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Evaluation on different hybrids of chilli (*Capsicum annum* L.) for growth, fruit yield and quality

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Abstract
In Sam Higginbottom University of Agriculture, Technology, and Sciences (SHUATS) horticulture research farms hosted a field study to assess the quality, productivity, and growth of ten hybrid cultivars of chilli (*Capsicum annuum* L.). Finding the variety that performed the best in terms of agronomic features was the main goal. The most promising variety to cultivate was H8 (Chilli NS 1701 DG F_1 Hybrid), which showed the highest growth, yield, and quality metrics of all the types assessed. H2 (Chilli F_1 hybrid Sonali), on the other hand, had the lowest performance across these metrics. These results highlight the need of choosing the right variety to maximize production and quality in chilli agriculture since they indicate considerable diversity among hybrid chilli varieties. It is advised that more research be done to determine the fundamental causes of H8 (Chilli NS 1701 DG F_1 Hybrid) 's higher performance.

Keywords: Chilli, hybrid, cultivars, growth, yield and quality

Introduction
With chromosomal number 2n-24, the chili (*Capsicum annum* L.) is one of the most prominent vegetables and spice crops in the Solanaceae family. Domesticated approximately 5000 BC, chilies are native to Tropical America. Because of its mild flavour and agreeable taste as well as its high ascorbic acid and other vitamin and mineral content, chilli has become a high-value crop in India and holds a special place among other vegetables in Indian cuisine. In addition to being farmed domestically, chillies are exported. About 33% of India's total spice exports come from the spice the business world, whilst about 16% of global trade involves chilies.

The genus Capsicum contains five domesticated species: *C. annum*, *C. frutescent*, *C. Chinese*, *C. pubescents*, and *C. baccatum*. of these, *C. annum* is the most frequently farmed species worldwide, with approximately 400 distinct cultivars found all over the world. The world's hottest chilli, the Naga Jolokia, was brought to Europe by Christopher Columbus and other early explorers in the fifteenth century, and pepper cultivation quickly expanded over the globe. In the Indian town of Tezpur, boot jolokia is grown in the mountainous regions near Assam. Pickles, spices, condiments, sauces, and veggies are all grown in different varieties (https://armarknet.gov.in). Chilli is an annual or perennial herbaceous plant with branches. The lone blossoms have an off-white hue. Berries make up the fruit, which can be green, yellow, orange, or red depending on maturity.

A number of factors make hybrid chilies useful in agriculture, including higher yields, resistance to disease, consistency, improved quality, adaptability, financial advantages, and efficient use of resources. In general, hybrid chilies contribute significantly to increased profitability, sustainability, and productivity in the field of chili cultivation.

Farmers benefit from a number of advantages provided by hybrid chili cultivars, including increased agricultural output and financial rewards. Higher yield, disease resistance, consistency, superior quality, adaptability, early maturity, and financial benefits are a few of the main benefits. All things considered, the introduction of hybrid chili types can greatly increase the production and profitability of chili farming, improving farmers' quality of life.

Materials and Methods

The Horticulture Research Farm, Department of Horticulture, Sam Higginbottom University of Agriculture, Sciences, and Technology was the site of the field experiment. Uttar Pradesh's Allahabad. It is located at 25.870N latitude and 81.150E longitude, which is 78 meters above sea level. This area has a subtropical climate with frigid winters, intense summer heat waves, and moderate rainfall. Growth parameters such as plant height, number of branches per plant, days to flower initiation and days to 50% flowering, number of fruits per plant, fruit diameter, length, weight, fruits per plant, fruits per plot, and seeds per fruit were examined based on observations made at various stages of the growth period. Net profit, benefit-cost ratio, and disease infestation costs associated with cultivation of Severity and Incidence. Table 1 provides information on the hybrids that were used. At 30, 60, and 90 DAT stages, the height of five randomly chosen plants from each plot was measured in centimetres using a 100 cm scale from the base of the plant to the tip of the shoot. Five randomly chosen plants were counted and their numbers of branches per plant were averaged to indicate the number of principal branches per plant. The plants were then allowed to grow to maturity. At 30, 60, and 90 days after planting, the number of branches per plant was counted. Days to first flowering is the total number of days from the date of sowing to the date on which the plants begin to bloom or the date on which the plants begin to bloom throughout the entire plot. And days to 50% flowering.

