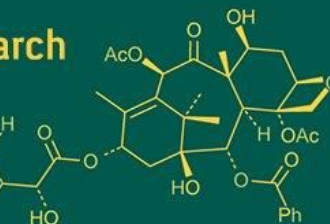


International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
ISSN Online: 2617-4707
IJABR 2024; SP-8(10): 662-665
www.biochemjournal.com
Received: 19-07-2024
Accepted: 25-08-2024

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Evaluation of newly bred industrially valued elite chilli (*Capsicum annuum* L.) genotypes for growth, yield and quality traits

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DOI: <https://doi.org/10.33545/26174693.2024.v8.i10Sh.2565>

Abstract

The present investigation in order to evaluate the performance of twenty elite genotypes of chilli (*Capsicum annuum* L.) for dry fruit yield and its component traits was carried out at Horticultural Research and Extension Centre, Haveri (Devihosur) during 2020-21 *kharif* season. The experiment with 20 genotypes was laid out in randomized complete block design with three replications. Analysis of variance revealed that the genotypes differed significantly for all the growth, yield and quality parameters. Among the genotypes studied, the stalk-less genotype NPC-5 was found superior with respect to days to first flowering (25.00), number of fruits per plant (76.45) and dry fruit yield (70.50 g), and followed by NPC-3 has performed better for plant height (85.96 cm), days to red fruit harvest (49.13) and dry yield per plant (74.46 g). The genotypes GPM 120 S1, Byadgi kaddi, Byadgi Dabbi, SRS-2, GCS 94/68 and DCA-161 were better performed for yield and yield attributing traits. The stalk-less genotypes NPC-1 (97,343.67 SHU), NPC-4 (75,065.85 SHU) and NPC-2 (69334.47 SHU) recorded significantly higher capsaisin content as compared to other genotypes including Byadgi Dabbi and Byadgi Kaddi.

Keywords: *Capsicum annuum*, Stalk-less, Capsaicin, Yield, NPC (Non-persistent calyx)

Introduction

The chilli (*Capsicum annuum* L.) is the most significant vegetable and spice crop. It is also called a hot pepper and belongs to the family *Solanaceae* of the genus *Capsicum*, with a chromosomal number of $2n = 24$. Chilli is a member of the *Solanaceae* family, belonging to the genus *Capsicum*, with chromosome number $2n=24$. It is native to South America and was first brought to India by Portuguese in 1584 from Brazil (Dhaliwal *et al.*, 2014) [9]. It is cultivated for a vegetable (green chilli), spice (dry chilli), condiment, sauce and pickle under tropical, sub-tropical and temperate climates (Chattopadya *et al.*, 2011) [5]. There are five domesticated species in genus *Capsicum* (*C. annuum*, *C. frutescens*, *C. chinense*, *C. pubescens* and *C. baccatum*), of which *Capsicum annuum* L. is the most widely cultivated species in the world for its various characteristics (Andrews, 1984) [1]. It is main constituent of many foods as it is adding flavour, colour, pungency, vitamin A and vitamin C. Simultaneously, it is also extensively used for the preparation of drugs against fever, cold, indigestion, constipation and as pain killer (Dagnoko *et al.*, 2013) [7].

Chilli is an important commercial crop, cultivated as a vegetable, spice and value-added product throughout India. Chilli has been acknowledged for extreme hotness or pungency due to presence of capsaicinoids in which predominant forms are capsaicin (8- methyl-N-vanillyl-6-enamide) and dihydrocapsaicin making upto 80-90 percent. The capsaicinoids have pharmaceutical applications namely, antioxidant, anti-obesity treatments, anti-arthritis, analgesic, antimicrobial and anticancer properties. Besides this, the colour exhibited in *Capsicum* is due to group of carotenoids of capsanthin, capsorubin, cryptoxanthine, zeaxanthine and others. The extracted colours of chilli are used in the food processing industries extensively to wide range of food products.

India is the world's largest producer, consumer and exporter of chillies, accounting for more than 36.57 percent of the world's total dry chilli production (Geetha *et al.*, 2017) [10]. In India cultivation spans over an area of 364(000') hectare, with a production of 3,720(000') tonnes

(Anon., 2019) [3]. Export of chilli and its derived products from India was about 484 (000') MT with value of Rs. 6,222 crores during the financial year 2020 and India share is about 38 percent of world production (Annon., 2020) [4]. In India, major chilli producing states are Andhra Pradesh, Telangana, Tamil Nadu, Karnataka and Madhya Pradesh. In Karnataka green chilli covers an area of 45.91(000') hectare with a production of 673.81(000') tonnes and whereas for dry chilli covers an area of 127.60 (000') hectare with a production of 260.14 thousand tonnes with an average productivity of 2.04 MT/ha (NHB-2018). In Karnataka, many chilli cultivars are grown in the various districts such as Dharwad, Gadag and Haveri since decades.

