

Performance of various chilli hybrids for growth, yield and quality attributes.**ABSTRACT**

The experiment was conducted during 2022 at the vegetable Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. The observations were recorded on various growth, yield and quality contributing characters. The results from the present investigation revealed that on the basis of mean performance of eighteen hybrids of Chilli, hybrids 20CHIHBY4 (50.03 q/ha) and 21CHIHBY3 (49.47 q/ha) were found superior in terms of Fruit yield (q/ha). On the basis of Analysis of variance significant difference was recorded for all the quantitative and qualitative traits indicating presence of large amount of variability in the hybrids. The maximum gross return, net return and Benefit cost ratio Rs. 101260.00, Rs. 41260.00 and 1.6 respectively were recorded in hybrid 20CHIHBY4.

Keywords: Chilli, hybrids, variability, economics.

INTRODUCTION

Chilli (*Capsicum annum* L.) is one of the most important commercial crops of India. It belongs to the genus *Capsicum* under the family Solanaceae. Chilli is an indispensable spice, due to its pungency, taste, appealing colour and flavor. It is the second largest commodity after black pepper (*Piper nigrum* L.) in the international spice trade. In India, it is an important ingredient in daily cuisine and is also used in the preparation of pickles, chutneys, etc. The pungency in chilli is due to a crystalline, acrid, volatile alkaloid, capsaicin present in placenta and pericarp of the fruit which has high diverse prophylactic and therapeutic uses in Allopathic and Ayurvedic medicine value. India is the largest producer, consumer and exporter of chilli with an annual production of 2.09 million tonnes from 0.84 million ha (National Horticulture Board, 2016-17). According to an estimate for 2016, in India, chillies (dry-red and fresh-green fruits) were cultivated in 797,029 ha with a total production of 1.3 million tonnes of dry fruits and 679,17 tonnes of fresh fruits. Average yield of dry chilli harvest was around 1.7 t/ha compared to that of 8.4 t/ha for green chilli (FAOSTAT, 2016). In India, the states of Andhra Pradesh, Telangana, Karnataka, Maharashtra, Orissa and Tamil Nadu account for more than 75% of the area and production of chilli. Studies on chilli genotypes revealed that great variation exists in ability to flowering, fruit set, yield and other qualitative attributes under different agro-climates (Wien *et al.*, 1989; Rani, 1996; Gupta, 2003). Therefore, the present study was undertaken to evaluate the growth, flowering behaviour and physical fruit parameters in various chilli genotypes in Prayagraj.

MATERIALS AND METHODS

The experiment was conducted during the year 2022 in Departmental vegetable Research field of Department of Horticulture and Sciences, Naini Agriculture Institute, Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The area is situated on the south of Prayagraj on the right bank of Yamuna at Rewa road at the distance of about 6 km from Prayagraj city. It is situated at the 25.08°N Latitude and 81.50°E meters from sea level. Prayagraj has a sub-tropical climatic with uttermost in summer (in the month of May and June) with temperature reaching around 115°F with hot blazing winds and in winter (December and January the temperature falls down as low as 32°F. The average rainfall is around 1013.4 (mm) annually with maximum concentration during July to September with occasional showers in winters. The experiment was laid out in Randomized Block Design (RBD), 18 varieties of chilli with 3 replications each.

RESULTS AND DISCUSSION

In the present experiment, a research has been done to study the varietal performance of chilli (*Capsicum annum*) at Prayagraj agro-climatic condition. The morphological growth parameters are namely days taken to germination, number of branches per plant, plant height (cm), plant spread (cm), days to 1st flowering, days to 50% flowering, days to 1st harvesting, number of pickings and yield parameters are length of fruits (cm), fruits diameter (cm), number of fruits per plant, average weight of fruits (g), fruits yield per plant (g), fruits yield (q/ha), and quality parameters are ascorbic acid (mg/100g) of fruits juice, TSS, number of seed per fruits and economics. The results obtained are presented in table 1, 2 and 3.