Table 1: Details of hybrids used

Sl. No.	Notation	Name of Hybrids
1.	H1	F_1 hybrid VNR - 305 chilli
2.	H2	Chilli F_1 hybrid Sonali
3.	H3	Kanchi F_1 hybrid
4.	H4	F_1 hybrid chilli NS 1101
5.	H5	Hot pepper Hana ts14
6.	H6	Hybrid hot pepper (SVHA 3131)
7.	H7	Hybrid Eagle hot pepper
8.	H8	Chilli NS 1701 DG F_1 hybrid
9.	H9	Naga chilli
10.	H10	Pusa Jwala

Results and Discussions

Growth Parameters

Plant height (cm)

The maximum plant height at 90 DAT (65.66cm) was recorded in the Chilli NS 1701 DG F_1 hybrid followed by F_1 hybrid VNR – 305 Chilli (65.33cm). Plant height was found in minimum (26.33 cm) in the F_1 hybrid Sonali.

Number of branches per plant

The maximum number of branches at 90 DAT (11.71) was recorded in the Chilli NS 1701 DG F_1 hybrid followed by Naga Chilli (10.59). The Minimum number of branches found in Chilli F_1 hybrid Sonali (7.40). The Maximum number of branches at 120 DAT (13.22) was recorded in the Chilli NS 1701 DG F_1 hybrid followed by Hot pepper Hana ts14 (11.85). The Minimum number of branches found in F_1 hybrid Sonali (9.12).

Earliness Parameter

Days to first flowering

Days to first flowering ranged from Naga Chilli (46.33) to F_1 hybrid VNR – 305 Chilli (60.67) with a mean of 53.27. The Minimum number of days to first flowering observed in hybrid Naga chilli (46.33) followed by Chilli NS 1701 DG F_1 hybrid (57.33). The Maximum number of days first flowering was observed in H1 F_1 hybrid VNR – 305 Chilli (60.67). The hybrid Naga chilli (46.33) was found significantly superior in all the hybrids. The hybrid Naga chilli gives minimum days to first flowering due to favourable Prayagraj Agro climatic conditions and genetic makeup of the hybrid to have wide adaptability.

Days to 50% flowering

Days to 50% flowering ranged from Chilli F_1 Hybrid Sonali (60.67) to Chilli NS 1701 DG F_1 hybrid (76.33) with a mean of 66.39. The Minimum numbers of days to 50% flowering observed in Chilli F_1hybrid Sonali (60.67) followed by F_1 hybrid VNR -305 Chilli (75.67). The maximum days to first flowering was observed in Chilli NS 1701 DG F_1 hybrid (76.33). The hybrid Sonali gives minimum days to minimum days to 50% flowering due to favourable Prayagraj agro climatic conditions and genetic makeup of the hybrid to have wide adaptability.

Yield Parameters

Number of fruits per plant

Number of fruits per plant ranged from Chilli F_1 hybrid Sonali (37.80) to Hot pepper Hana ts14 (52.85) with a mean of 46.83. Maximum number of fruits per plant are observed in Hot pepper Hana to 14 with 52.85 fruits per plant superior over rest of the hybrids, followed by Chilli NS 1701 DG F_1 hybrid with 50.33 fruits per plant, while the minimum number of fruits per plant observed in hybrid in hybrid Sonali with 37.80 fruits per plant. The hybrid hot pepper Hana (ts14) gives maximum number of fruits per plant due to Favourable conditions and genetic makeup of hybrid to have wide adaptability.

Length of fruit (cm)

Average fruit length ranged from Chilli F_1 hybrid Sonali (6.04cm) to Chilli NS 1701 DG F_1 hybrid (12.76cm) with a mean of 9.63. Maximum average fruit length was observed in hybrid Chilli NS 1701 DG F_1 hybrid with 12.76cm fruits and was superior to rest of the hybrids, followed by Kanchi F_1 hybrid with 11.62cm, while the minimum average fruit length was observed in hybrid Chilli F_1 hybrid Sonali with 6.04cm fruits. The hybrid Chilli NS 1791 DG F_1 hybrid gives maximum average fruit length due to favourable conditions, and genetic makeup of the hybrid to have wide adaptability.

Fruit diameter

Average fruit diameter ranged from Chilli F_1 hybrid Sonali (0.47cm) to Chilli NS 1701 DG F_1 hybrid (0.60cm) with a mean of 0.523. Maximum average fruit diameter was observed in hybrid Chilli NS 1701 DG F_1 hybrid with 0.60cm and was superior to rest of the hybrids, followed by Naga Chilli with 0.59cm, while the minimum average fruit diameter was observed in hybrid Chilli F_1 hybrid Sonali with 0.47cm fruits. The hybrid Chilli NS 1791 DG F_1 hybrid gives maximum average fruit length due to favourable conditions, and genetic makeup of the hybrid to have wide adaptability.

