUATION OF F4 PROGENIES OF CHILLI (*CAPSICUM ANNUM* L.) UNDER KONKAN CONDITIONS

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Abstract: Chilli (Capsicum annum L.) holds significant economic importance and is extensively cultivated. The chilli genotypes, sourced from traditional agricultural systems, underwent a thorough assessment of their morphological characteristics. The experiment focused on the F4 generation of chilli, cultivated under Kokan conditions in Maharashtra. Sixteen genotypes were included in the study, organized in a Randomized Block Design (RBD). All progenies exhibited a 'Solitary' flowering habit and a 'Pendent' position habit for the fruits, influenced by the strong genetic behavior of the genotypes. Fruit shapes were categorized into three ranges: short, medium, and very long. The fruit colors ranged from light green to dark green, and physical parameters such as fruit length varied from 9.86 cm (Jwala x Pant C-3) to 4.49 cm (DPL-C-5 x Pant C-3). Similarly, the diameter of fruits spanned from 1.08 cm (DPLC-5 x BC-28) to 0.73 cm (Jwala x DPL-C-5). Counting the number of seeds per fruit revealed that the progeny DPLC-5 x BC-28 exhibited the highest seed count at 68.10, while the lowest count was observed in LCA-206 x Jwala at 29.04. Additionally, the study found that capsaicin content in fruits ranged from 0.222 to 0.814 mg/100 g. These diverse characteristics within the progenies make them valuable for potential use in future breeding programs.

Keyword: F4 progenies, Physical parameter, Fruit length, Pungency

INTRODUCTION

Chilli (Capsicum annum L.) stands as a significant vegetable crop within the Solanaceae family and boasts widespread cultivation globally. Originating from South and Central America, it continues to be cultivated in those regions (Pickersgill, B, 1997). Historical evidence establishes chilli as the first spice employed by humans, with archaeological findings indicating its consumption dating back approximately 6000 years (Hill et al., 2013). Chilli is a nutritional powerhouse, containing proteins, essential vitamins such as A and C, and serving as a rich source of various minerals, including calcium, phosphorous, and iron (Bose et al., 1993). Moreover, the spicier variants of chillies are abundant in capsaicin, a digestive stimulant (Baloch, 1994). In India, the cultivation of chillies is widespread, encompassing almost every state in the country. Among these, Andhra Pradesh emerges as the leading producer, contributing approximately 26% to the overall chilli cultivation area, followed by Maharashtra (15%), Karnataka (11%), Orissa (11%), Madhya Pradesh (7%), with other states collectively contributing around 22% to the total chilli cultivation area. When it comes to production, Andhra Pradesh takes a dominant role, contributing a significant 57% to the total output. Following suit, Karnataka stands as the second-largest producer, contributing 12% to the overall production, trailed by Orissa (5%), West Bengal (5%), Maharashtra (4%), Madhya Pradesh (3%), and other states contributing about 14%. (NHB 2016- 17). The yield of red chilli fruits is directly linked to the effective management of agronomic practices, variety selection, drying methods, climatic conditions, and the interplay between different varieties. Chilli not only adds vibrant color and a distinctive pungent flavor as a seasoning but also plays a crucial role in influencing positive yield attributes. This study focuses on examining various factors, including fruit color, shape, length, diameter, position, as well as the number of seeds per fruit and capsaicin content. The aim of the present investigation is to analyze chilli progenies with divergent yield attributes, seeking to understand their impact on overall yield results.

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MATERIALS AND METHODS

Location and planting materials

The current research was carried out throughout the Rabi season of 2017–2018 at the Central Experiment Station, Wakawali, Vegetable Improvement Scheme, on the campus of Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth in Dapoli, District Ratnagiri, Maharashtra, India. Table 1 provides information on the experimental setting, which comprised 16 progenies and Konkan Kirti as the check variety. A baseline dosage of 150 kg N, 80 kg P2O5, and 100 kg K2O per ha was applied during planting. Half of the nitrogen was given as a baseline dosage upon transplanting, along with the entire quantities of phosphate and potash. The residual nitrogen was divided into two dosages, which were given 30 days and 60 days following transplantation, respectively. Plantings of carefully chosen seedlings with consistent development and high health were made in a 3.6 m × 2.4 m space, 60 x 60 cm apart. Each treatment was performed twice in the randomized block design (RBD) experiment. The Panse and Sukhatme (1995) technique was employed for the statistical analysis.

Physical parameters of fruit:

Shape of fruit

The fruit shape recorded at mature fruit stage as long, very long, tapering, conical, and oval.

Colour of fruit

The mature green stage of the genotype was observed, and the recorded fruit colors included light green, green, and dark green.

Length of fruit (cm)

The fruit length classification was based on three categories: short, measuring up to 4 cm; medium, ranging from 4 to 6 cm; and very long, exceeding 6 cm. The measurement process involved assessing the length of five fruits from five plants selected at random, measured from the base to the tip of each fruit.

Diameter of fruit (cm)

The measurement of fruit diameter involved assessing five fruits from five randomly chosen plants, with the measurement taken from the top shoulder of each fruit.

Position of fruit

The position of the fruits was visually observed and categorized as either pendent or upright.

Number of seeds per fruit

The counting of seeds in five fruits was conducted individually, and an average was calculated for each genotype.