To meet the higher demand of chilli due to increased population, necessary efforts should be made in order to increase the production and productivity. Increased chilli growing area is one key to increase production but one should consider alternate solution for increasing productivity of the crop instead viz., cultivation of local adopted and high yielding cultivars. Although the crop is available throughout the year, the demand of chilli is further increasing with the expanding population. A wide range of variability reportedly exists in this crop with respect to growth and yield attributes. Therefore, the present study was aimed at comparison of different advanced elite chilli genotypes to screen for growth, yield and quality parameters.

Material and methods

The present experiment was conducted at Horticultural Research and Extension Centre, Devihosur, Haveri of University of Horticultural Sciences Bagalkot during *Kharif* season 2020-21. To evaluate the performance of twenty elite chilli genotypes including five stalk-less (non-persistence calyx) genotypes for various yield and yield attributing traits under field condition with three replications in randomized complete block design. The chilli seeds were planted during second week of May, 2020. The (UHSB POP, 2018) recommended dose of fertilizer i.e. nitrogen 100 Kg, phosphorus 50 Kg and potassium 50 Kg per hectare was applied. Half nitrogen was applied at the time of planting and remaining was applied in two splits i.e., at 30 and 60 DAP. Five plants were randomly selected per accession and observations recorded on different growth, yield and quality parameters. The study on analysis of variance and mean performance of genotypes was carried out for different growth and yield parameters.

Results and Discussion

Analysis of variance

Analysis of variance calculated for both quantitative and qualitative traits including vegetative, yield attributing traits and quality parameters of twenty chilli lines. For sixteen characteristics, the results a significant ($P=0.05$) difference between genotypes (Table 1). This suggested the presence of substantial amount of genetic variation among the genotypes that could be exploited in selection for desirable traits.

Per se performance of genotypes for yield and yield attributing traits

The yield mainly depends on traits like number of fruits per plant and weight of the fruit. The morphological features influence the contribution of these yield attributing

characters to yield. In the present study we considered both green fruit yield and dry fruit yield were considered.

Dry chilli fruit yield per plant was significantly higher in NPC-3 (74.46 g/plant) followed by NPC-5 (70.50 g/plant) and NPC-2 (68.61 g/plant) all are stalk-less (deciduous) varieties and these are on par with each other. These non-persistent genotypes showed better performance than Byadgi varieties and other improved lines with respect to dry chilli. Both number of fruits per plant and average fruit weight have supported for higher yield in NPC-3 as number of fruits per plant (75.97), average wet fruit weight (2.16 g) and Average dry fruit weight (0.87 g) were higher in this genotype. Similarly, the green chilli fruit yield per plant was significantly higher in GPM 120 S1 (944.82 g/plant) followed by Byadgi Kaddi (840.75 g/plant) and NPC-2 (713.67 g/plant). Both number of fruits per plant and average fruit weight have contributed for higher yield in GPM 120 S1 as number of fruits per plant (71.96), average wet fruit weight (3.54 g) and Average dry fruit weight (1.46 g) were comparatively higher in this genotype. Among the 20 genotypes, NPC-5 (76.45) recorded higher number of fruits per plant followed NPC-3 (75.97), Byadgi kaddi (75.36) and GCS 94/68 (75.35). The least number of fruits per plant was recorded in DCA-233 (19.86).

The average red fruit weight was higher (3.70 g/plant) in Byadgi Dabbi and next best were Byadgi Kaddi (3.63 g/plant) and GPM 120 S1 (3.54 g/plant). The lower average red fruit weight was observed in DCA-233 (0.90 g/plant). Similarly, the Average dry fruit weight recorded was significantly higher (2.27 g/plant) in DCA-161 as compared to the other all the remaining genotypes and followed best genotypes were recorded in GPM 120 S1 (1.46 g/plant) and Byadgi Kaddi (1.44 g/plant). The lowest Average dry fruit weight was observed in DCA-233 (0.30 g/plant). The fruit length was higher in SRS-2 (17.74 cm) followed by Byadgi kaddi (16.71 cm), and GPM 120 S1 (11.89 cm). These differences may be attributed to their genetic makeup and stalk length. The fruit width was higher in Byadgi Dabbi (2.11 cm) as compared to the other genotypes followed by genotype GPM 120 S1 (1.59). The fruit width ranged from 0.74 cm (NPC- 3) to 2.11 cm (Byadgi Dabbi) and average width was 1.17 cm.

