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Evaluation of F_1 hybrids in chilli for vegetative and yield characters

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Abstract
The experimental material for the study comprise thirty F_1 hybrids, three standard checks and thirteen parents which are collected from Horticulture Research Scheme, (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. Among the thirty F_1 hybrids evaluated in comparision to parents and checks, the hybrids P_2 X P_5, P_1 X P_8, P_1 X P_{13}, P_2 X P_{13} and P_2 X P_9 showed significantly higher yield.

Keywords: Chilli, hybrid, vegetative, yield, fruit length

1. Introduction
Chilli (*Capsicum annuum* L.) is one of the most important vegetable cum spice crops belonging to the family Solanaceae. Chilli has attained a status of high value crop in India and occupies a unique place among vegetables in Indian cuisine because of its delicate taste and pleasant flavor coupled with rich content of ascorbic acid and other vitamins and minerals. Different varieties are grown for vegetables, spices, condiments, sauces and pickles. Chilli is a branched herbaceous annuals or perennials. The single flowers are off-white colour. The fruit are berries that may be green, yellow, orange or red when ripe. Chillies are rich source of Vitamin A, C and E. Chillies are in different sizes, shapes and colours and have two important qualities, the presence of biting pungency attributed to an alkaloid capsaicin and captivating red colour due to a pigment capsanthin. The oleoresins of chilli are used by food industries, in the preparation of processed products and also for incorporation into a number of pharmaceutical formulations (Rohini and Lakshmanan, 2017) [11]. The main goal of most of the plant breeding programme is to increase the yielding ability of crop plants.

2. Material and Methods
A field experiment was conducted to "Evaluation of F_1 hybrids in chilli for Vegetative and Yield characters" in Horticulture Research Scheme (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani with an objective to find out the most desirable F_1s in chilli. The field experiment was laid out in randomized block design with two replications and thirty F_1 hybrids, thirteen parents and three standard checks which are collected from Horticulture Research Scheme, (Vegetable), Vasantrao Naik Marathwada Krishi Vidyapeeth, Parbhani. The treatments consisted of T_1- P_1 X P_4, T_2- P_1 X P_5, T_3- P_1 X P_6, T_4- P_1 X P_7, T_5- P_1 X P_8, T_6- P_1 X P_9, T_7- P_1 X P_{10}, T_8- P_1 X P_{11}, T_9- P_1 X P_{12}, T_{10}- P_1 X P_{13}, T_{11}- P_2 X P_4, T_{12}- P_2 X P_5, T_{13}- P_2 X P_6, T_{14}- P_2 X P_7, T_{15}- P_2 X P_8, T_{16}- P_2 X P_9, T_{17}- P_2 X P_{10}, T_{18}- P_2 X P_{11}, T_{19}- P_2 X P_{12}, T_{20}- P_2 X P_{13}, T_{21}- P_3 X P_4, T_{22}- P_3 X P_5, T_{23}- P_3 X P_6, T_{24}- P_3 X P_7, T_{25}- P_3 X P_8, T_{26}- P_3 X P_9, T_{27}- P_3 X P_{10}, T_{28}- P_3 X P_{11}, T_{29}- P_3 X P_{12}, T_{30}- P_3 X P_{13}, T_{31}- PBNC-6, T_{32}- PBNC-26, T_{33}- PBNC-17, T_{34}- Parbhani Tejas, T_{35}- PBNC-1, T_{36}- Kokan Kirti, T_{37}- Phule Jyoti, T_{38}- G-4, T_{39}- Byadgi, T_{40}- Byadgi-341, T_{41}- Teja, T_{42}- Pusa Jawala, T_{43}- Pusa Sadabahar, T_{44}- BSS 378 (C_1), T_{45}- BSS 273 (C_2) and T_{46}- BSS 273 (C_3). Each treatment was planted at a plant spacing of 60 cm x 45cm.The recommended cultural practices, raising of seedling, seed treatment, transplanting, weeding, fertilizer, irrigation and plant protection were done. The observations on vegetative growth and yield attributes were recorded from randomized selected five plants in each treatment. The results obtained along with relevant discussion are presented.

3. Results and Discussion
3.1 Growth parameters
Growth parameters like, plant height and number of branches per plant, decides the vigour of

plant, which is related with the biological yield of crop. All the growth parameters were varied significantly. The data pertaining to growth parameters are presented in Table 1.