1.GROWTH PARAMETERS

The analysis of variance (Table 1) revealed significant differences among the genotypes for all the 18 varieties studied indicating the presence of variability for various growth parameters. The seed germination and seedling growth parameters showed different variation in their performance with respect to the different hybrids taken. These results are in conformity with earlier reports of *Farhad et al.*, (2008), *Gupta et al.*, (2009), *Suryakumari et al.*, (2010) and *Kumar et al.*, (2012) in chilli.

The data recorded on days taken to germination are presented in table 1. From the data it was observed that days taken to germination varied significantly in chilli genotypes with a mean from 7 to 9, recorded the maximum was 20CHIHBY3(9) followed by 21CHIHBY7(8) in chilli hybrids. minimum in the hybrids Suraj Mukhi (check) (7) in chilli hybrids. Such variation in the days taken to germination may be due to genotypes characteristic of genotypes, interaction with environment and soil factors. These results are conformity with the findings of *Chaudhary et al.*,(2008),*Arshia Debbarma et al.*,(2018), *Veerendra et al.*,(2018),*Ch. Inao Khaba et al.*,(2020),*D. Balasankar et al.*,(2017).

The data recorded on number of branches produced per plant at last harvest in all the varieties are presented in table 1. From the data it was observed that the number of branches produced per plant varied significantly in chilli genotypes during last harvest of growth. The genotypes at last harvest stage produced maximum branches in 20CHIHBY1 (16.70) followed by 21CHIHBY8 (16.40) and minimum number of branches per plant were produced in Suraj Mukhi (7.67). Such variation in the number of branches per plant may be due to genotypes characteristic of genotypes, interaction with environment and soil factors. These results are conformity with the findings of *Amith et al.*, (2014), *Ukkund et al.*, (2007) and *Vijaya et al.*, (2014), *Versha et al.*,(2017),*Mopidevi et al.*,(2018),*Prasad et al.*,(2019).

The plant height represents the extension of primary growth and constitutes an important component of plant architecture. The data pertaining to mean height of the plant in chilli varieties under study at different growth stages is presented in table 1. It was evident from the data that plant height differed significantly in chilli varieties at various growth stages. Generally, plant height increased from transplanting 1th month onwards, reaching its maximum height at 4th month and then it declined at the last harvest stage. All the genotypes showed similar trend. By and large, significant variations in the plant height were observed among chilli varieties at all the stages of plant growth. Plant height of genotypes varied with a mean from 42.13cm to 49.83 cm (Table 1). Among the genotypes, Suraj Mukhi (Check) (49.83 cm) recorded maximum plant height followed by 21CHIHBY8(49 cm), whereas, minimum plant height was recorded in 21CHIHBY1 (42.13 cm). The difference observed in the plant height of the different genotypes at different stages of crop growth could be attributed to their genotype characteristics. This may be due to difference in the genotypes genetic makeup, environment and soil of Prayagraj. These results are in accordance with the finding of *Rivitra et al.*,(2021),*Sarita et al.*,(2019),*Rupali et al.*,(2017),*Smitha et al.*,(2006),*Ukkund et al.*,(2007).

Plant spread is the results of process of differentiation occurring in plant. It was observed that the maximum plant spreads was recorded at last harvest in all the genotypes (Table 1). It was observed from the data that the plant spread differed significantly in chilli genotypes during last harvest stage. The maximum plant spread was observed in genotype 20CHIHBY3 (44.79 cm) followed by 20CHIHBY9 (44.36 cm) which was significantly superior to all the varieties at last harvest days stage. The minimum plant spread was observed in the genotype Suraj Mukhi (check) (30.33 cm) .The wide range of variation in the plant spread observed may be due to direct effect of soil and agro-climatic condition of Prayagraj and indirect effect of number of branches per plant. Significant variations in plant spread were reported

by Nehru *et al.*, (2003), Smitha and Basavaraja (2006), Yatagiri *et al.*,(2017),Bharadwaj *et al.*,(2007),Rivitra *et al.*,(2021).