The genotypes NPC-3 (85.96 cm) recorded significantly higher plant height followed NPC-1 (79.82 cm), NPC-5 (77.89 cm), and on par with SRS-2 (77.19 cm), GPM 120 S1 (75.89 cm), and Byadgi Kaddi (75.39 cm). The lower plant height was recorded in DCA-259 (47.71 cm). The 20 genotypes evaluated during maximum growth period GCS 94/68 (53.28 cm) recorded significantly higher plant spread followed by genotype Byadgi kaddi (48.69 cm), and NPC-5 (48.34 cm). Genotype NPC-2 (3.64) recorded significantly more number of primary branches per plant and which is on par with by NPC-3 (3.05). The lower number of primary branches was recorded in ST-03 (2.40) genotype per plant. Genotype NPC-2 (6.74) had higher number of secondary branches per plant followed by NPC-5 (6.57) and NPC-3 (5.90) genotypes. The lowest number of secondary branches per plant recorded in DCA-255 (3.27).

Genotype NPC-5 (25.00) has taken minimum number of days for first flowering (Table 2) followed by NPC-3 (26.33) compared to other genotypes. The genotype DCA - 233 (34.00) has taken maximum number of days for first flowering and with respect to days to first flowering, genotype NPC-3 took lowest number of days (49.13)

followed by NPC-1 (50.38) and NPC-5(50.45). The genotype, DCA-88 (62.52) took a greater number of days to attain days to fruit harvest compared to other genotypes. The genotypes had seen higher yield as a result of increased number of fruits per plant, average fruit weight, or both, as evidenced by a positive relationship between these attributes. Genetic makeup is linked to variety yielding potential because yield is a complex attribute regulated by polygenes. The genetic makeup of the crop and the influence of environmental factors are the main causes of variation in plant height. The highest plant height (85.96 cm in NPC-3), spread of plant (53.28 cm in GCS 94/68) and number of primary branches and secondary branches might have resulted in better canopy size. The canopy size determines the site of ontogeny of flower. Further, it also determines quantum of photo assimilates produced by interception of solar energy. The parameters like days to first flowering, days to fruit harvest, are the indicators of earliness. In this investigation, the high yielding genotypes namely NPC- 3 and NPC-5 were comparatively early, indicated by significantly negative correlation with yield. This result shows that high yielding early genotypes are efficient utilizers of photosynthates by translocating higher photosynthates to sink over longer picking period. Among the genotypes the existence of such variations in all these characters has been reported by Srinivas *et al.* (2017) [16], Kerketta *et al.* (2017) [14], Chowdary *et al.* (2015) [6], Chattopadhyay *et al.* (2011) [5], Datta *et al.* (2016) [8] and Jaisankar *et al.* (2015) [12] in chilli.

Per se performance of genotypes for quality traits

The genotype NPC -1 had higher capsaicin content (97,343.67 SHU) followed by NPC-4 (75,065.85 SHU) and NPC-2 (69334.47 SHU). The lower capsaicin content was observed in Byadgi Dabbi (4311.02 SHU). The difference in capsaicin content is might be due to variation in genotype and influence of change in environmental fluctuations. The differences in capsaicin compound present in seed and placenta of the fruit also leads to variation in the capsaicin content. Byadgi Dabbi (17.32 percent) recorded highest oleoresin content and followed by NPC -5 (15.90 percent) and GPM 120 S1 (14.88 percent). Lowest oleoresin content is observed in NPC-1 (7.63 percent). The genotype GPM 120 S1 recorded higher colour count (196.40) and followed by Byadgi Dabbi (188.90) and Byadgi kaddi (182.90). The lowest colour count observed in DCA -259 (75.80). The differences in colour count observed because of variation in capsanthin compound present in fruit by environmental conditions and cultural practices. Similar results were reported by Jyothi *et al.* (2008) [13], Srinivas *et al.* (2017) [16], Datta *et al.* (2016) [8], Jaisankar *et al.* (2015) [12] and Maurya *et al.* (2017) [15] in chilli.

