



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating: 5.20
www.agronomyjournals.com
2025; 8(6): 464-468
Received: 11-03-2025
Accepted: 13-04-2025

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Performance of chilli (*Capsicum annum* L.) varieties and hybrids for growth, yield and quality

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DOI: <https://www.doi.org/10.33545/2618060X.2025.v8.i6f.3060>

Abstract

An experiment was conducted on “Performance of Chilli (*Capsicum annum* L.) Varieties and Hybrids for Growth, Yield and Quality” during August, 2024 to January, 2025 at the Research Field of Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj. Although numerous chilli varieties have been developed and recommended by various Research Institutes and State Agricultural Universities, their adaptability and productivity differ across regions. Therefore, there is a growing need to identify a variety well-suited to the agro-climatic conditions of Prayagraj. The experiment comprised of 10 different varieties and hybrids viz., Arka Meghana F1, Arka Swetha F1, Kashi Anmol, Kashi Abha, Chilli Black Purple F1, Pusa Jwala, Suraj Mukhi, AK-47, G-4 and F1 Hybrid Long. These 10 different varieties and hybrids were laid out in Randomized Block Design (RBD) with three replications and were used to study the most promising variety/ hybrid in terms of growth, yield and quality with 15 characteristics. Among the 10 varieties and hybrids, V₂ (Arka Swetha F1) was found to be the most superior hybrid variety with days to germination (4.90 days), days to 50% flowering (43.80 days), days of first picking of fruit (62.86 days), fruit length (11.82 cm), fruit diameter (2.43 cm), number of fruits per plant (57.67), average weight of fruit (4.47 g), fruit yield per plant (257.05 g), fruit yield (126.94 q/ha). In terms of economics, the maximum Benefit cost ratio was found in V₂ (Arka Swetha F1) with 3.59.

Keywords: Growth, yield, quality, varieties, hybrids, chilli

1. Introduction

Chilli (*Capsicum annum* L.) belongs to the family Solanaceae with chromosome no. $2n = 2x = 24$. In India, chilli is one of the most important commercial crops. India grows chilli (*Capsicum annum* L.), a lucrative commercial spice and vegetable crop, under a variety of agroclimatic settings, including temperate, tropical, and sub-tropical regions (Hazra *et al.*, 2011)^[5]. Chilli's flavour, colour, and alluring texture make it an essential spice. It is used to produce pickles, chutneys, and other condiments and is a basic element in Indian cookery. The crystalline, bitter, volatile alkaloid capsaicin, which is present in the pericarp and placenta of the fruit and has a variety of allopathic and Ayurvedic medical uses, gives chillies their strong flavour. India is the world's top producer, user, and exporter of chillies, producing 2.09 million tonnes annually from 0.84 million hectares (National Horticulture Board, 2016-17)^[14].

With 1.29 mg of protein, 11 mg of calcium, 870 I.U. of vitamins A, 175 mg of ascorbic acid, 0.06 mg of thiamine, 0.03 mg of riboflavin, 0.55 niacin, and 321 mg of vitamin C per 100 g of edible fruit, chilli is a great source of high nutritional value. In lieu of artificial colouring, the natural colour of chillies also contributes to their increased worth. 75% of the total land used for its production and cultivation is in the states of Tamil Nadu, Maharashtra, Karnataka, and Andhra Pradesh. The eastern districts of Uttar Pradesh—Ballia, Azamgarh, Mirzapur, Basti, and Faizabad—are where the majority of the state's chillies are farmed (Katheek *et al.*, 2018)^[7]. The alkaloid capsaicin gives chillies their pungency. There are about 22 wild and 5 cultivated species in the genus *Capsicum*, including *C. annum*, *C. baccatum*, *C. Chinese*, *C. frutescens*, and *C. pubescens*. The classification of chilli falls under the category of frequently cross-pollinated crops, and reports of natural out-crossing have reached 66.4 percent (Singh *et al.*, 1994)^[18]. Increasing the productivity and quality of chillies requires three key nutrients: potassium (K), phosphorus (P) and nitrogen (N). Applying fertilizer is a common practice to maximize plant

development and boost output per unit area while improving input use efficiency. One of the main financial obstacles to chillies production worldwide is anthracnose disease, which is particularly severe in tropical and subtropical areas when the crop reaches maturity. There is need to select the variety which shows tolerance or resistant to leaf curl disease (Kumar *et al.*, 2016)^[9].

2. Materials and Methods

The present investigation “Performance of Chilli (*Capsicum annum* L.) Varieties and Hybrids for Growth, Yield and Quality” during August, 2024 to January, 2025. The experiment was carried out at a Research field, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj (U.P.).

