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Varietal evaluation in cucumber (*Cucumis sativus* L.) hybrid under Prayagraj agro-climatic condition

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Abstract
This research assessed the performance of eight cucumber hybrids in the agro-climatic conditions of Prayagraj, focusing on flowering traits, growth metrics, and yield factors. The hybrid Jingle-4048 consistently outperformed the others in all evaluated characteristics. It showed the earliest flowering times (31.33 days for male and 31.67 days for female flowers), produced the highest flower counts (195.33 male and 32.67 female per vine), and exhibited the most robust growth with the longest vine length (190.73 cm) and the most branches (16.33 per vine). In terms of yield, Jingle-4048 had the highest fruit count (16.67 per vine), largest fruit size (19.57 cm in length and 4.19 cm in diameter), heaviest fruits (168.07 gm), shortest time to first harvest (44.33 days), greatest yield per vine (2.88 kg), and highest total soluble solids content (5.82 °Brix). Saira 934 and SW 216 consistently ranked second and third, while Shaila (CU-1101) performed the worst across all metrics. The variations in performance are likely due to genetic factors, adaptability to the environment, hormonal influences, and overall plant health. The results indicate that Jingle-4048 is particularly well- suited for cultivation in the Prayagraj area, providing farmers with a significantly higher- yielding alternative compared to other hybrids.

Keywords: Cucumber hybrids, flowering traits, jingle-4048, growth metrics, yield factors, Prayagraj agro-climatic conditions

Introduction
Cucumber (*Cucumis sativus* L.) is a significant vegetable crop grown in various agro-climatic regions around the globe. It belongs to the Cucurbitaceae family and is among the oldest cultivated vegetables, with its origins traced back to the Indian subcontinent. Historical evidence suggests that cucumber has been domesticated and cultivated in India for more than 3,000 years. Its versatility and numerous applications have established it as a vital element in both subsistence and commercial agriculture.

Cucumber is valued not only for its culinary applications but also for its nutritional and medicinal properties. The fruit is predominantly composed of water, rendering it a hydrating food, and it is rich in essential minerals such as potassium and magnesium, in addition to dietary fibre that supports digestion. Furthermore, it contains natural antioxidants and phytochemicals, including flavonoids and lignans, which provide therapeutic advantages, such as anti-inflammatory and metabolic health benefits.

From an agricultural perspective, cucumber is a fast-growing, annual vining plant that necessitates careful management to achieve optimal yields. It is susceptible to environmental and cultural factors that can influence flowering, fruit development, and overall productivity. A prevalent challenge for cucumber cultivators is the occurrence of misshapen fruits, often resulting from stress or unfavourable genetic traits. To enhance yield quality and consistency, it is essential to select and utilize improved hybrids that are well-suited to local conditions. In numerous regions of India, including Prayagraj in Uttar Pradesh, farmers primarily rely on traditional or local cucumber varieties.

Material and methods
The present investigation on eight cucumber hybrids conducted at the Horticulture Research Farm, SHUATS, Prayagraj, during the Kharif season of 2024 revealed significant variability across genotypes for all the studied parameters. Among the hybrids evaluated, Jingle-4048 consistently outperformed others in terms of growth, flowering, fruit yield, and quality traits.

It exhibited early flowering and fruiting, higher fruit number per vine, larger fruit dimensions, and the highest yield both per vine (2.88 kg) and per hectare (19.23 t/ha). Similarly, Saira 934 also performed well across most parameters and closely followed Jingle-4048 in terms of yield and quality. Moderate performances were recorded in hybrids like SW 216, Sanya, TMCU 3112, and Saraswati, while Shaila (CU-1101) consistently showed the lowest.

It is used as a chewing stick and as a treatment for stomach problems and tuberculosis in Kano, Nigeria [10]. Pharmacologically, various parts of the plant have antioxidants [11], antidiabetic [12], Anticholesterol and antihypertensive [13], anti-malarial [14], anthelmintic [15], anti-viral [16], and antibacterial [17, 18] activities performance in most traits. The observed differences may be attributed to genetic potential, hormonal responses, environmental adaptability, and vine vigour of the respective hybrids.

In addition to agronomic performance, economic analysis further supported the superiority of Jingle-4048 and Saira 934, as both recorded the highest benefit-cost ratios, making them promising candidates for profitable cucumber cultivation in the Prayagraj agro-climatic zone. These results are supported by earlier findings of researchers such as Singh *et al.* (2019), Kumar *et al.* (2020), and Rani *et al.* (2021), who also emphasized the importance of genotype selection for improving cucumber productivity and profitability. Based on this comprehensive evaluation, it can be concluded that Jingle-4048 and Saira 934 are highly suitable for commercial cultivation and should be promoted among local farmers to enhance yield and income under Kharif season conditions in eastern Uttar Pradesh.

Results and Discussion

Days to First Appearance of Male Flower

Minimum days to first male flower appearance were observed in Jingle-4048 (31.33 days), followed by Saira 934**,** SW 216**,** and Sanya. The maximum was recorded in Shaila (CU-1101**)** (39.67 days). This trait influences crop earliness, timely pollination, and fruit set, and is affected by genetic and environmental factors.

Days to First Appearance of Female Flower

Minimum days to first female flower appearance were recorded in Jingle-4048 (31.67 days), followed by Saira 934, SW 216, and others, while the maximum was in Shaila (CU-1101) (41.33 days). This variation may be due to differences in internodal length, node number, plant vigour, and hormonal balance, as also reported by Rao *et al.* (2019), Bairwa *et al.* (2021), and Mandal *et al.* (20.