Twenty genotypes, analyzed for capsaicin content in dry red chilli were grouped based on SHU. Among 5 stalk-less genotypes, the genotypes NPC-2 and NPC-4 were grouped as highly pungent types and NPC-1 included in very high pungent type. The genotypes NPC-3 and NPC-5 were included in moderate pungent group with all other varieties. (Table 3).

Table 1: Analysis of variance (mean sum of squares) for growth, yield and quality parameters in chilli genotypes

Particulars	Parameters	Replication	Treatments	Error	Sem	CD	
						1%	5%
Growth parameters	Plant height (cm)	46.13	9159.57**	1279.57	3.35	12.85	9.56
	Plant spread (cm)	64.58	2388.45**	486.75	2.07	7.93	5.92
	Number of primary branches	0.07	12.77**	1.84	0.13	0.49	0.37
	Number of secondary branches	0.27	46.83**	7.06	0.25	0.95	0.71
Yield parameters	Days to first flowering	9.28	297.11**	324.09	1.69	5.18	4.83
	Days to red fruit harvest	1.58	1065.62**	1080.60	3.08	9.47	8.84
	Number of fruits per plant	32.07	25510.74**	611.64	2.32	8.82	6.63
	Fruit length (cm)	0.91	801.57**	27.86	0.49	1.90	1.41
	Fruit width (cm)	0.05	5.67**	0.53	0.07	0.26	0.19
	Average red fruit weight (g)	0.21	31.15**	2.50	0.15	0.59	0.43
	Average dry fruit weight (g)	0.05	14.52**	0.41	0.06	0.23	0.17
	Green fruit yield / Plant (g)	167.62	1734748.90**	86416.9	27.53	105.80	78.83
Quality parameters	Dry fruit yield / Plant (g)	83.90	8082.09**	884.23	2.79	10.68	7.98
	Capsaicin (SHU)	1019730.17	39759270374.22**	14060451.33	351.19	1346.73	1005.44
	Oleoresin (%)	0.14	390.31**	4.09	0.19	0.73	0.54
	Colour value (ASTA)	26.54	65781.73**	442.49	1.97	7.55	5.64

Table 2: Per se performance for growth, yield and quality parameters in twenty elite chilli genotypes

Genotypes	PH	PS	NPB	NSB	DFP	DRFH	NFP	FL	FW	ARFW	ADFW	GYP	DYP	CC	OC	CV
NPC-1	79.82	39.81	2.43	4.72	28.00	50.38	39.82	10.64	1.10	2.53	1.19	685.45	63.95	97343.67	7.63	94.73
NPC-2	57.85	42.22	3.64	6.74	27.50	56.83	48.88	9.91	0.86	2.42	1.66	713.67	68.61	69334.47	9.95	98.02
NPC-3	85.96	39.04	3.05	5.90	26.33	49.54	75.97	10.94	0.74	2.16	0.87	647.46	74.46	21607.68	10.49	144.91
NPC-4	74.78	33.65	2.93	5.74	28.73	60.07	66.51	7.95	0.85	2.13	1.33	658.60	53.69	75065.85	13.74	103.94
NPC-5	77.89	48.34	2.97	6.57	25.00	50.45	76.45	9.65	1.07	2.26	0.90	686.09	70.50	14908.48	15.90	87.51
Byadgi Kaddi	75.39	48.69	2.34	5.17	27.00	56.30	75.36	16.71	0.85	3.63	1.44	840.75	54.29	6286.39	14.50	182.90
GPM-120-S-1	75.89	42.92	2.45	4.76	27.50	56.76	71.96	11.89	1.59	3.54	1.46	944.82	52.51	6710.74	14.88	196.41
GCS 94/68	65.94	53.28	2.34	4.97	30.00	59.71	75.35	10.69	0.94	2.27	0.66	540.48	48.63	11514.83	10.47	156.92
SRS-2	77.19	40.33	2.52	5.47	29.00	57.01	44.63	17.74	1.03	2.27	0.64	605.48	50.70	11138.42	9.15	140.25
Byadgi Dabbi	68.75	37.20	2.35	4.96	31.00	50.47	32.49	10.39	2.11	3.70	1.61	544.31	51.64	4311.02	17.32	188.90
DCA-82	53.74	32.92	2.24	4.43	31.50	60.5	26.63	6.94	1.02	2.26	0.63	442.99	48.95	6900.73	10.78	146.01
DCA-88	56.82	35.54	2.15	4.42	30.50	62.52	24.80	8.63	1.35	2.33	0.67	469.29	44.46	6356.40	12.41	136.07
DCA-161	61.37	43.85	2.15	4.43	29.50	57.16	25.81	10.85	1.44	3.35	2.27	629.47	53.88	12845.30	10.68	126.03