Number of fruits per plot

Number of fruits per plot ranged from Chilli F_1 hybrid Sonali (189) to Hot pepper Hana ts14 (264.84) with a mean of 223.65. Maximum number of fruits per plot are observed in Hot pepper Hana to 14 with 264.84 fruits per plant superior over rest of the hybrids, followed by Chilli NS 1701 DG F_1 hybrid with 251.65 fruits per plot, while the minimum number of fruits per plot observed in hybrid in hybrid Sonali with 189 fruits per plot. The

hybrid hot pepper Hana (ts14) gives maximum number of fruits per plot due to Favourable conditions and genetic makeup of hybrid to have wide adaptability.

Fruit yield per plant (gm)

Fruit yield per plant ranged from Chilli F_1 hybrid Sonali (161.91gm) to Chilli NS 1701 DG F_1 hybrid (774.50gm) with a mean of 498.74. Maximum fruit yield per plant are observed in Chilli NS 1701 DG F_1 hybrid with 774.50gm fruits yield per plant superior over rest of the hybrids, followed by hybrid Hot pepper Hana ts14 with 751.30gm fruit yield per plant, while the minimum number of fruits yield per plant observed in hybrid in hybrid Chilli F_1 hybrid Sonali with 161.91gm fruit yield per plant. The Chilli NS 1701 DG F_1 hybrid gives maximum number of fruit yield per plant due to Favourable conditions and genetic makeup of hybrid to have wide adaptability.

Fruit yield per hectare (q/ha)

Fruit yield per hectare ranged from Chilli F_1 hybrid Sonali (49.07q/ha) to Chilli NS 1701 DG F_1 hybrid (88.60q/ha) with a mean of 69.78. Maximum fruit yield per hectare is observed in Chilli NS 1701 DG F_1 hybrid with 88.60q/ha fruits yield per hectare superior over rest of the hybrids, followed by hybrid Hot pepper Hana ts14 with 87.73q/ha fruit yield per hectare, while the minimum number of fruits yield per plant observed in hybrid in hybrid Chilli F_1 hybrid Sonali with 49.07q/ha fruit yield per hectare. The Chilli NS 1701 DG F_1 hybrid gives maximum number of fruit yield per hectare due to Favourable conditions and genetic makeup of hybrid to have wide adaptability.

Seeds per fruit

Number of seeds per fruit ranged from Chilli F_1 hybrid Sonali (42.64) to Hot pepper Hana ts14 (76.92) with a mean of 63.98. Maximum number of seeds per fruit are observed in Hot pepper Hana ts 14 with 76.92 seeds per fruit superior over rest of the hybrids, followed by Chilli NS 1701 DG F_1 hybrid with 71.92 seeds per fruit, while the minimum number of seeds per fruit observed in hybrid in hybrid Sonali with 42.64 seeds per fruit. The hybrid hot pepper Hana (ts14) gives maximum number of seeds per fruit due to Favourable conditions and genetic makeup of hybrid to have wide adaptability.

Economics

In terms of economics maximum Gross Return Rs. 481920.00, Net Return Rs. and Cost Benefit Ratio 2.16 was recorded in Variety 8 (H8) (Chilli NS 1701 DG F_1 Hybrid Followed by H6 (HYBRID HOT PEPPER) with Gross Return Rs. 455896.00, Net Return Rs. 361386.00 And Cost Benefit Ratio 2.05 And Minimum Gross Return Rs. 282344.00, Net Return Rs. 190034.00 and Cost Benefit Ratio 1.17 was recorded in H2 (CHILLI F_1 HYBRID)

Disease Infestation (%)

Incidence (%)

Incidence ranged from Chilli NS 1701 DG F_1 hybrid (30.9%) to Chilli F_1 hybrid Sonali (47.5%). Maximum incidences are observed in Chilli F_1 hybrid Sonali with 47.5% superior over rest of the hybrids, followed by Hybrid eagle hot pepper with 42.6% incidence while the minimum incidence observed in hybrid Chilli NS 1701 DG F_1 with 30.9%

Severity (%)

