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Comparative performance of F_4 progenies of chilli for growth, yield, and yield attributing characteristics

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Abstract
This study aimed to assess the comparative performance of F_4 progenies of chilli in terms of growth, yield, and yield attributing characteristics. Chilli, also known as hot pepper, is an economically important vegetable crop in India. However, there is a lack of knowledge on the selection and evaluation of suitable chilli types in the Marathwada region of Maharashtra. The study was conducted during the *Kharif* season of 2021-22 at the experimental farms of the Horticulture Research Scheme in Parbhani. Thirteen F_4 progenies and three standard checks were used as experimental materials. Various yield parameters such as days to first harvest, days to last harvest, harvesting duration, number of pickings, average weight of fruit, number of fruits per plant, fruit yield per plant, and fruit yield per hectare were evaluated. The results showed significant variation among the progenies for these parameters. Five F_4 progenies (PBNC-15, PBNC-16, PBNC-17, PBNC-19, and PBNC-20) demonstrated superior yield characteristics, particularly in terms of green fruit yield per hectare. PBNC-16 exhibited the highest green fruit yield, followed by PBNC-15 and PBNC-17. These progenies could be recommended for direct sowing or further breeding programs aimed at enhancing chili productivity. The findings contribute to the understanding of chilli performance and can help in the selection and cultivation of suitable chilli varieties.

Keywords: Chilli, growth, progenies, yield, performance

Introduction
The *Capsicum annuum* var. *annuum* L., commonly known as chilli or hot pepper, holds significant economic and agricultural prominence in India, serving as a widely cultivated vegetable crop. Its utilization encompasses both the consumption of green fruits as a vegetable and the red variant as a spice. Belonging to the Solanaceae family, the origin of chilli can be traced back to New Mexico, Guatemala, and Bulgaria in Latin America (Robinson, 2017). It is extensively cultivated in various tropical regions, with India, Mexico, Japan, Ethiopia, Uganda, Nigeria, Thailand, Turkey, Indonesia, China, and Pakistan being key contributors. Additionally, Italy, Spain, and the United States engage in limited cultivation.
Vegetables, including chillies, constitute a vital component of daily dietary intake due to their rich content of vitamins, minerals, proteins, fats, carbohydrates, and organic acids, all at a relatively modest cost. Furthermore, vegetables are recognized as "protecting foods" owing to their ability to safeguard against various deficiency disorders. In the context of Maharashtra, diverse chilli varieties with distinct characteristics are prevalent. However, the existing knowledge base on the systematic selection and evaluation of suitable chilli types is insufficient and warrants further research efforts for yield improvement (Samindre *et al*., 2022) [7]. Consequently, there is a critical need to assess chilli types in the Marathwada region for superior quality, yield, growth performance, and resilience to biotic and abiotic stress. Considering this, the present study aims to investigate the comparative performance of F_4 progenies of chilli, specifically focusing on growth, yield, and yield attributing characteristics.

Materials and Methods
The field experiment was conducted at the experimental farms of the Horticulture Research Scheme (Vegetable), College of Agriculture, Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani, during the Kharif season of 2021-22. The experimental materials consisted of thirteen F_4 progenies and three standard checks sourced from the Horticulture Research Scheme (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The experiment was arranged in a Randomized Block Design, incorporating 13 F_4 progenies and 3 standard checks with two replications.

Each F_4 progeny was treated as an individual treatment and randomly replicated. Planting was carried out in five rows, each containing eight plants, with a spacing of 60 cm x 45 cm. Uniform seedlings, 40 days old and with an average height of 15 cm, were selected and immersed in a solution prepared by combining 10 ml of Trichoderma and 25 g of Carbendazim in 10 litters of water to mitigate the risk of pests and diseases. Chilli seedlings were transplanted with a spacing of 60 x 45 cm. A random sampling technique was employed, selecting five plants from each treatment in all replications for a comprehensive investigation into yield and yield attributing characters.

Various yield parameters, including days to first harvest, days to last harvest, harvesting duration, number of pickings, average weight of fruit (g), number of fruits per plant, fruit yield per plant (g), and fruit yield per hectare (q), were evaluated. The mean values for all considered traits were utilized for subsequent statistical analysis. The statistical analysis employed standard methods described by Panse and Sukhatme (1985) [6]. Standard errors (S.E.) of means were calculated, and critical differences (CD) at a 5% significance level were determined when the results exhibited significance. Individual plant characters data were subjected to the method of analysis of variance commonly applicable to the randomized block design.