The data pertaining to the number of days to initiation of flowering is presented in table 1. The minimum number of days to initiation of flowering was observed in the genotypes 20CHIHBY2 (37.63) followed by 20CHIHBY5(38.77). The maximum days in the genotype 20CHIHBY3(45.36) followed by 21CHIHBY4 (44.20) and variation in days to initiation of flowering might be due to moderately genetic factors of varieties, less influence by hormonal factors and environmental factors. The results are in conformity with the findings of Manju and Sreelathakumary (2002), Arup *et al.*,(2011),Amit *et al.*, (2014),Yatagiri *et al.*,(2017),Asma *et al.*,(2022).

The data pertaining to the number of days to 50% of flowering are presented in table 1. It was noticed that genotype 20CHIHBY4 required minimum (44.07)number of days followed by 20CHIHBY2 (44.43)days and the genotype Suraj Mukhi required the maximum days (55.00) followed by 20CHIHBY4(49.51) days. The variation of the days to 50% flowering may be due to highly genetic makeup of genotypes, less environmental, and vigor growth of crop (Chaitali, 2014). Similar results were also observed by Shiva *et al.*, (2013), Chattopadhyay (2011), Pulari (2013), Vijaya *et al.*,(2014).

Harvesting duration is the important character specially in vegetable crops which are consumed at immature tender stage. The more harvesting span is considered as favourable character and given into consideration during selection. Number of the days to first harvesting determined the earliness of genotypes. It was noticed that the genotype the Suraj Mukhi(Check)(60) was recorded minimum (44.07) followed by 21CHIHBY8(63.33), and the maximum days to first harvesting was 21CHIHBY6(66.67), followed by 20CHIHBY8(63.33).This may be due to difference in the genotypes genetic makeup, environment and soil of Prayagraj. These variation in result agree with findings of Sharma *et al.*,(2010), Pulari,(2013),Vikram *et al.*,(2014),Muhammad *et al.*,(2019),Rupee *et al.*,(2022).

Number of pickings indicates the longevity or harvesting duration. The variations may be due to appearance to 50 percent flowering, number of fruits per plant, moderately and less effect of climatic condition, soil in Prayagraj. It was noticed that the genotype 20CHIHBY5(6.00) was recorded the maximum number of first pickings followed by 20CHIHBY2(5.67) and the minimum number of pickings was 21CHIHBY8(4.33). Similar results regarding the number of picking per plant had noticed by Kumari *et al.*,(2012), Pawar (2016), Sadam *et al.*,(2019), Meenakshi *et al.*,(2019),Ajaz *et al.*,(2020) .

Table 1. Growth parameters of different chilli genotypes

Hybrids	Days taken to germination	No. of branches per plant	Plant height (cm)	Plant spread(cm)	Days to first flowering	Days to 50% flowering	Days to first harvesting	Number of pickings
20CHIHBY1	9	16.7	43.90	39.32	39.92	44.44	66.67	5.00
20CHIHBY2	8	15.5	45.33	41.13	37.63	44.43	66.67	5.67
20CHIHBY3	9	15.9	42.57	44.79	45.36	49.51	60.00	5.33
20CHIHBY4	9	15.2	42.33	40.01	38.77	44.07	60.00	5.00
20CHIHBY5	8	16.1	45.10	41.97	40.93	45.23	63.33	6.00
20CHIHBY6	8	14.4	45.57	41.79	42.68	49.42	66.67	6.00
20CHIHBY7	7	16.0	42.47	41.90	40.43	45.37	66.67	5.00
20CHIHBY8	8	16.1	43.27	41.30	41.47	46.73	63.33	6.00
20CHIHBY9	7	15.7	46.27	44.36	39.93	45.73	63.33	5.00
21CHIHBY1	7	15.5	42.13	40.63	41.00	45.37	63.33	6.00
21CHIHBY2	9	15.5	43.60	41.63	41.80	45.86	66.67	5.67
21CHIHBY3	9	15.1	42.50	41.23	41.93	47.27	63.33	5.00
21CHIHBY4	9	15.9	43.37	41.50	44.20	49.00	63.33	6.00
21CHIHBY5	9	15.5	44.30	41.00	42.80	49.16	63.33	5.33
21CHIHBY6	9	14.1	47.43	41.35	42.87	48.07	66.67	6.00
21CHIHBY7	8	15.6	46.50	42.80	40.40	45.47	63.33	5.67
21CHIHBY8	8	16.4	49.00	40.99	42.07	45.73	63.33	4.33
SURAJ MUKHI	7	7.6	49.83	30.33	40.00	55.00	60.00	5.00
F-test	S	S	S	S	S	S	S	S
SE(d)	0.06	0.68	1.36	1.30	1.78	1.66	3.93	0.26
C.D.	0.11	1.38	2.87	2.64	3.61	3.37	7.99	0.54
C.V.	0.84	5.49	3.86	3.88	5.27	4.37	7.54	5.94