Severity ranged from Chilli NS 1701 DG F_1 hybrid (19.9%) to Chilli F_1 hybrid Sonali (36.2%) with a mean of. Maximum incidences are observed in Chilli F_1 hybrid Sonali with 36.2% superior over rest of the hybrids, followed by Hybrid eagle hot pepper with 31.1% incidence while the minimum incidence observed in hybrid Chilli NS 1701 DG $F_1$with 19.9%

Table 2: Growth and earliness parameters of chilli hybrid

Variety Notation	Hybrids	Plant height(cm)			Number of branches		Days to first flowering	Days to 50% flowering
		30 DAT	60DAT	90DAT	90DAT	120DAT		
H1	F_1 Hybrid VNR-305 Chilli	39.66	54.33	65.33	9.67	12.19	60.67	75.67
H2	Chilli F_1 hybrid Sonali	8.66	21.33	26.33	7.40	9.12	46.67	60.67
H3	Kanchi F_1 hybrid	37.33	51.33	62.66	10.07	12.19	52.67	67.67
H4	F_1 hybrid Chilli NS 1101	34	49.33	60.66	9.85	11.70	55	70
H5	Hot pepper Hana (ts14)	26.33	42.66	53.66	9.37	11.85	51.33	66.33
H6	Hybrid hot Pepper (svha3131)	14.66	33	43.33	9.59	11.26	47.33	62.33
H7	Hybrid Eagle hot pepper	23.66	29.33	41.66	10.30	11.70	56.33	71.33
H8	Chilli NS 1701 DG F_1 hybrid	41.33	56.66	65.66	11.71	13.22	57.33	76.33
H9	Naga Chilli	18.33	26.33	44.66	10.59	11.08	46.33	61.33
H10	Pusa Jwala	9.66	39.66	42.33	8.70	9.48	47.67	62.67
	F Test	NS	S	S	S	S	S	S
	S.E(d)±	1.81	2.33	2.46	0.76	0.83	1.03	1.03
	CD (0.05)	3.80	4.89	5.17	1.60	1.74	2.18	2.18
	CV (%)	9.79	10.60	10.69	9.41		2.41	1.87

Table 3: Yield and Quality Parameters of Chilli Hybrids

Variety Notation	Hybrids	Fruit length(cm)	Fruit Diameter	No. of fruits per plant	No. of Fruits per Plot	Fruit yield per plant (gm)	Fruit yield per hectare (q/ha)	Seeds per fruit	Incidence (%)	Severity (%)
H1	F_1 Hybrid VNR-305 Chilli	9.50	0.52	38.13	190.65	459.83	52.73	67.61	36.7	22.8
H2	Chilli F_1 hybrid Sonali	6.04	0.47	37.80	189	161.91	49.07	42.64	47.5	36.2
H3	Kanchi F_1 hybrid	11.62	0.58	41.96	209.84	517.53	60.00	61.63	37.6	24.8
H4	F_1 hybrid Chilli NS 1101	10.32	0.59	43.81	219.05	503.60	65.40	59.39	37.5	24.6
H5	Hot pepper Hana (ts14)	10.07	0.58	52.85	264.25	751.30	87.73	76.92	30.9	19.6
H6	Hybrid hot Pepper (svha3131)	11.24	0.58	49.81	249.05	233.40	71.13	60.92	39.9	29.6
H7	Hybrid Eagle hot pepper	10.87	0.58	48.86	244.3	254.20	77.07	62.84	42.6	31.1
H8	Chilli NS 1701 DG F_1 hybrid	12.76	0.60	50.33	251.65	774.50	88.60	71.92	30.9	19.9

H9	Naga Chilli	10.87	0.59	39.11	195.55	459.83	81.13	63.21	38.6	26.7
H10	Pusa Jwala	10.27	0.58	41.49	207.45	461.91	70.20	49.10	39.9	28.9
	F Test	S	S	S	S	S	S	S		
	S.E(d)±	0.496	0.01	1.881	9.25	58.14	4.31	8.21		
	CD (0.05)	1.016	0.03	3.71	19.26	124.69	9.08	17.21		
	CV (%)	6.416	0.79	5.05	21.37	14.40	7.40	11.51		

Conclusion

In the experiment evaluating eight varieties of chilli, Variety8, Chilli NS 1701 DG F_1 hybrid (denoted as H8) demonstrated outstanding performance. It recorded the highest yield of 88.60q/ha, displaying superior growth and quality characteristics. Additionally, this variety proved to be economically viable, with a benefit-cost ratio of 2.16.

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