Result and Discussion

Increasing the number of green fruits produced per plant was one of the program's main goals for crop improvement. Studying yield parameters is therefore very important. In the current investigation, a variety of yield and yield-attributing characters were examined and are shown in Table 1. The number of days needed to begin the first harvesting of chilli progenies varied non-significantly, with a general mean of 71.31 days and a range of 68.33 days to 74.31 days. Progeny PBNC-19 had the lowest minimum number of days needed to begin first harvesting (68.38 days), which was noticeably better than all other progenies. However, progeny PBNC-16 recorded the maximum number of days (79.52) needed to begin first harvesting. Days to first harvest was a significant yield-attributing factor from the perspective of commercial cultivation. Farmers start getting income as and when the harvesting is started. Therefore, early harvesting is beneficial to the farmers as it gives early returns. The variation in chilli progenies for days to first harvest was noticed by Barche and Nair (2013) [1] and Datta and Jana (2014) [2] in their studies in chilli genotypes.

It was observed from the data in Table 1 and the graphic representation in Fig. 8 that there was no significant variation in the days to the last harvest. The range of days to the last harvest was 121.10 to 130.21 days, with a mean of 125.64 days overall. The progeny PBNCBSS-273 observed the lowest days (121.10) since the previous harvest. The progeny PBNC-10 (127.63) and PBNC-16 (130.21) exhibited the highest number of days until their last harvest. The Marathwada region's low environmental impact and highly genetic progenies' characteristics account for the variation in the days until the last harvest amongst progenies. These differences in the outcomes concur with the conclusions drawn by Shiva *et al*. (2013) [9] and Sharma *et al*. (2010) [8]. According to the data in Table 1, there was no significant variation in the harvest duration, which ranged from 50.69 days to 57.90 days with an average of 54.33 days. Progeny PBNC-16 was found to have the shortest harvest duration (50.69) days, while progeny PBNC-13 had the longest harvest duration (57.90) days. The starting flowering, 50% flowering, number of fruits per plant, somewhat genetic characteristics of progenies, and minimal influence of environmental factors were the reasons for the variation in the harvesting duration. Modak (1989) [4] and Sharma *et al*. reported similar variations concerning harvesting duration (2009).

Based on the information presented in Table 1, there was no discernible difference in the average harvest duration of 54.33 days, ranging from 50.69 days to 57.90 days. It was discovered that progeny PBNC-13 had the longest harvest duration (57.90 days), while progeny PBNC-16 had the shortest (50.69) days. The factors that caused the variation in the harvesting duration were the beginning of flowering, 50% flowering, number of fruits per plant, somewhat genetic characteristics of progenies, and minimal influence of environmental factors. Similar variations regarding the duration of harvesting were reported by Modak (1989) [4] and Sharma *et al*. (2009). Data presented in Table 1 observed that average fruit weight was also non significantly varies and it was ranged between from 4.66 g to 10.17 g, ranged to mean 6.44 g. The heaviest fruit weight (10.17 g) was observed in progeny PBNC-16 which was significantly superior over all progenies. The lightest fruit weight (4.66 g) was observed in progeny PBNC-19. The variation in fruit weight probably due to the difference in accumulation of photosynthates which were transported from source (leaves) to sink (fruits) as opined by Tesfaw *et al.*, (2013) [12].

One of the key factors influencing yield is the quantity of fruits. The selection process needs to be strengthened for the promising lines that the current investigation found. The information displayed in Table 1 showed that the average number of fruits produced by a plant ranged from 139.00 to 462.00, with a mean of 275.10. The progeny PBNC-16 had the highest number of fruits per plant (462.00), which was comparable to the progeny PBNC-15 (442.50) and PBNC-17 (412.50). Conversely, progeny PBNC-11 had the fewest fruits (139.00). The primary cause of this could be the plant's genetic composition. These findings concur with those of Mohanty (2003), who also noted that the X-235 genotype of chilli produced the greatest number of fruits per plant (233.97). The findings are corroborated by the outcomes of Amit *et al*. (2014) and Jyothi *et al*. (2011). The fruit yield per plant showed a significant difference, according to the data in Table 1. The highest fruit yield per plant was recorded by progeny PBNC-16 (1903.38 g), which was comparable to progeny PBNC-15 (1901.93 g) and PBNC-17 (1844.92 g). Conversely, the PBNC-19 progeny produced the least amount of fruit per plant (1011.23 g). Fruit production per plant is a crucial factor to take into account when choosing chili progenies. The ability of the progenies to perform well under various environmental conditions may be linked to the potential fruit yield and this might be due to the inherent genetic nature of the hybrid and also due to more number of fruits per plant, higher fruit weight in addition to comparatively more number of primary and secondary branches. This is in harmony with the results of Herison, *et al.* (2014) [3] and Zhani *et al.* (2015) [13] where they also opined that the highest yield was due to highest number of fruits per plant.