3.1.1 Plant Height (cm)

Height of plant is an important growth character in chilli. The yield of crop was influenced by vigour of plant, where the height of plant plays an important role.

Data presented in Table 1 showed that the plant height ranged from 32.37 to 96.99 cm at full maturity. The highest plant height was observed in the hybrid P_2 X P_{11} (96.99 cm) which was on par with parent P_{11} (96.70 cm), P_2 X P_{12} (95.30 cm), P_1 X P_{12} (95.15 cm). While, the lowest plant height was observed in the hybrid P_1 X P_7 (32.37 cm) which was at par with parent P_3 (41.19 cm), P_9 (43.62 cm).

The differences in plant height are mostly attributed to the genetic potential and also due to the environmental factors, especially temperature which should be around 25°C for good vegetative growth. Similar results were obtained for Dhaliwal *et al.* (2015) [3] and Dhumal *et al.* (2020) [4].

3.1.2 Number of branches per plant

The data pertaining to number of branches per plant is given in Table 1.

The highest number of branches per plant were present in the hybrid P_2 X P_{13} (13.59) which was on par with P_2 X P_5 (13.16) compared to parents and checks and the lowest number of branches were present in the hybrid P_1 X P_4 (7.17) which was at par with P_2 X P_4 (8.17) compared to parents and checks.

In chilli, high branching is desirable for easy picking of fruits and for effective inter cultivation and to prevent rotting of fruits. The results obtained were relevant to the results attained by Karak *et al.* (2015) [9], Yatagiri *et al.* (2017) [12], Rohini and Lakshmanan (2017) [11] and Nivedha *et al.* (2019) [10].

Table 1: Performance of chilli parental genotypes and hybrids for plant height and number of branches per plant.

Treatment	Name of the treatment	Plant height (cm)	Number of branches per plant
T-01	P_1 X P_4	65.08	7.17
T-02	P_1 X P_5	56.14	10.45
T-03	P_1 X P_6	66.12	11.16
T-04	P_1 X P_7	32.37	9.37
T-05	P_1 X P_8	74.85	12.06
T-06	P_1 X P_9	61.34	10.42
T-07	P_1 X P_{10}	88.95	9.04
T-08	P_1 X P_{11}	93.86	10.65
T-09	P_1 X P_{12}	95.15	11.82
T-10	P_1 X P_{13}	66.99	12.61
T-11	P_2 X P_4	68.95	8.17
T-12	P_2 X P_5	83.16	13.16
T-13	P_2 X P_6	69.47	10.26
T-14	P_2 X P_7	66.57	12.40
T-15	P_2 X P_8	81.87	10.70
T-16	P_2 X P_9	63.70	12.52
T-17	P_2 X P_{10}	93.80	10.23
T-18	P_2 X P_{11}	96.99	10.65
T-19	P_2 X P_{12}	95.30	10.92
T-20	P_2 X P_{13}	73.66	13.59
T-21	P_3 X P_4	72.38	9.51
T-22	P_3 X P_5	68.68	10.08
T-23	P_3 X P_6	64.76	12.50
T-24	P_3 X P_7	56.11	12.57
T-25	P_3 X P_8	57.78	12.16
T-26	P_3 X P_9	57.94	12.61
T-27	P_3 X P_{10}	72.27	12.55
T-28	P_3 X P_{11}	76.13	12.08
T-29	P_3 X P_{12}	72.22	10.91
T-30	P_3 X P_{13}	61.82	11.88
T-31	P_1	53.76	10.25
T-32	P_2	61.77	11.98
T-33	P_3	41.49	12.00
T-34	P_4	54.04	10.95
T-35	P_5	61.20	11.57
T-36	P_6	68.91	9.64
T-37	P_7	44.40	11.91
T-38	P_8	63.71	10.46
T-39	P_9	43.62	12.01
T-40	P_{10}	59.18	11.43
T-41	P_{11}	96.70	9.53
T-42	P_{12}	91.36	9.90
T-43	P_{13}	83.83	11.69
T-44	C_1	67.46	9.66
T-45	C_2	69.70	9.75
T-46	C_3	71.62	10.03

	Grand Mean	69.28	11.02
	SE (m)	3.04	0.87
	CD @ 5%	8.7	2.5
	C.V.	6.21	11.26

3.2 Yield parameters

3.2.1 Length of fruit (cm)

The data presented in Table 2. revealed that the highest fruit length was observed in the hybrid P_2 X P_5 (13.45 cm) which was on par with P_2 X P_8 (13.24 cm), P_1 X P_8 (13.16 cm) compared to parents and checks while, lowest length of fruit was observed in P_1 X P_7 (6.78 cm) which is at par with the parent P_7 (6.88 cm).