Capsaiscin content (mg/100 g)

Using spectrophotometric measurement, the samples' total capsaicin content was calculated, as stated by the protocol described by Sadasivam and Manikkam (1992). The procedure started with the weight of 0.5g of chili powder placed inside a volumetric flask in a test tube with a glass stopper. After pipetting 10 milliliters of dry acetone into the flask, the mixture was agitated using a mechanical shaker for three hours. Following a 10-minute centrifugation at 10,000 rpm to enable the contents to settle, 1 milliliter of the clear supernatant was pipetted into a test tube and dried in a hot water bath. After dissolving the residue in 5 milliliters of 0.4% sodium hydroxide solution, 3 milliliters of 3% phosphomolybdic acid was added. To get rid of any floating debris, the solution was quickly filtered into centrifuge tubes after shaking the contents and letting them stand for an hour. For ten to fifteen minutes, centrifugation was done at 500 rpm or as such. After that, the clear blue solution was transferred into a cuvette, and the absorbance at 650 nm was measured. The test samples were conducted simultaneously with a blank for the reagent. Furthermore, a standard graph with a capsaicin range of 0-200 µg was created. To do this, pipette out 0.2, 0.4, 0.6, 0.8, and 1 milliliter of the working standard solution and proceed as previously described.

RESULTS AND DISCUSSION

Flowering habit

The 'Solitary' flowering habit was observed in all progenies, a trait likely influenced by the persistent genotype-specific genetic behavior. These findings align with previous studies conducted by Mahmood et al. (2002), Dhamayanthi and Reddy (2003), and Pawar (2016).

Position of fruit (Pendent/Upright)

The 'Pendent' position habit was noted in all F4 progenies of chili, suggesting a high likelihood of genetic influence and minimal impact from environmental factors. These observations find support in studies conducted by Mahmood et al. (2002), Dhamayanthi and Reddy (2003), Chattopadhyay et. al. (2011), Nascimento et. al. (2014), and Dhumal (2016) on various chilli genotypes.

Shape of fruit

The short fruits were evident in progenies T12 and T13, while long fruits were noted in treatments T1, T3, T5, T6, T7, T8, T9, T10, T11, T12, T14, T16, and T17. Conversely, very long fruits were identified in progenies T2 and T4 (Table 2). This variation may be attributed to a combination of moderate environmental factors and the substantial genetic influence of the genotypes. Comparable results have been recorded in studies conducted by Dhamayanthi and Reddy (2003), Nkansah et al. (2011), Chattopadhyay et al. (2011), Nazia and Rangahoo-Sanmukhiya (2013), and Pawar (2016).

Colour of fruit

The research results showed that light green-colored fruits were present in progenies T2, T4, T7, T8, T9, T11, T12, T13, T14, and T15, while treatments T1, T5, and T6 displayed green-colored fruits. Conversely, treatment T3, T10, T16, and the variety

Konkan Kirti (T17) exhibited dark green-colored fruits (Table 2). The observed variation is likely attributed to a combination of moderate environmental factors and significant genetic influences. Similar color variations have been noted in studies conducted by Mahmood et al. (2002), Nkansah et al. (2011), Nazia and Rangahoo-Sanmukhiya (2013), and Pawar (2016).

Length of fruit (cm)

The length of fruit ranged from 4.49 cm to 9.86 cm, with an average of 7.08 cm (Table 3). The maximum fruit length (9.86 cm) was observed in T9 (Jwala x Pant C-3), which was comparable to treatments T2 and T10. Conversely, the minimum length of fruit (4.49 cm) was recorded in T14 (DPL-C-5 x Pant C-3), as illustrated graphically in Fig. 1. The variance in fruit length between several genotypes under study is likely attributed to genotypic characteristics, reflecting differences in the genetic makeup of the various genotypes. Similar variations in fruit length have been reported in studies conducted by Sreelatha Kumary and Rajamony (2004), Smitha and Basavaraja (2006), Dahal et al. (2008), Tembhurne et al. (2008), Pramila et al. (2009), Cheema et al. (2010), Chattopadhyay et al. (2011), Saravaiya et al. (2011), Shiva et al. (2013), Dhaliwal et al. (2015), Rohini and Lakshmanan (2014), Vijaya et al. (2014), Pawar (2016), Kumari et al. (2017), and Yatagiri et al. (2017).

Diameter of fruit (cm)

The diameter of chilli fruit exhibited a range from 0.73 cm to 1.08 cm, with an average of 0.94 cm (refer to Table 3 and the graphical representation in Fig. 2). The maximum diameter of the fruit (1.08 cm) was observed in the progeny T13 (DPLC-5 x BC-28), and it was comparable to treatments T1, T3, T7, T8, T14, T15, and T17. Conversely, the minimum diameter of the fruit (0.73 cm) was noted in the progeny T10 (Jwala x DPL-C-5). Variations in the fruit diameter among the F4 genotypes of chili were attributed to the genetic makeup of the genotypes. Similar variations in fruit diameter have been documented in studies conducted by Smitha and Basavaraja (2006), Tembhurne et al. (2008), Chattopadhyay et al. (2011), Saravaiya et al. (2011), Dhaliwal et al. (2014), Rohini and Lakshmanan (2014), Vijaya et al. (2014), Pawar (2016), and Yatagiri et al. (2017).

Number of seeds per fruits:

It was revealed from the Table 4 that the range of the each fruit's seed count was 29.04 to 68.10, with an average of 48.96. Similar to T7, T9, T15, and T17, the progeny of DPLC-5 x BC-28 (T13) had the greatest each fruit's seed count (68.10). On the other hand, as shown in Fig. 3, LCA-206 x Jwala (T16) had the fewest seeds per fruit (29.04). Manju and Sreelatha Kumary (2002), Smitha and Basavaraja (2006), Chattopadhyay et al. (2011), and Dhaliwal et al. (2015) all published comparable findings with relation to the quantity of seeds per fruit in chilli genotypes.