Fruit yield per hectare ranged from 288.66 q to 923.75 q, with an overall mean of 523.37 q, according to data shown in

Table 1. PBNC-15 (923.75 q) had the highest fruit yield per hectare, followed by PBNC-16 (910.65 q) and PBNC-17 (889.00). However, PBNC-19 (288.66 q) produced the lowest fruit yield per hectare, followed by PBNC-18 (330.20 q) progeny. The number of fruits per plant, fruit weight, and fruit length all had a direct positive correlation with yield, as reported by Sharma *et al*. (2010) [8]. Tembhurne *et al*. (2008) [11] also reported that indirect effects on yield, number of branches per plant, and plant spread could account for variation in the fruit yield per hectare.

Table 1: Harvesting parameters, Fruit parameters, Yield parameters in different chilli progenies.

Genotypes	Days to start first harvesting	Days to last harvesting	Fruit Length (cm)	Fruit Diameter (mm)	Harvesting duration	No. of fruit per plant
PBNC-6	73.68	126.45	9.95	9.26	52.77	255
PBNC-7	73.74	126.7	11.84	8.68	52.96	222.5
PBNC-10	74.31	127.63	10.93	10.68	53.32	157.5
PBNC-11	69.45	125.36	9.89	7.9	55.91	139
PBNC-13	69.54	127.44	10.63	10.84	57.9	346
PBNC-14	71.72	125.23	12.09	9.89	53.51	263
PBNC-15	73.38	126.39	9.93	8.88	53.01	442.5
PBNC-16	79.52	130.21	9.93	10.78	50.69	462
PBNC-17	71.52	123.44	8.84	8.24	51.92	412.5
PBNC-18	68.59	125.34	9.33	9.3	56.75	153.5
PBNC-19	68.38	126.73	9.06	9.94	58.35	124.5
PBNC-20	69.33	123.44	8.7	11.85	54.11	231.5
BSS 273	68.4	121.1	10.71	9.93	52.7	374
BSS 355	69.66	124.5	9.9	10.31	54.84	393
BSS-378	68.44	124.71	9.63	10.89	56.27	350
Mean	71.31	125.64	10.09	9.82	54.33	275.1
Range	68.33-74.31	121.10-130.21	8.70-12.09	7.90-11.85	50.69-57.90	139.00-462.00
Result	NON-SIG	NON-SIG	NON-SIG	NON-SIG	-	SIG
SE(m)	0.37	0.21	0.23	0.17	-	22.32
CD	1.14	0.64	0.7	0.53	-	68.08

Genotypes	Average weight of fruit	No. of pickings per	Green fruit yield per plant (g)	Green fruit yield per plot (kg)	Green fruit yield per ha (kg)
PBNC-6	4.88	5.19	1155.01	23.36	373.2
PBNC-7	5.72	5.23	1303.02	22.36	349.1
PBNC-10	4.68	4.9	1284.66	22.47	345.25
PBNC-11	4.8	4.62	1411.02	28.59	452.8
PBNC-13	6.69	4.84	1564.82	32.4	492.75
PBNC-14	7.78	4.69	1638.31	32.65	485.75
PBNC-15	7.82	5.99	1901.93	38.1	923.75
PBNC-16	10.17	7.95	1903.38	39.29	910.65
PBNC-17	6.95	5.38	1844.92	37.23	889
PBNC-18	5.01	4.82	1051.16	21.24	330.2
PBNC-19	4.66	3.91	1011.23	20	288.66
PBNC-20	6.69	6.35	1303.4	25.62	477.95
BSS 273	7.07	6.01	1663.28	35.77	516.2
BSS 355	6.97	5.24	1739.1	34.71	518.65
BSS-378	6.75	5.04	1633.05	34.89	496.75
Mean	6.44	5.34	1493.88	29.91	523.37
Range	4.66-10.17	3.91-7.95	1011.23- 1903.38	20.00-39.29	288.66-923.75
Result	NON-SIG	SIG	SIG	SIG	SIG
SE(m)	0.15	0.39	35.49	1.24	20.26
CD	0.47	1.19	108.7	3.82	62.06

Conclusion

Although chili peppers are known to be a more resource-intensive crop, their overall yield is comparatively lower. To enhance productivity, the implementation of high-yielding F_4 hybrids with superior genetic traits represents a crucial initial step. In an endeavor to identify optimal chili F_4 progenies for cultivation in the Maharashtra region, a comprehensive study was conducted to evaluate these progenies based on growth and yield parameters. Among the thirteen F_4 progenies and three checked progenies scrutinized, five F_4 progenies—PBNC-15, PBNC-16, and PBNC-17—demonstrated green fruit yields exceeding 600 q/ha, outperforming other F_4 progenies. PBNC-16 exhibited the highest green fruit yield at 923.75 q/ha, followed by PBNC-15 (910.65 q/ha) and PBNC-17 (889 q/ha). These identified progenies, notably PBNC-15, PBNC-16, and PBNC-17, exhibiting superior yield characteristics, may be recommended for direct sowing or considered for incorporation into subsequent breeding programs aimed at further enhancing chili productivity.

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