There is varietal variation for fruit length in chilli and the variation is also due to the genitical and environmental factors. The results are in accordance with the results obtained by Chattopadhyay *et al.* (2011) [1] and Herison *et al.* (2014) [6].

3.2.2 Green fruit weight (g): The data pertaining to green fruit weight are presented in Table 2. showed that the highest weight of fruit is recorded in the hybrid P_1 X P_8 (7.63 g) which was at par with P_2 X P_5 (7.52 g) compared to parents and checks and lowest weight of fruit was observed in the parent P_{10} (2.64 g) which was on par with P_7 (2.92 g). Fruit weight at maturity varies according to cultivars, time of harvest, soil fertility and cultural management. Dhaliwal *et al*. (2014) [2] revealed that fresh fruit weight varies among the chili varieties. Fruit weight varies with variation in fruit length and diameter. The findings were in comformity with Jamal *et al.* (2015) [7] and Yatagiri *et al*. (2017) [12].

Table 2: Performance of chilli parental genotypes and hybrids for fruit length and Green fruit weight characteristics.

Treatment	Name of the treatment	Length of fruit (cm)	Green fruit weight (g)
T-01	P_1 X P_4	11.23	5.97
T-02	P_1 X P_5	11.07	6.60
T-03	P_1 X P_6	10.85	6.24
T-04	P_1 X P_7	6.78	5.31
T-05	P_1 X P_8	13.16	7.63
T-06	P_1 X P_9	11.60	6.11
T-07	P_1 X P_{10}	11.26	5.69
T-08	P_1 X P_{11}	12.88	7.30
T-09	P_1 X P_{12}	11.83	6.26
T-10	P_1 X P_{13}	10.21	6.33
T-11	P_2 X P_4	12.43	7.16
T-12	P_2 X P_5	13.45	7.52
T-13	P_2 X P_6	10.12	5.15
T-14	P_2 X P_7	8.20	5.07
T-15	P_2 X P_8	13.24	7.12
T-16	P_2 X P_9	10.71	6.09
T-17	P_2 X P_{10}	11.03	5.84
T-18	P_2 X P_{11}	11.82	6.15
T-19	P_2 X P_{12}	11.93	6.45
T-20	P_2 X P_{13}	11.04	6.46
T-21	P_3 X P_4	10.39	5.00
T-22	P_3 X P_5	10.64	4.50
T-23	P_3 X P_6	7.41	3.80
T-24	P_3 X P_7	6.89	3.86
T-25	P_3 X P_8	9.98	5.84
T-26	P_3 X P_9	9.86	4.03
T-27	P_3 X P_{10}	10.20	5.49
T-28	P_3 X P_{11}	10.31	3.98
T-29	P_3 X P_{12}	10.36	4.66
T-30	P_3 X P_{13}	8.11	3.84
T-31	P_1	10.19	6.82
T-32	P_2	11.66	6.31
T-33	P_3	8.67	3.87
T-34	P_4	10.26	5.25
T-35	P_5	10.91	6.21
T-36	P_6	7.74	3.01
T-37	P_7	6.88	2.92
T-38	P_8	9.31	5.10
T-39	P_9	10.06	3.74
T-40	P_{10}	8.50	2.64
T-41	P_{11}	11.10	4.03
T-42	P_{12}	11.01	4.69
T-43	P_{13}	8.78	2.99
T-44	C_1	10.12	5.64
T-45	C_2	10.00	4.32
T-46	C_3	9.65	6.02
	Grand Mean	10.30	5.32

	SE (m)	0.55	0.20
	CD@5%	1.56	0.59
	C.V.	7.50	5.55

3.2.3 Number of fruits per plant

The data pertaining to number of fruits per plant are presented in Table 3. The highest number of fruits per plant were recorded in the hybrid P_2 X P_{13} (339.64) which was at par with P_2 X P_5 (327.14) compared to parents and checks whereas the lowest number of fruits per plant were observed in P_1 X P_4 (99.00) which was on par with P_2 X P_4 (109.95).