Capsaicin (mg/100 g)

The pungency and market desirability of chilli are influenced by its capsaicin content. The data regarding capsaicin content in chilli fruits, as presented in Table 5, indicate a significant variation. The capsaicin content ranged from 0.222 to 0.814 mg/100 g, with an average of 0.413. The highest content was observed in the progeny (T6) Jwala x LCA-206 (0.814 mg/100 g), comparable to the T13 progeny. Conversely, the lowest content was noted in the progeny (T5) BC-28 x Pb Gucchedar (0.222 mg/100g), as illustrated graphically in Fig. 4.

Table 1. List of Genotypes and checks used in the study

Sr. No.	Treatment	Genotype
1	T_1	Pant C-3 x LCA-206
2	T_2	Pant C-3 x Jwala
3	T_3	Pant C-3 x BC-28
4	T_4	K.Kirti x Jwala
5	T_5	BC-28 x Pb Gucchedar
6	T_6	Jwala x LCA-206
7	T_7	Jwala x BC-28
8	T_8	Jwala x Pb Gucchedar
9	T_9	Jwala x Pant C-3
10	T_{10}	Jwala x DPL-C-5
11	T_{11}	ACS-9818 x Pb Gucchedar
12	T_{12}	ACS-9818 x BC-28
13	T_{13}	DPLC-5 x BC-28
14	T_{14}	DPL-C-5 x Pant C-3
15	T_{15}	DPL-C-5 x Pb Gucchedar
16	T_{16}	LCA-206 x Jwala
17	T_{17}	Konkan Kirti (C)

Table 2. Morphological characters of fruits of F_4 chilli progenies

Sr. No.	Progenies	Fruit Shape	Fruit Colour
T_1	Pant C-3 x LCA-206	Long	Green
T_2	Pant C-3 x Jwala	Very Long	Light Green
T_3	Pant C-3 x BC-28	Long	Dark Green
T_4	K.Kirti x Jwala	Very Long	Light Green
T_5	BC-28 x Pb Gucchedar	Long	Green
T_6	Jwala x LCA-206	Long	Green
T_7	Jwala x BC-28	Long	Light Green
T_8	Jwala x Pb Gucchedar	Long	Light Green
T_9	Jwala x Pant C-3	Long	Light Green
T_{10}	Jwala x DPL-C-5	Long	Dark Green
T_{11}	ACS-9818 x Pb Gucchedar	Long	Light Green
T_{12}	ACS-9818 x BC-28	Short	Light Green
T_{13}	DPLC-5 x BC-28	Short	Light Green
T_{14}	DPL-C-5 x Pant C-3	Long	Light Green
T_{15}	DPL-C-5 x Pb Gucchedar	Long	Light Green
T_{16}	LCA-206 x Jwala	Long	Dark Green
T_{17}	Konkan Kirti (C)	Long	Dark Green

Table 3. Physical parameters of fruit of F_4 chilli progenies

Sr. No.	Progenies	Fruit length (cm)	Fruit Diameter (cm)
T_1	Pant C-3 x LCA-206	5.93	1.017
T_2	Pant C-3 x Jwala	9.05	0.819
T_3	Pant C-3 x BC-28	6.23	0.992
T_4	K.Kirti x Jwala	7.34	0.848
T_5	BC-28 x Pb Gucchedar	7.97	0.881
T_6	Jwala x LCA-206	6.06	0.907
T_7	Jwala x BC-28	8.69	1.019
T_8	Jwala x Pb Gucchedar	6.19	1.016
T_9	Jwala x Pant C-3	9.86	0.946
T_{10}	Jwala x DPL-C-5	8.97	0.734
T_{11}	ACS-9818 x Pb Gucchedar	8.61	0.915
T_{12}	ACS-9818 x BC-28	6.56	0.949
T_{13}	DPLC-5 x BC-28	4.92	1.083
T_{14}	DPL-C-5 x Pant C-3	4.49	1.076
T_{15}	DPL-C-5 x Pb Gucchedar	5.05	1.028
T_{16}	LCA-206 x Jwala	6.89	0.805
T_{17}	Konkan Kirti (C)	7.62	0.985
	Range	**4.49 - 9.86**	**0.734 – 1.08**
	S.Em±	**0.367**	**0.043**
	CD at (5%)	**1.102**	**0.130**

Table 4. Number of seeds per fruit

Sr. No.	Progenies	Number of seeds per fruit
T_1	Pant C-3 x LCA-206	49.28
T_2	Pant C-3 x Jwala	48.34
T_3	Pant C-3 x BC-28	54.98
T_4	K.Kirti x Jwala	45.2
T_5	BC-28 x Pb Gucchedar	47.66
T_6	Jwala x LCA-206	34.52
T_7	Jwala x BC-28	58
T_8	Jwala x Pb Gucchedar	51.9
T_9	Jwala x Pant C-3	57.42
T_{10}	Jwala x DPL-C-5	54.4
T_{11}	ACS-9818 x Pb Gucchedar	44.04
T_{12}	ACS-9818 x BC-28	42.64

T_{13}	DPLC-5 x BC-28	68.1
T_{14}	DPL-C-5 x Pant C-3	30.86
T_{15}	DPL-C-5 x Pb Gucchedar	58.16
T_{16}	LCA-206 x Jwala	29.04
T_{17}	Konkan Kirti (C)	57.9
	Range	**29.04 - 68.10**
	S.Em±	**3.59**
	CD at (5%)	**10.77**