Geographically, it is situated at an elevation of 78 meters above sea level at 25.8°N latitude and 81.15°E longitude.

The experiment was laid out in Randomized Block Design (RBD) with three replications. 10 different varieties were planted using row and plant spacing of 45 cm x 45 cm. The experimental field was prepared in raised bed 15 cm above ground level. The seeds are treated with fungicide thiram @ 2.5 g/kg of seed. The experimental plot size was 2 m x 2 m and at basal dose 60 kg N, 60 kg P₂O₅ and 60 kg K₂O per hectare were applied before transplanting the seedlings.

Observations on growth, yield and quality parameters were recorded in five randomly selected plants in each variety/hybrid. The data collected were analyzed by analysis of variance (ANOVA) as suggested by Panse and Sukhatme (1985)^[16].

Table 1: Details of varieties and Hybrids

Sl. No.	Symbol	Name of varieties/ Hybrids	Source
1.	V ₁	Arka Meghana F1	IIHR, Bangalore
2.	V ₂	Arka Swetha F1	IIHR, Bangalore
3.	V ₃	Kashi Anmol	IIVR, Varanasi
4.	V ₄	Kashi Abha	IIVR, Varanasi
5.	V ₅	Chilli Black Purple F1	Healthunbox Pvt. Ltd. (MP)
6.	V ₆	Pusa Jwala	IARI, New Delhi
7.	V ₇	Suraj Mukhi	Annex Biotech Seeds Pvt. Ltd., Delhi
8.	V ₈	AK-47	Bharathi Agro Tech., Telangana
9.	V ₉	G-4	APAU, Lam, Guntur, AP
10.	V ₁₀	F1 Hybrid Long	SAU, New Delhi

3. Results and Discussion

3.1 Growth parameters

There is significant variation in different growth attributes viz., days to germination, plant height (cm), number of branches per plant, plant spread (cm) (NS-EW), days to 1st flower initiation, days to 50% flowering and days to 1st picking of fruits of chilli varieties/ hybrids and is presented in table 2.

V₂ (Arka Swetha F1) was the earliest to germinate taking 4.90 days followed by V₁ (Arka Meghana F1) taking 5.07 days and V₅ (Chilli Black Purple F1) took the longest time to germinate taking 10.73 days.

Plant height (cm), number of branches per plant and plant spread (cm) (NS-EW)

There is considerable amount of changes in different varieties and hybrids of plant height, number of branches per plant and plant spread and are measured at 30, 60, 90 and 120 DAT to evaluate the differences. The statistical data of 120 DAT presented in Table 2. The maximum plant height and plant spread was recorded in V₉ (G-4) having (53.66 cm), (50.90 cm) followed by V₂ (Arka Swetha F1) having (52.46 cm), (48.93cm) and the minimum was recorded in V₃ (Kashi Anmol) having (47.60 cm), (44.46 cm). This may be due to the factors of different genetic makeup, environmental factors, plant spacing, nutrient availability, hormonal regulation or soil pH and salinity. The results are in conformity with those of the findings of Vijaya *et al.* (2014)^[21]; Mamatha *et al.* (2017)^[12]; Srinivas *et al.* (2017)^[19]; Arya *et al.* (2018)^[1]; Jan *et al.* (2020); Dhal *et al.* (2021)^[4]; Indrabi *et al.* (2022)^[6]; Nauni (2022)^[15]; Sharath *et al.* (2023)^[17].

The maximum number of branches plant⁻¹ (12.87) was recorded in V₆ (Pusa Jwala) followed by V₅ (Chilli Black Purple F1) having 12.73 and minimum number of branches plant⁻¹ (8.80) was recorded in V₂ (Arka Swetha F1). Those with more plant

height could be utilized for enhancing the growth and development by increasing the plant response to sunlight and soil inputs by the way of photosynthesis and translocation resulting in gain in vegetative development in the plants. Corresponding to the findings of present investigation, variability in number of branches per plant have also been reported by Vijaya *et al.* (2014)^[21]; Srinivas *et al.* (2017)^[19]; Mamatha *et al.* (2017)^[12]; Arya *et al.* (2018)^[1]; Dhal *et al.* (2021)^[4]; Indrabi *et al.* (2022)^[6]; Nauni (2022)^[15]; Sharath *et al.* (2023)^[17].