2. YIELD AND QUALITY PARAMETER : The data on yield and quality parameters are given in table 2

The maximum fruits length (17.53cm) was reported in the hybrid 20CHIHBY3 followed by 21CHIHBY7 (11.63cm) and the minimum length of the fruits was recorded in the hybrids 21CHIHBY5 (7.40cm). The length of fruits is one of the major factors for deciding the yield of the crop. The variation in fruits length might have been due to the internodal length, sex ratio, fruit set percentage, genetic nature and their response to varying environment condition and higher uptake nutrient. Similar results have been found in Rupali and Rajesh (2017), Yatagiri *et al.*, (2017), Sadam *et al.*, (2019), Ajaz *et al.*, (2020), Ballabh *et al.*, (2013).

The variation in diameter of fruits may be due to its hybrid vigour and adoptability to Allahabad agro-climatic condition. The maximum number of fruits diameter was recorded in the hybrids (2.43cm) followed by 21CHIHBY3 (2.17cm). The minimum number of fruits diameter was recorded in the hybrids Suraj Mukhi (1.10cm). Similar findings have been reported by Ridwan and Dean (1990), Kiran *et al.*, (2019), Pallerla *et al.*, (2021), Smitha *et al.*, (2006), Tembhrne *et al.*, (2008).

The maximum number of fruits per plants was recorded (53.67) reported in the hybrid 20CHIHBY3 followed by 20CHIHBY1 (52.67). The minimum number of fruits per plants was recorded in the hybrids Suraj Mukhi (30.33), which were on par with each other and the variation is due to the inherent characters and genetic makeup of the hybrids, higher uptake of nutrient and environmental conditions. The results are conformity with finding of Ratna *et al.*, (2018), Kiran *et al.*, (2019), Sarita *et al.*, (2019), Rupee *et al.*, (2022), Ibrahim *et al.*, (2022).

The maximum average pod weight (13.20g) was recorded in the hybrid 20CHIHBY3 followed by 20CHIHBY7 (10.97g). The minimum average pod weight was recorded in the hybrids 20CHIHBY4 (3.23g), which were on par with each other and the significant variation in weight of fruits might have been due to fruit set percentage, fruit length, number of fruits per vine and fruits width, genetic nature, environmental factors and vigour of the crops and higher uptake of nutrient. The results are in conformity with the findings of Pradhepan *et al.*, (2018), Sarita *et al.*, (2019), Yatagiri *et al.*, (2017), Dhamanthi *et al.*, (2003).

The maximum fruit yield per plant (673.50g) reported in the hybrid 20CHIHBY3 followed by 21CHIHBY3 (510.60g). The minimum fruit yield per plant was recorded in the hybrids 21CHIHBY5 (147.27g) which were on par with each other and increasing of number of fruits plant is mostly influenced by genetic factor, environmental factor, hormonal factor vigour of the crop the fruit plant is one of the major factors for deciding the yield of the crop. The variation in fruit plant have been to sex ratio and fruit set percentage. The results are in agreement with the finding of Ridwan (1990), Kiran *et al.*, (2019), Pallerla *et al.*, (2021).