Table 5. Chemical composition of mature green fruits of F_4 chilli progenies

Sr. No.	Progenies	Capsaicin (mg/100 g)
T_1	Pant C-3 x LCA-206	0.288
T_2	Pant C-3 x Jwala	0.338
T_3	Pant C-3 x BC-28	0.454
T_4	K.Kirti x Jwala	0.295
T_5	BC-28 x Pb Gucchedar	0.222
T_6	Jwala x LCA-206	0.814
T_7	Jwala x BC-28	0.490
T_8	Jwala x Pb Gucchedar	0.386
T_9	Jwala x Pant C-3	0.335
T_{10}	Jwala x DPL-C-5	0.398
T_{11}	ACS-9818 x Pb Gucchedar	0.313
T_{12}	ACS-9818 x BC-28	0.435
T_{13}	DPLC-5 x BC-28	0.572
T_{14}	DPL-C-5 x Pant C-3	0.576
T_{15}	DPL-C-5 x Pb Gucchedar	0.411
T_{16}	LCA-206 x Jwala	0.443
T_{17}	Konkan Kirti (C)	0.262
	Range	**0.222 – 0.814**
	S.Em ±	**0.003**
	CD @ 5%	**0.011**

FIGURES

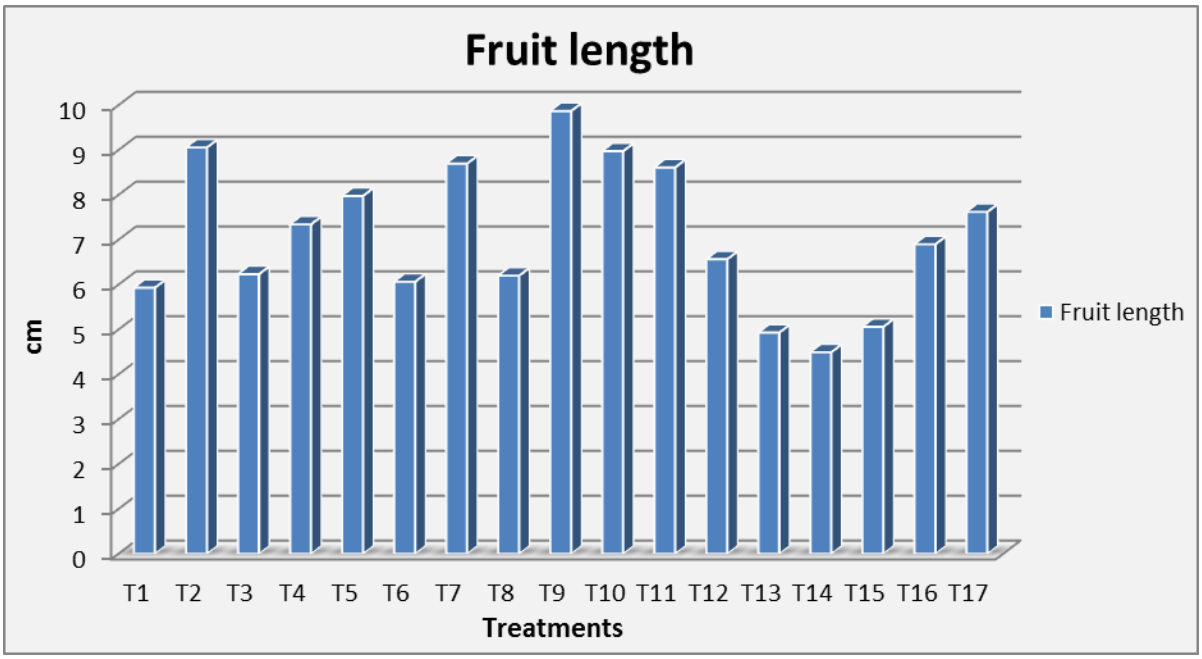


Fig. 1: Fruit length (cm) of F_4 chilli progenies

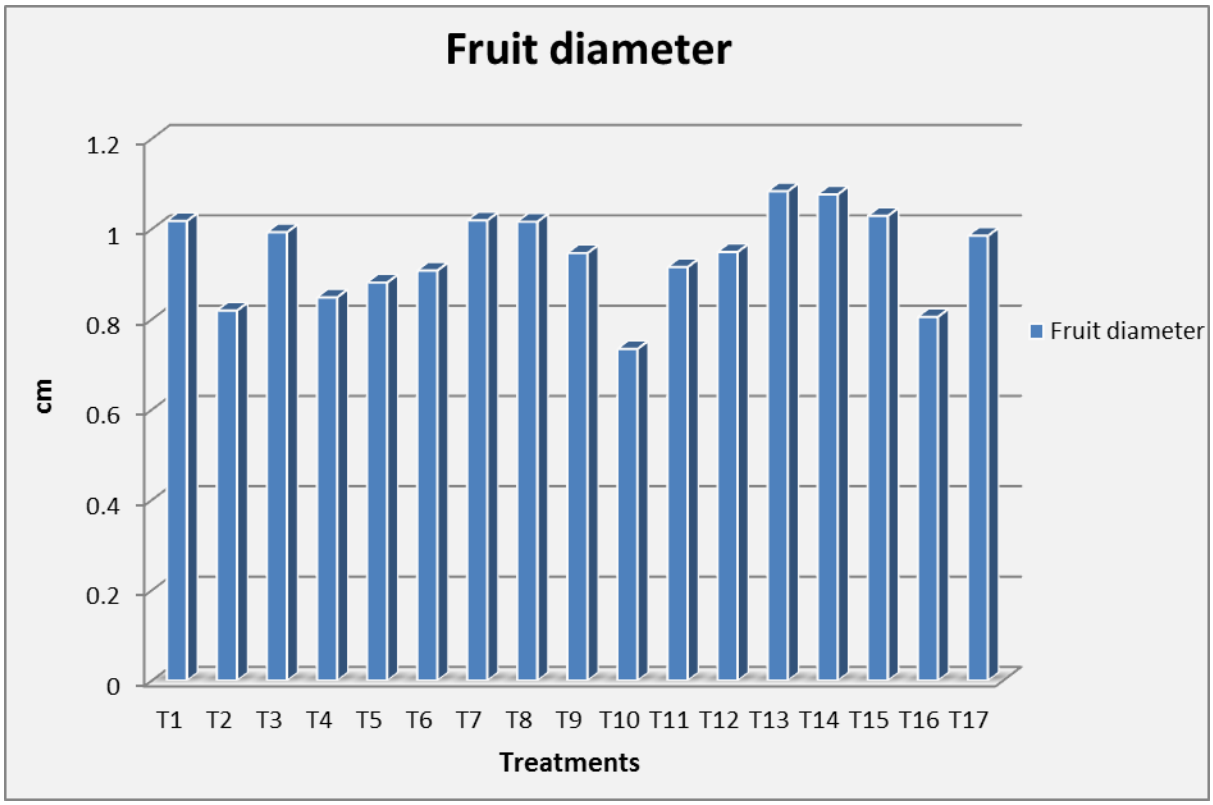


Fig. 2: Fruit diameter (cm) of F_4 chilli progenies

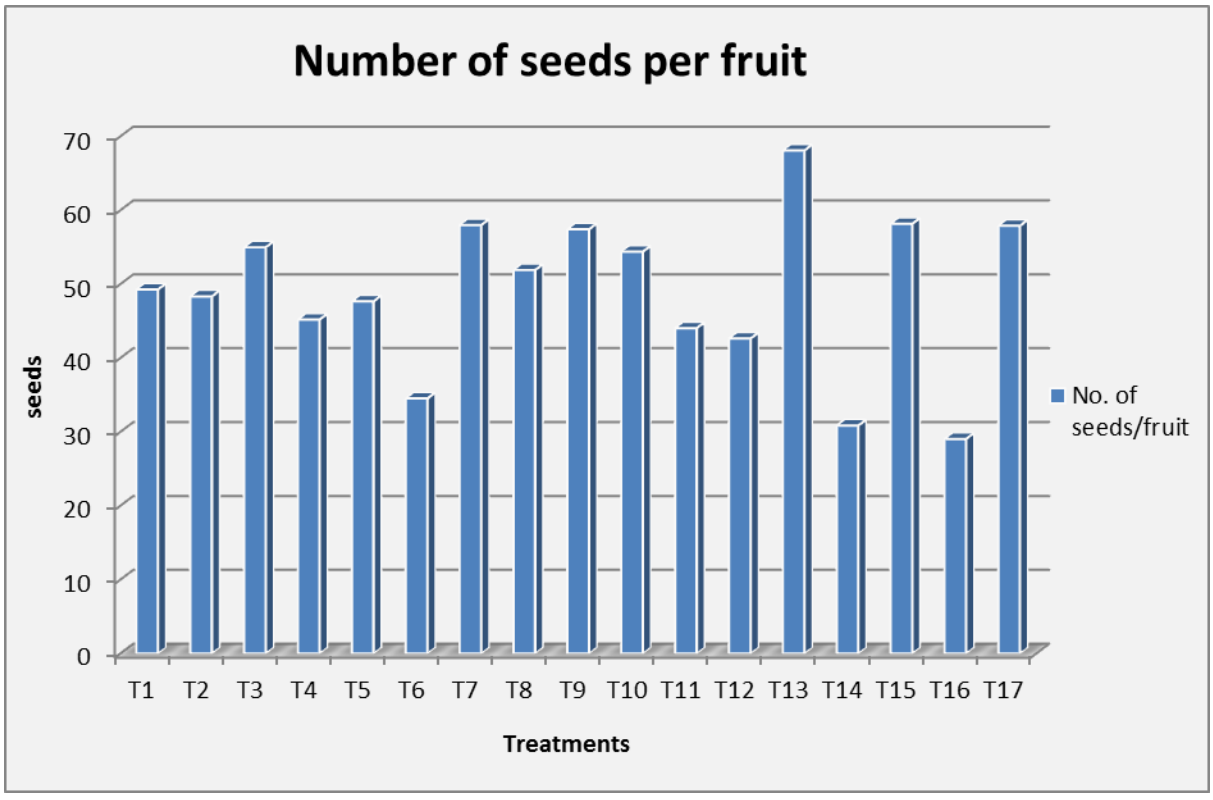


Fig. 3: Number of seeds per fruit F_4 chilli progenies

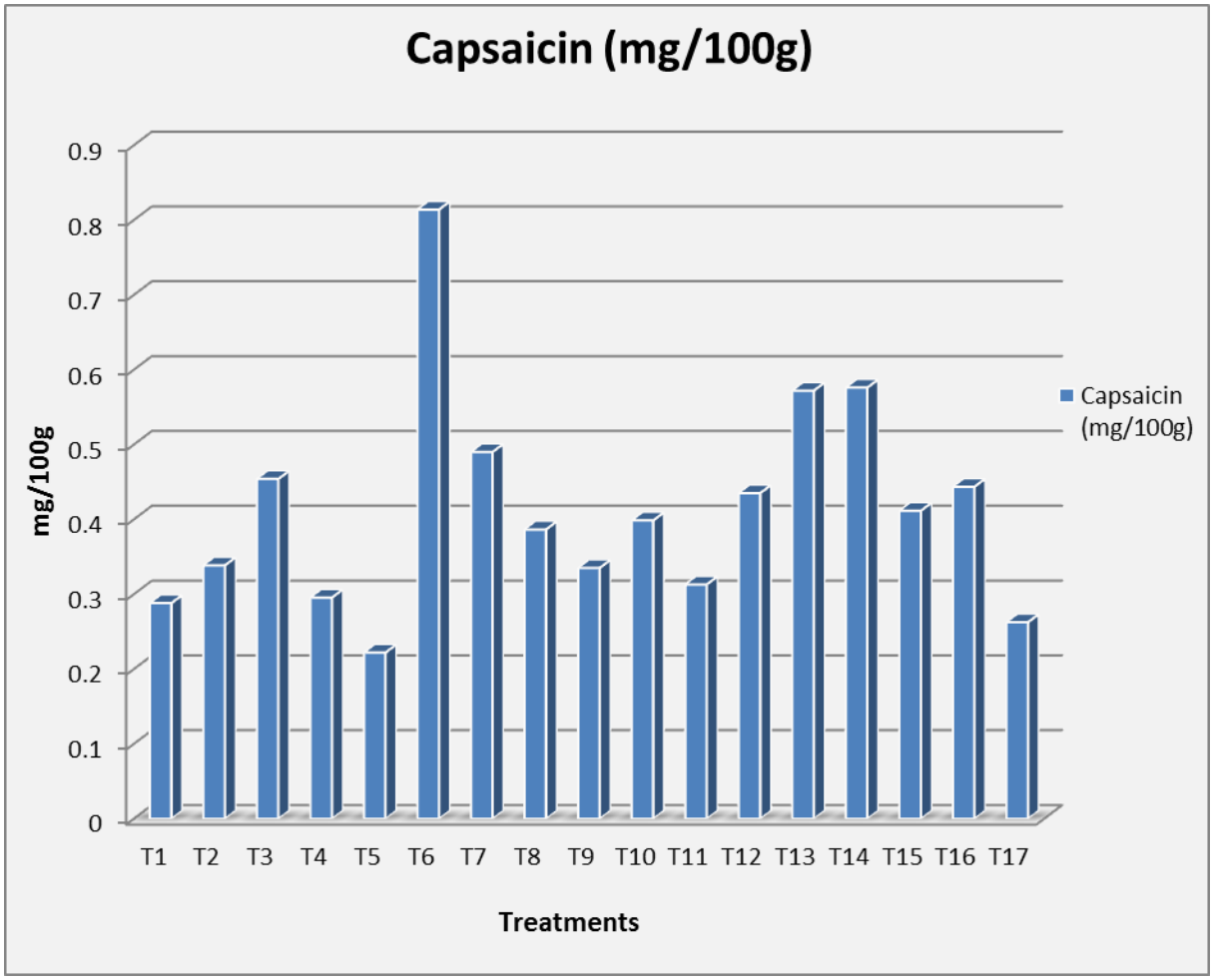
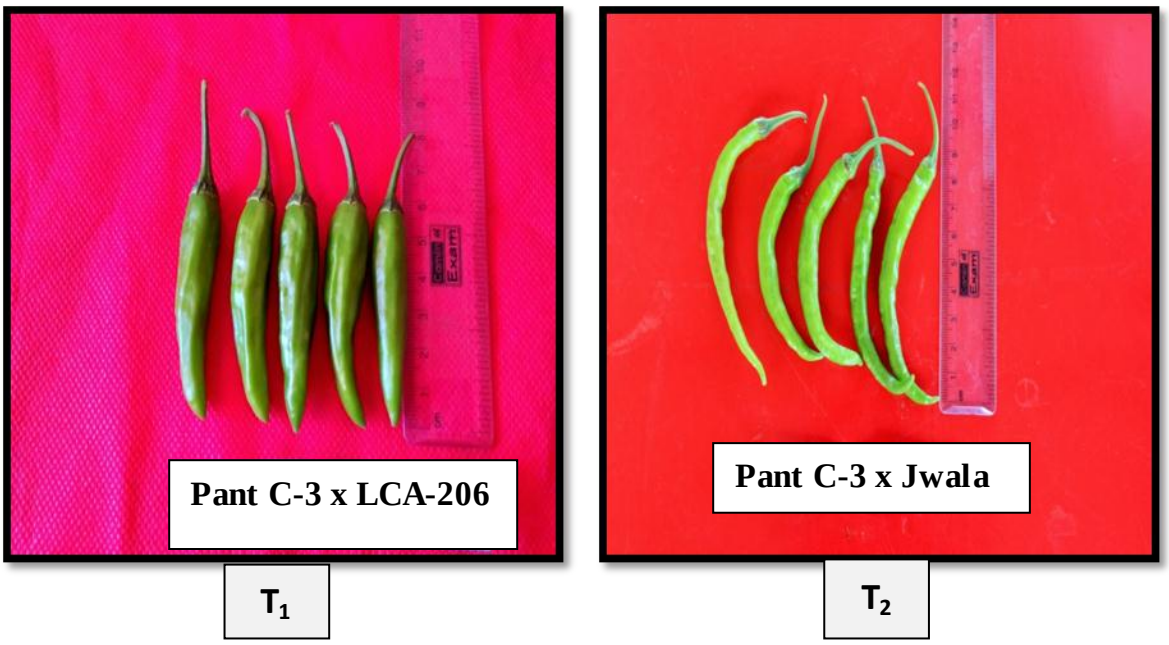