Days to 1st flower initiation, 50% flowering and 1st picking of fruits

V₁ (Arka Meghana F1) was observed to be the earliest in first flower initiation taking only 27.60 days followed by V₃ (Kashi Abha) taking 28.66 days and V₅ (Chilli Black purple F1) was observed to take the longest time in first flower initiation taking 33.40 days. Similar findings have also been reported by Mishra *et al.* (2017)^[13]; Mamatha *et al.* (2017)^[12]; Jan *et al.* (2020); Dhal *et al.* (2021)^[4]; Sharath *et al.* (2023)^[17]. V₂ (Arka Swetha F1) was observed to be the earliest in 50% flowering taking only 43.80 days followed by V₁ (Arka Meghana F1) taking 43.93 days and V₇ (Suraj Mukhi) was observed to take the longest time in 50% flowering taking 60.26 days. The variation in the results are in conformity with those of the findings of Mishra *et al.* (2017)^[13]; Mamatha *et al.* (2017)^[12]; Arya *et al.* (2018)^[1]; Indrabi *et al.* (2022)^[6]; Nauni (2022)^[15]. V₂ (Arka Swetha F1) was observed to be the earliest to harvest the fruits taking 62.86 days followed by V₃ (Kashi Anmol) taking 63.53 days and V₇ (Suraj Mukhi) was observed to be late variety to harvest the fruits taking 70.93 days. The variation in the results are in conformity with those of the findings of Mishra *et al.* (2017)^[13]; Mamatha *et al.* (2017)^[12]; Deshmukh *et al.* (2021)^[3].

Table 2: Growth parameters of different Chilli varieties/ Hybrids

Sl. No.	Symbol	Varieties/ Hybrids	Days to germination	Plant height (cm)	No. of branches plant ⁻¹	Plant spread (cm) (NS-EW)	Days to 1 st flower initiation	Days to 50% flowering	Days to 1 st picking of fruits
1.	V ₁	Arka Meghana F1	5.07	49.47	9.00	48.57	27.60	43.93	63.93
2.	V ₂	Arka Swetha F1	4.90	52.47	8.80	48.93	29.47	43.80	62.87
3.	V ₃	Kashi Anmol	5.97	47.60	9.93	44.47	30.20	49.73	63.53
4.	V ₄	Kashi Abha	5.97	48.13	10.13	48.43	28.67	48.67	65.33
5.	V ₅	Chilli Black Purple F1	10.73	48.67	12.73	46.23	33.40	57.87	69.53
6.	V ₆	Pusa Jwala	7.90	51.53	12.87	48.50	31.00	51.33	69.47
7.	V ₇	Suraj Mukhi	10.20	49.13	11.27	46.17	31.93	60.27	70.93
8.	V ₈	AK-47	7.03	48.93	9.53	46.97	32.20	53.40	68.73
9.	V ₉	G-4	7.20	53.67	10.67	50.90	28.87	47.93	64.53
10.	V ₁₀	F1 Hybrid Long	9.90	50.40	11.07	47.30	29.60	50.07	63.93
F-test			S	S	S	S	S	S	S
SE.d(±)			0.21	0.73	0.60	0.98	1.21	2.11	0.66
CD(5%)			0.45	1.54	1.26	2.06	2.55	4.42	1.38
CV			3.48	1.80	6.93	2.52	4.92	5.09	1.21

3.2 Yield parameters

There is significant variation in different yield attributes viz., fruit length (cm), fruit diameter (cm), average weight of fruit (g), number of fruits per plant, fruit yield per plant (g) and fruit yield (q/ha) of chilli varieties/ hybrids and is presented in table 3.

Fruit length (cm) and Fruit diameter (cm)

The maximum fruit length was recorded in V₂ (Arka Swetha F1) having 11.82 cm length followed by V₁₀ (F1 Hybrid Long) having 11.70 cm and minimum fruit length was recorded in V₄ (Kashi Abha) having 4.07 cm. The variation in fruit length occur due to genetic variation, gene expression, breeding and selection, environmental selection, light intensity and duration, plant spacing, irrigation or pollination and fruit set. The results are in agreement with Vijaya *et al.* (2014) [21]; Mamatha *et al.* (2017) [12]; Srinivas *et al.* (2017) [19]; Kumari *et al.* (2017) [10]; Arya *et al.* (2018) [1]; Nauni (2022) [15]; Indrabi *et al.* (2022) [6]; Deshmukh *et al.* (2023) [3]; Sharath *et al.* (2023) [17]. The maximum fruit diameter was recorded in V₂ (Arka Swetha F1) having 2.43 cm followed by V₄ (Kashi Abha) having 2.30 cm and minimum fruit diameter was recorded in V₆ (Pusa Jwala) having 1.64 cm. This occur due to genetic factors like cultivar-specific traits, fruit shape genes, ploidy level, availability of water and soil nutrients, PGRs. The results are in agreement with Vijaya *et al.* (2014) [21]; Srinivas *et al.* (2017) [19]; Kumari *et al.* (2017) [10]; Mamatha *et al.* (2017) [12]; Kumari *et al.* (2017) [11]; Indrabi *et al.* (2022) [6]; Sharath *et al.* (2023) [17].