DCA-216	53.76	41.79	1.85	3.43	31.00	50.55	27.84	8.52	1.27	1.88	0.66	361.59	39.92	11468.41	14.18	115.59
DCA-233	48.52	28.50	2.05	4.59	34.00	61.55	19.86	3.65	1.09	0.90	0.30	362.72	37.93	21658.67	9.13	127.21
DCA-234	48.79	28.33	2.15	4.45	32.00	54.99	20.44	3.75	1.19	0.97	0.35	328.66	36.34	22656.82	9.26	121.06
DCA-255	48.67	35.33	1.65	3.27	29.00	60.52	34.41	5.59	1.24	2.42	0.85	322.40	39.42	12242.60	11.74	115.51
DCA-259	47.71	36.39	2.15	4.87	31.00	57.51	29.69	4.78	0.96	2.28	0.76	376.82	35.73	4568.18	14.22	75.80
DCA-279	48.43	37.31	2.03	4.31	31.00	60.94	32.33	5.75	1.40	2.26	0.58	434.14	38.83	8692.47	13.01	106.35
DCA-295	58.55	34.15	1.85	3.80	32.50	61.12	32.76	6.69	1.25	2.04	0.73	446.52	36.94	7644.61	10.28	95.09
Mean	63.29	38.98	2.36	4.85	29.63	56.74	44.07	9.08	1.17	2.38	0.98	552.08	50.07	21662.78	11.98	127.96
S. E±m	3.35	2.07	0.13	0.25	1.69	3.08	2.32	0.49	0.07	0.15	0.05	27.53	2.79	351.19	0.19	1.97
CD (0.05)	9.59	5.92	0.36	0.71	4.83	8.81	6.63	1.42	0.19	0.42	0.17	78.82	9.97	1005.44	0.54	5.64
CV	9.17	9.18	9.31	8.89	9.86	9.40	9.11	9.43	10.10	10.78	10.70	8.64	9.63	2.81	2.74	2.67

PH - Plant height (cm) PS - Plant spread (cm) NPB - Number of primary branches NSB - Number of secondary branches

DFH- Days to first flowering DRFH- Days to red fruit harvest NFP- Number of fruits per plant FL - Fruit length (cm)

FW- Fruit width (cm) ARFW- Avg. red fruit weight (g) ADFW - Avg. dry fruit weight (g) GYP- Green chilli yield per plant (g)

DYP - Dry chilli yield per plant (g) CC - Capsaicin content (SHU) OC- Oleoresin content (%) CV - Colour value (ASTA)

Table 3: Grouping of chilli genotypes based on SHU (Scoville Heat Units)

Pungency range (SHU)	Genotypes
Non-pungent (0-700 SHU)	-
Mildly pungent (700-3,000 SHU)	-
Moderately pungent (3,000-25,000 SHU)	NPC-3, NPC-5, Byadgi Kaddi, Byadgi Dabbi, GPM 120 S ₁ , GCS 94/68, SRS -2, DCA-82, DCA-88, DCA-161, DCA-216, DCA-233, DCA-234, DCA-255, DCA-259, DCA-279, DCA- 295
Highly pungent (25,000-70,000 SHU)	NPC -2 and NPC -4
Very highly pungent (80,000 SHU)	NPC-1

Conclusion

Among the 20 genotypes evaluated, NPC-3 and NPC-5 recorded significantly higher plant height, minimum number of days for first flowering, minimum number with respect to days to fruit harvest, number of fruits per plant and dry fruit yield as compared to the other genotypes. The stalk-less (NPC genotypes) genotypes were recorded highest pungency values compare to other advanced lines. The current study discovered that the germplasm has a lot of genetic diversity in terms of colour and pungency. Byadgi Dabbi and Byadgi Kaddi genotypes had high colour and low pungency, and could be used to breed high yielding varieties with extractable colour. The present of high variation among these elite lines for growth, earliness, yield and quality parameters will leads to good selection criteria for development of new high yielding chilli hybrids.

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