The maximum fruit yield q/ha (50.03) was reported in the hybrid 20CHIHBY4 followed by 21CHIHBY3 (49.37q/ha). The minimum fruit yield q/ha was recorded in the hybrids Suraj Mukhi (5.43q/ha). The higher yield plant due to its inherent characteristics, better adoptability for the environmental conditions and efficiently all available factors viz. water, nutrient, light and CO₂. None of the treatment significantly influenced the plant standard. The result are in agreement with the finding of Chakrabarty and Aminul (2017), Dahan *et al.*, (2018), Mopidevi *et al.*, (2018), Yatagiri *et al.*, (2017).

The maximum ascorbic acid (102.67mg/100g) reported in the hybrid 20CHIHBY3 followed by 21CHIHBY1 (101.67 mg/100g), 21CHIHBY7 (98.33mg/100g). The minimum ascorbic acid (mg/100g) was recorded in the hybrids Suraj Mukhi (75.67 mg/100g). The variation may be due to the inherent character and genetic makeup of the hybrids and environment condition and the results are conformity with finding of Omraj and Subba (2009), Orobiji *et al.*, (2015), Rahul *et al.*, (2022).

The maximum total soluble solid (7.07 °Brix) reported in the hybrid 21CHIHBY8 followed by 20CHIHBY6 (6.70°Brix). The minimum total soluble solid was recorded in the hybrids 20CHIHBY1(5.37 °Brix). Mudasir and Anju (2018) observed a significant increase in TSS irrespective of treatment and reported that the increase in TSS could be due to the conversion of starch and other insoluble carbohydrates into sugars which was similar to the result obtained. Similar finding was observed by the findings of Grewal *et al.*, (2017), Nagireddypalli *et al.*, (2022), Ajaykumar *et al.*, (2012), Karale *et al.*, (2019).

The maximum number of seed per fruits(128.33) reported in the hybrid 20CHIHBY6 followed by 20CHIHBY3 (116.67), 20CHIHBY4 (105.00) and the minimum number of seed per fruits was recorded in the hybrids Suraj Mukhi (50.33). Number of seeds showed significant variation among cultivars. Number of seeds per fruit varied due to the variation of genetic materials in chilli. Bylla Prasad *et al.*, (2013), Dhamayanthi and Reddy(2003), Jogdhande *et al.*, (2017) also found similar results in Chilli genotypes.

Table 2. Yield and quality parameters of different chilli genotypes

Hybrids	Length of the fruits(cm)	Fruits diameter (cm)	Number of fruits per plant	Average weight of fruits(g)	Fruit yield per plant(g)	Fruit yield (q/ha)	Ascorbic acid (mg/100)	TSS (^o Brix)	No. of seed/fruits
20CHIHBY1	7.53	1.47	52.67	3.53	183.10	38.27	94.67	5.37	82.67
20CHIHBY2	11.07	1.77	44.00	8.93	391.40	37.83	97.67	5.73	78.67
20CHIHBY3	17.53	2.43	53.67	13.20	673.50	50.03	102.67	6.17	116.67
20CHIHBY4	7.50	1.47	49.33	3.23	161.53	35.97	94.00	6.10	105.00
20CHIHBY5	9.03	1.67	45.67	4.87	222.67	46.80	85.67	6.03	85.33
20CHIHBY6	9.47	1.53	43.00	6.10	339.77	34.63	89.67	6.70	128.33
20CHIHBY7	11.17	2.13	50.00	10.93	414.67	42.93	87.33	6.13	88.67
20CHIHBY8	10.17	1.77	47.67	7.33	325.03	38.53	94.33	6.97	99.33
20CHIHBY9	11.27	1.87	51.00	5.57	386.20	36.40	86.00	5.90	98.00
21CHIHBY1	11.00	2.13	48.00	7.67	365.90	36.97	101.67	6.07	82.00
21CHIHBY2	10.13	2.13	47.67	8.70	409.93	36.47	95.67	6.43	79.33
21CHIHBY3	10.40	2.17	49.67	10.27	510.60	49.37	95.67	6.17	89.67
21CHIHBY4	10.20	1.47	49.67	6.23	346.93	33.10	91.00	6.70	81.33
21CHIHBY5	7.40	1.27	45.33	3.63	147.27	46.40	88.67	6.30	95.67
21CHIHBY6	10.60	1.47	45.33	6.70	306.17	30.93	88.33	6.40	97.67
21CHIHBY7	11.65	2.17	51.67	9.27	478.47	34.20	98.33	6.03	67.67
21CHIHBY8	10.33	2.13	52.33	7.60	394.80	40.40	82.00	7.07	66.67
Suraj Mukhi	7.80	1.10	30.33	3.37	147.33	5.43	75.67	6.43	50.33
F-Test	S	S	S	S	S	S	S	S	S
SE(d)	0.73	0.05	5.27	0.71	55.97	2.84	7.03	0.80	19.12
C.D.	1.49	0.10	10.72	1.44	113.75	5.76	14.28	1.63	38.85
C.V.	8.77	3.25	13.41	12.14	19.81	17.76	9.40	15.66	26.46