The number of fruits per plant was appreciably high for certain hybrids and thus provides good scope for selection of these genotypes for improvement in chilli for yield characters. The variation is due to the difference in percentage fruit set, genitical and environmental factors. The results obtained are in accordance with Janaki *et al.* (2015) [8], Nivedha *et al.* (2019) [10] and Dhumal *et al*. (2020) [4].

3.2.4 Green fruit yield per plant (g)

The data presented in Table 3 found that fruit yield per plant was highest for the hybrid P_2 X P_5 (2262.97 g) which was at par with P_1 X P_8 (2254.92 g) compared to parents and checks, while the fruit yield per plant was lowest in the parent P_6 (490.96 g) which was on par with P_1 X P_4 (611.11 g).

The fruit yield per plant is influenced by the fruit length. It is indirectly affected by the number of branches per plant and fruit weight. The yield per plant was significantly and positively associated with both genotypic and phenotypic levels (Farhad *et al.*, 2008) [5]. The results are in agreement with Yatagiri *et al.* (2017) [12] and Nivedha *et al*. (2019) [10].

Table 3: Performance of chilli parental genotypes and hybrids for number of fruits per plant and Green fruit yield per plant.

Treatment	Name of the treatment	Number of fruits per plant	Green fruit yield per plant (g)
T-01	P_1 X P_4	99.00	611.11
T-02	P_1 X P_5	182.04	1483.35
T-03	P_1 X P_6	233.04	1601.60
T-04	P_1 X P_7	149.88	794.42
T-05	P_1 X P_8	281.08	2254.92
T-06	P_1 X P_9	251.43	1772.97
T-07	P_1 X P_{10}	131.09	880.02
T-08	P_1 X P_{11}	247.94	1692.99
T-09	P_1 X P_{12}	282.56	1759.19
T-10	P_1 X P_{13}	302.15	2065.64
T-11	P_2 X P_4	109.95	801.73
T-12	P_2 X P_5	327.14	2262.97
T-13	P_2 X P_6	167.59	844.26
T-14	P_2 X P_7	290.16	1452.51
T-15	P_2 X P_8	228.17	1684.79
T-16	P_2 X P_9	307.05	1873.26
T-17	P_2 X P_{10}	136.56	811.55
T-18	P_2 X P_{11}	178.14	1068.51
T-19	P_2 X P_{12}	196.42	1173.81
T-20	P_2 X P_{13}	339.64	2217.39
T-21	P_3 X P_4	207.74	1071.79
T-22	P_3 X P_5	259.20	1169.72
T-23	P_3 X P_6	294.76	1199.72
T-24	P_3 X P_7	303.60	1339.73
T-25	P_3 X P_8	276.46	1372.03
T-26	P_3 X P_9	295.63	1118.26
T-27	P_3 X P_{10}	291.00	1399.62
T-28	P_3 X P_{11}	273.94	1050.34
T-29	P_3 X P_{12}	255.70	1137.41
T-30	P_3 X P_{13}	263.20	1054.99
T-31	P_1	160.97	1189.67
T-32	P_2	277.61	1744.51
T-33	P_3	262.98	1089.43
T-34	P_4	258.69	1309.67
T-35	P_5	278.59	1739.72
T-36	P_6	167.26	490.96
T-37	P_7	273.01	851.75
T-38	P_8	230.49	1105.36
T-39	P_9	279.71	1041.80
T-40	P_{10}	273.52	719.82
T-41	P_{11}	176.56	730.73
T-42	P_{12}	242.37	1137.24
T-43	P_{13}	269.31	809.66
T-44	C_1	324.39	1832.63
T-45	C_2	321.49	1416.32
T-46	C_3	319.20	1904.61

	Grand Mean	244.40	1307.27
	SE (m)	11.41	65.07
	CD@5%	32.61	185.96
	C.V.	6.58	7.04

4. Conclusions

One of the first step to increase productivity is introduction of F_1 hybrids, which are genetically superior and high yielding, among the thirty F_1 hybrids evaluated in Comparision to parents and checks, the hybrids P_2 X P_5, P_1 X P_8, P_1 X P_{13}, P_2 X P_{13} and P_2 X P_9 showed significantly higher yield. These F_1 hybrids can be recommended for commercial cultivation of chilli.

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