Average fruit weight (g) and number of fruits per plant

Table 3: Yield parameters of different Chilli varieties/ Hybrids

Sl. No.	Symbol	Varieties/ Hybrids	Fruit length (cm)	Fruit Diameter (cm)	Weight of fruit (g)	No. of fruits plant ⁻¹	Fruit Yield plant ⁻¹ (g)	Fruit Yield (q/ha)
1.	V ₁	Arka Meghana F1	11.04	2.15	3.82	52.00	198.51	98.03
2.	V ₂	Arka Swetha F1	11.82	2.43	4.47	57.67	257.05	126.94
3.	V ₃	Kashi Anmol	6.73	1.71	3.00	49.00	147.05	72.62
4.	V ₄	Kashi Abha	4.08	2.30	2.77	53.33	146.88	72.53
5.	V ₅	Chilli Black Purple F1	5.40	1.66	3.87	41.67	161.00	79.50
6.	V ₆	Pusa Jwala	5.84	1.64	3.14	39.67	125.07	61.76
7.	V ₇	Suraj Mukhi	5.08	2.17	2.47	37.33	91.97	45.42
8.	V ₈	AK-47	6.76	1.98	2.83	49.33	139.31	68.79
9.	V ₉	G-4	6.11	1.87	3.95	47.67	188.45	93.79
10.	V ₁₀	F1 Hybrid Long	11.70	2.06	4.25	52.33	221.27	109.27
F-test			S	S	S	S	S	S
SE.d(±)			0.29	0.14	0.25	2.46	12.21	6.03
CD(5%)			0.61	0.30	0.52	5.18	25.65	12.67
CV			4.80	8.72	8.86	6.29	8.92	8.92

The maximum weight of fruit and number of fruits per plant was found in V₂ (Arka Swetha F1) having (4.47 g), (57.67) followed by V₁₀ (F1 Hybrid Long) having (4.25 g), (52.33) and minimum was found in V₇ (Suraj Mukhi) having (2.47 g), (37.33). The variation is may be due to varietal traits, growth habit, flower-to-fruit ratio, optimal temperature promote flowering and fruit setting, light intensity, plant spacing, weed, pest and disease incidence and different management practices. The results are in conformity with those of the finding of Tembhurne *et al.* (2008) [20]; Vijaya *et al.* (2014) [21]; Kumari *et al.* (2017) [11]; Srinivas *et al.* (2017) [19]; Mamatha *et al.* (2017) [12]; Arya *et al.* (2018) [1]; Jan *et al.* (2020); Dhal *et al.* (2021) [4]; Indrabi *et al.* (2022) [6]; Nauni (2022) [15]; Kirmani *et al.* (2023) [8]; Sharath *et al.* (2023) [17]; Deshmukh *et al.* (2023) [3].

Fruit yield per plant (g) and Fruit yield (q/ha)

The maximum Fruit Yield plant⁻¹ and Fruit yield (q/ha) was obtained in V₂ (Arka Swetha F1) with (257.05 g), (126.94 q/ha) followed by V₁₀ (F1 Hybrid Long) with (221.27 g), (109.27 q/ha) and minimum was obtained in V₇ (Suraj Mukhi) with (91.97 g), (45.42 q/ha). This variation is may be due to genetic yield potential, disease resistance genes, soil fertility, water availability, population density, fertilizer application, weed and pest management and flower retention. The results are in agreement with Tembhurne *et al.* (2008) [20]; Srinivas *et al.* (2017) [19]; Kumari *et al.* (2017) [10]; Mamatha *et al.* (2017) [12]; Dhal *et al.* (2021) [4]; Indrabi *et al.* (2022) [6]; Kirmani *et al.* (2023) [8].

3.3 Quality parameters

The statistical data of different quality attributes viz., TSS ($^{\circ}$ Brix) and ascorbic acid (mg/100 g) of fruit juice of chilli varieties/ hybrids is presented in table 4.