3.Economics of different chilli hybrids genotypes.

The economics of the chilli hybrids was calculated by summed cost of all agronomical practices, protection measures, land etc including labour and farm machinery. The total cost of cultivation is (INR 60000).

The total yield of particular hybrids is multiplied by marked price of chilli at a time. The total cost of cultivation is subtracted from total income, all the middleman margin and market charge was subtracted from total income for determining the net return.

The maximum net return per hectare was obtained by 20CHIHBY4 i.e.,101260 INR and followed by 21CHIHBY3 i.e., 98940 and the minimum gross return hectare by SURAJ MUKHI i.e.,10860 INR. The maximum net income per hectare was obtained by 20CHIHBY4 i.e.,41260 and followed by 21CHIHBY3 i.e., 38940 and the minimum net return per hectare was obtained by 21CHIHBY i.e.,1860 INR. Among the different chilli hybrids 20CHIHBY4 has the highest cost benefit ratio 1.6 followed by 21CHIHBY3 i.e.,1.6 and the minimum cost benefit ratio was obtained in SURAJ MUKHI (check) i.e.,0.1.

Table 3. Cost benefit ratio

HYBRIDS	FRUIT YIELD (q/ha)	SELLING RATE (Rs/q)	GROSS RETURN (INR/ha)	COST OF CULTIVATION (INR/ha)	NET RETURN (INR/ha)	BENEFIT COST RATIO
20CHIHBY1	38.27	2000	76540	60000	16540	1.2
20CHIHBY2	37.83	2000	75660	60000	15660	1.2
20CHIHBY3	34.20	2000	68400	60000	8400	1.1
20CHIHBY4	50.03	2000	101260	60000	41260	1.6
20CHIHBY5	46.80	2000	93600	60000	33600	1.5
20CHIHBY6	34.63	2000	69260	60000	2260	1.1
20CHIHBY7	42.93	2000	85860	60000	25860	1.4
20CHIHBY8	38.53	2000	77060	60000	17060	1.2
20CHIHBY9	36.40	2000	72800	60000	12800	1.2
21CHIHBY1	36.97	2000	73940	60000	13940	1.2
21CHIHBY2	36.47	2000	72940	60000	12940	1.2
21CHIHBY3	49.47	2000	98940	60000	38940	1.6
21CHIHBY4	33.10	2000	66200	60000	6200	1.1
21CHIHBY5	46.40	2000	92800	60000	32800	1.5
21CHIHBY6	30.93	2000	61860	60000	1860	1.0
21CHIHBY7	35.97	2000	71940	60000	11940	1.1
21CHIHBY8	40.40	2000	80800	60000	20800	1.3
SURAJ MUKHI	5.43	2000	10860	60000	49140	0.1

CONCLUSION

From the above experiment it can be concluded that 20CHIHBY3 was found to be best in terms of growth parameters. However, on the basis of earliness parameters (flowering and fruit setting), treatment 20CHIHBY2 performed best. On the basis of Yield Parameters, treatment 20CHIHBY3 was found to be the best, on the basis of Ascorbic Acid in Fruits, 20CHIHBY3 is the best and the Total soluble solids was found best in 21CHIHBY7. The highest gross return was found in the 21CHIHBY4 and the B:C ratio was found in the same with 1.6.

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