Fig. 4: Capsaicin content (mg/100g) in F_4 chilli progenies



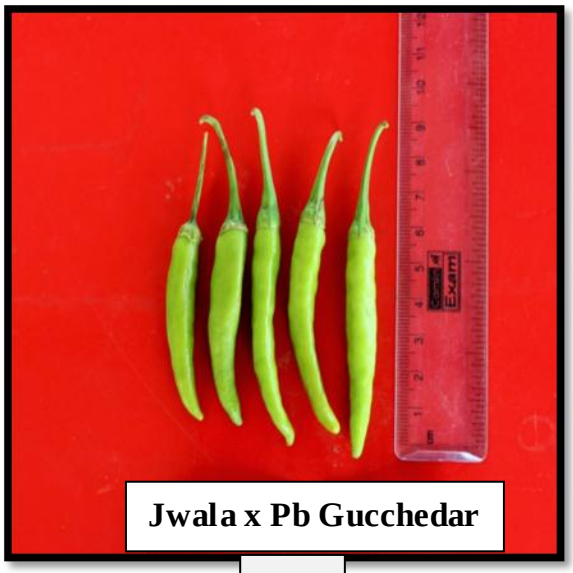
T_3

T_4

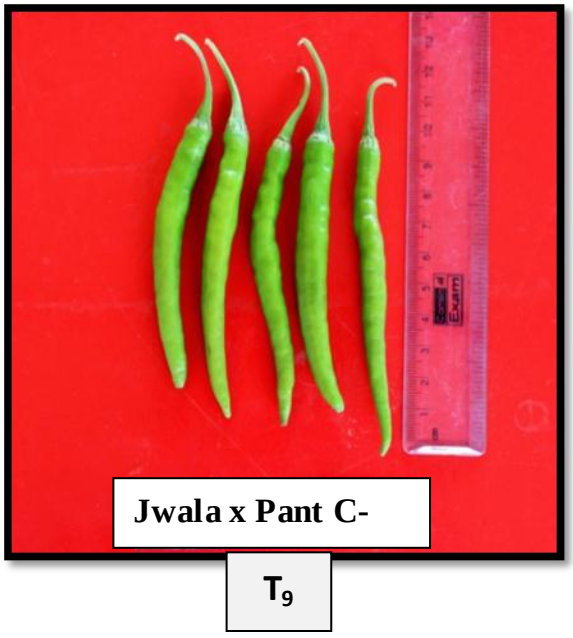
T_5

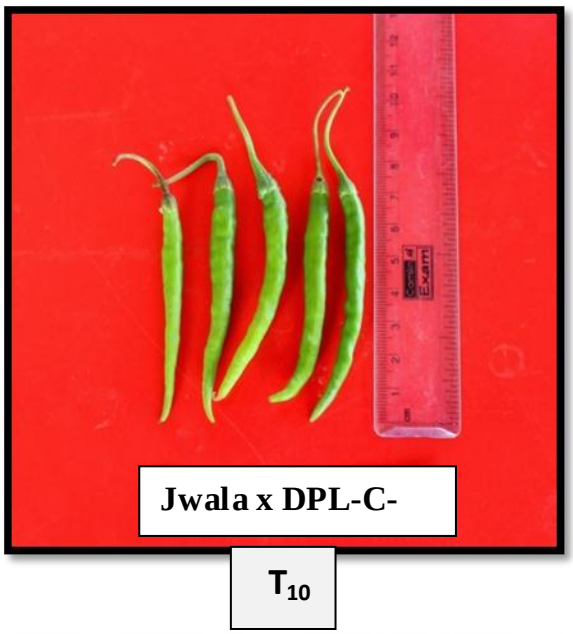
T_6

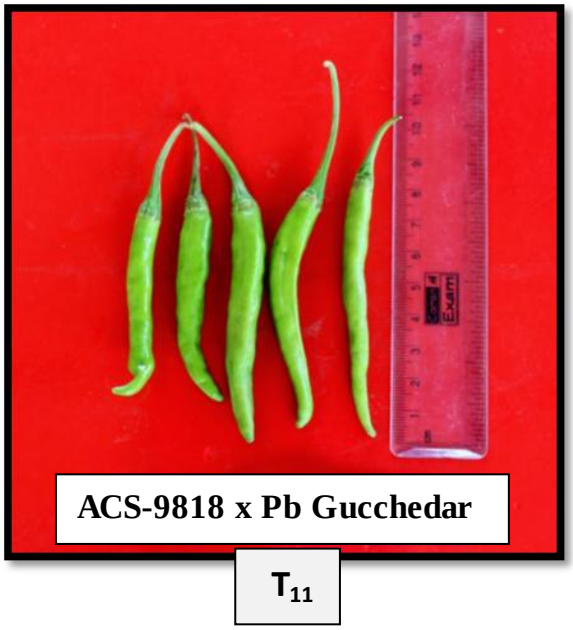
T_7

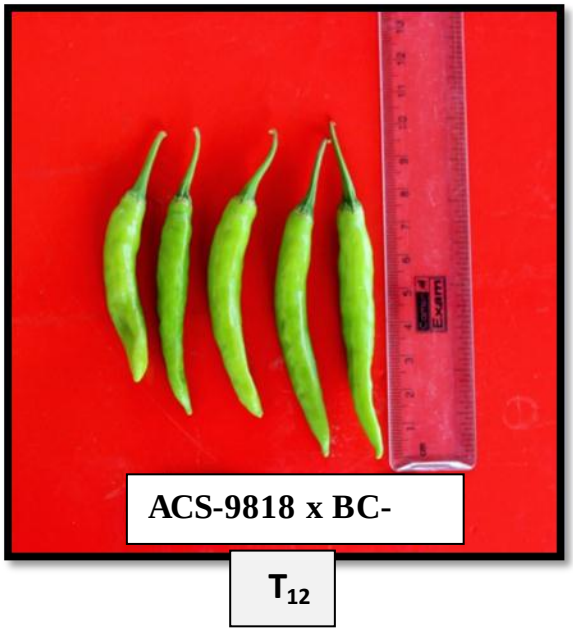


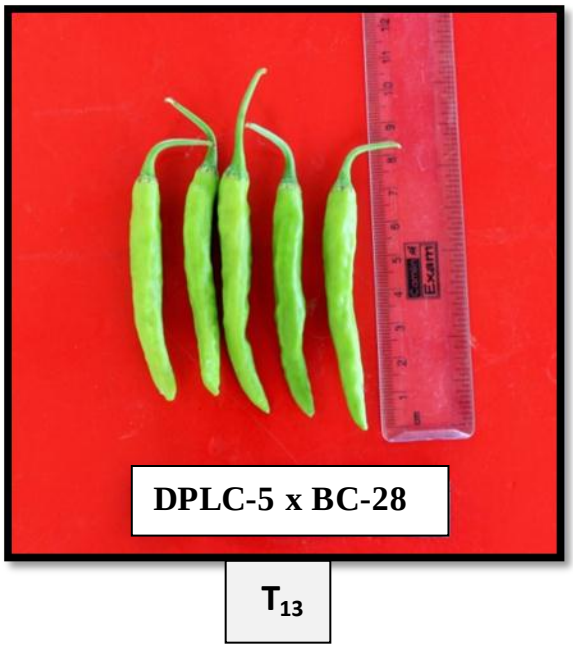
T_8

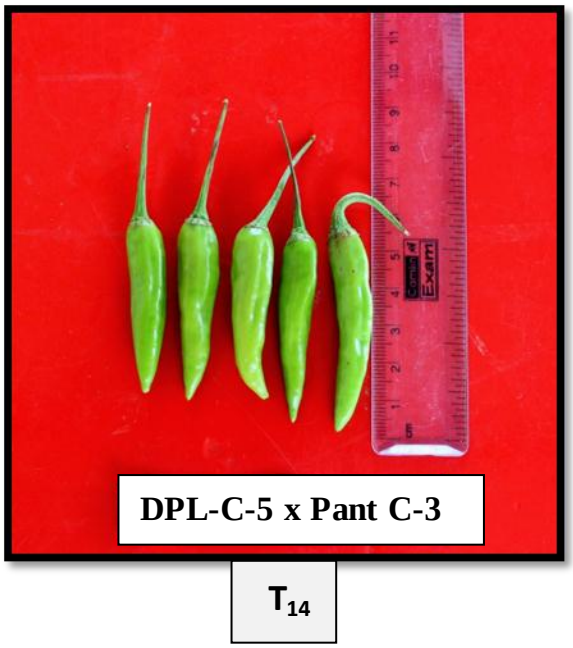

Jwala x Pant C-
T9

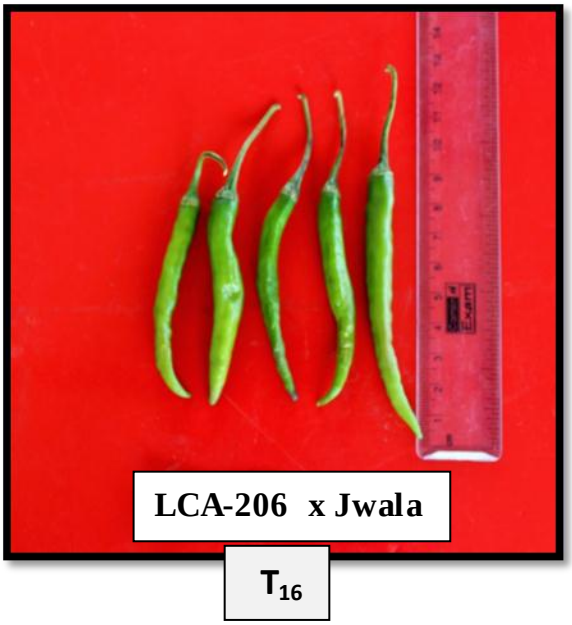

Jwala x DPL-C-
T10

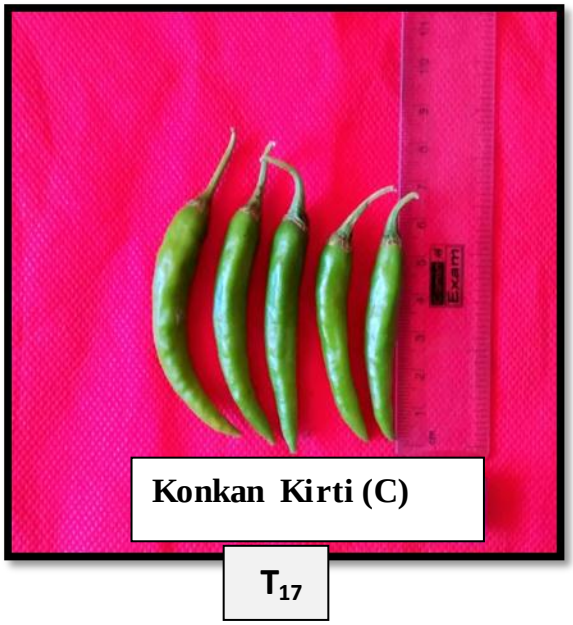

ACS-9818 x Pb Gucchedar
T11


ACS-9818 x BC-
T12


DPLC-5 x BC-28
T13


DPL-C-5 x Pant C-3
T14





CONCLUSION

The present study highlights significant variations in various physical and morphological characteristics within the F4 progenies of chilli, encompassing parameters such as fruit length, fruit diameter, number of seeds per fruit, as well as the colour and shape of the fruits. Furthermore, the capsaicin content was analyzed across all progenies. Notably, certain progenies, including Jwala x Pant C-3, DPLC-5 x BC-28, and Jwala x LCA-206, demonstrated promising outcomes in terms of physical attributes and capsaicin content, exceeding the overall average in the agro-climatic conditions of Konkan. As a result, these specific progenies merit prioritized attention for further exploration in the F5 generation.

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