The maximum Total Soluble Solid ($^{\circ}$ Brix) was found in V₈ (AK-47) having 5.71 ($^{\circ}$ Brix) followed by V₄ (Kashi Abha) having 5.30 ($^{\circ}$ Brix) and minimum Total Soluble Solid ($^{\circ}$ Brix) was found in V₁ (Arka Meghana F1) having 4.24 ($^{\circ}$ Brix). Similar findings

were also reported by Nauni (2022)^[15]. The maximum Ascorbic acid (mg/100 g) of fruit juice was found in V₉ (G-4) having 157.00 (mg/100 g) followed by V₂ (Arka Swetha F1) having 156.33 (mg/100 g) and minimum Ascorbic acid (mg/100 g) of fruit juice was found in V₅ (Chilli Black Purple F1) having 136.33 (mg/100 g). Similar finding was also reported by Datta *et al.* (2016)^[2].

Table 4: Quality parameters of different Chilli varieties/ Hybrids

Sl. No.	Symbol	Varieties/ Hybrids	Total Soluble Solid ($^{\circ}$ Brix)	Ascorbic acid (mg/100 g)
1.	V ₁	Arka Meghana F1	4.24	146.67
2.	V ₂	Arka Swetha F1	4.63	156.33
3.	V ₃	Kashi Anmol	4.69	148.00
4.	V ₄	Kashi Abha	5.31	145.33
5.	V ₅	Chilli Black Purple F1	4.90	136.33
6.	V ₆	Pusa Jwala	4.58	142.00
7.	V ₇	Suraj Mukhi	4.82	147.33
8.	V ₈	AK-47	5.71	151.67
9.	V ₉	G-4	4.71	157.00
10.	V ₁₀	F1 Hybrid Long	4.53	148.00
F-test			S	S
SE.d(±)			0.15	3.45
CD(5%)			0.31	7.25
CV			3.72	2.86

Economics of Chilli crop

In terms of economics maximum Cost of Cultivation (Rs. 106053.00/ha), Gross return (Rs. 380820.00/ha), Net return (Rs. 274767.00/ha) and Benefit cost ratio (3.59) was recorded in V₂ (Arka Swetha F1) followed by V₁₀ (F1 Hybrid Long) with Gross

return (Rs. 327810.00/ha), Net return (Rs. 222757.00/ha) and Benefit cost ratio (3.12) and minimum Gross return (Rs. 136260.00/ha), Net return (Rs. 31707.00/ha) and Benefit cost ratio (1.30) was recorded in V₇ (Suraj Mukhi). The economics and benefit cost ratio is presented in Table 5.

Table 5: Economics and Benefit cost ratio of different Chilli varieties/ Hybrids

Symbol	Varieties/ Hybrids	Total cost of cultivation (Rs./ha)	Gross return (Rs./ha)	Net return (Rs./ha)	Cost Benefit ratio
V ₁	Arka Meghana F1	106053.00	294090.00	188037.00	2.77
V ₂	Arka Swetha F1	106053.00	380820.00	274767.00	3.59
V ₃	Kashi Anmol	105553.00	217860.00	112307.00	2.06
V ₄	Kashi Abha	105553.00	217590.00	112037.00	2.06
V ₅	Chilli Black Purple F1	105053.00	238500.00	133447.00	2.27
V ₆	Pusa Jwala	104553.00	185280.00	80727.00	1.77
V ₇	Suraj Mukhi	104553.00	136260.00	31707.00	1.30
V ₈	AK-47	105053.00	206370.00	101317.00	1.96
V ₉	G-4	104553.00	279180.00	174627.00	2.67
V ₁₀	F1 Hybrid Long	105053.00	327810.00	222757.00	3.12

4. Conclusion

On the basis of present investigation, it is concluded that V₂ (Arka Swetha F1) giving 126.94 q/ha fruit yield was found superior in terms of growth, yield and quality followed by V₁₀ (F1 Hybrid Long) 109.27 q/ha and V₁ (Arka Meghana F1) 98.03 q/ha. Moreover, the minimum days to germination, days to 50% flowering, days to 1st picking of fruits, and maximum fruit length, fruit diameter, average weight of fruit, no. of fruits per plant, fruit yield per plant, fruit yield (q/ha) was significantly highest in V₂ (Arka Swetha F1). It was also recorded that V₂ gave maximum Net Return (Rs 2,74,767.00/ha), higher Gross Return (Rs 3,80,820.00/ha) and Cost Benefit ratio of 3.59. So, the V₂ hybrid variety can be considered as the suitable variety for the farmers of Prayagraj region (UP) since it can increase the income of the farmers.

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