Node at Which First Male Flower Appears

The node number for first male flower appearance varied among hybrids, with the highest in Jingle-4048 (7.53) and the lowest in Shaila (CU-1101**)** (5.35). Moderate values were recorded in the remaining hybrids. These differences may be influenced by genetics, hormonal balance, and environmental factors, as reported by Choudhary *et al.* (2020), Islam *et al.* (2018), and Tripathi *et al.* (2021).

Node at Which First Female Flower Appears

The node number for first female flower appearance varied among hybrids, highest in Jingle- 4048 (9.13) and lowest in Shaila (CU-1101) (5.06). Moderate values were observed in other hybrids. Early appearance at lower nodes promotes early fruiting and may be influenced by genetic and environmental factors, as noted by Ali *et al.* (2017), Patel *et al.* (2019), and Das *et al.* (2021).

Number of Male Flowers per Vine

The number of male flowers per vine varied among hybrids, with the highest in Jingle-4048 (195.33) and the lowest in Shaila (CU-1101) (151.33). Moderate values were observed in other hybrids. This variation may be due to genetic traits, hormonal regulation, and environmental influences, as also reported by Singh *et al.* (2019), Rani *et al.* (2020), and Verma *et al.* (2018).

Number of Female Flowers per Vine

The number of female flowers per vine varied significantly, with the highest in Jingle-4048 (32.67) and the lowest in Shaila (CU-1101) (26.33). Moderate values were observed in other hybrids. A higher number of female flowers enhance fruit set and yield, influenced by genetic potential, hormonal activity, and environmental factors, as reported by Yadav *et al.* (2019), Kumar *et al.* (2020), and Meena *et al.* (2018).

Vine Length (cm)

Vine length varied among cucumber hybrids, with the longest in Jingle-4048 (190.73 cm) and the shortest in Shaila (CU-1101) (172.23 cm). Moderate values were noted in other hybrids. This variation may be due to genetic potential, plant vigour, and environmental adaptability, as also observed by Patel *et al.* (2020), Kumar *et al.* (2019), and Rani *et al.* (2021).

Number of Branches per Vine

The number of branches per vine varied among hybrids, highest in Jingle-4048 (16.33) and lowest in Shaila (CU-1101) (10.33), with moderate values in others**.** Branching variation may result from genetic makeup, vine length, and hormonal or environmental factors, as also noted by Kumar *et al.* (2020), Sharma *et al.* (2018), and Yadav *et al.* (2021).

Number of Fruits per Vine

The number of fruits per vine varied significantly, with the highest in Jingle-4048 (17.10) and the lowest in Shaila (CU-1101) (5.97). Moderate fruit counts were observed in hybrids like Sanya, TMCU 3112, and Saraswati. This variation may be due to differences in sex ratio, fruit set, and genotype-environment interaction, as reported by Rani *et al.* (2019), Sharma *et al.* (2020), and Verma *et al.* (2018).

Fruit Diameter (cm)

Fruit diameter varied among hybrids, with the maximum in Jingle-4048 (5.20 cm) and minimum in Shaila (CU-1101) (3.43 cm). Moderate values were seen in Sanya, TMCU 3112, and Saraswati. This variation influences yield and may be due to genetic traits and environmental factors, as noted by Yadav *et al.* (2020), Kumar *et al.* (2019), and Meena *et al.* (2018).

Fruit Length (cm)

Fruit length varied notably among hybrids, with the longest in Jingle-4048 (19.57 cm) and shortest in Shaila (CU-1101) and Saraswati (13.47 cm). Moderate lengths were seen in Sanya, TMCU 3112, and Suchitra. Differences may be due to genotype, hormones, and environment, as supported by Patel *et al.* (2021), Sharma *et al.* (2020), and Singh *et al.* (2018).

Fruit Weight (g)

Fruit length varied notably among the hybrids, with the longest in Jingle-4048 (19.57 cm) and the shortest in Shaila (CU-1101) and Saraswati (13.47 cm). Moderate lengths were observed in Sanya, TMCU 3112, and Suchitra. This variation may be attributed to genetic makeup, hormonal activity, and environmental conditions, as noted by Patel *et al.* (2021), Sharma *et al.* (2020), and Singh *et al.* (2018).

Days to First Fruit Harvest

Days to first fruit harvest varied among hybrids, with Jingle-4048 (44.33 days) and Saira 934 (44.67 days) maturing earliest, while Shaila (CU-1101) was latest (51.33 days). Most others harvested around 49-50 days. This variation is influenced by genetics and crop vigour, as reported by Rani *et al.* (2020), Kumar *et al.* (2018), and others.

Fruit Yield per Vine (kg)

Fruit yield per vine varied significantly, with Jingle-4048 (2.88 kg), Saira 934 (2.80 kg), and SW 216 (2.56 kg) yielding highest, while Shaila (CU-1101) had the lowest (1.55 kg).

Moderate yields were seen in TMCU 3112, Sanya, Saraswati, and Suchitra. Differences were due to fruit size, number, and genetic potential, as noted by Singh *et al.* (2019).

Fruit Yield (t/ha)

Cucumber hybrids showed notable yield variation under Prayagraj conditions. Jingle-4048 recorded the highest yield (19.23 t/ha), followed by Saira 934 and SW 216, while Shaila (CU- 1101) had the lowest (14.65 t/ha). Differences were mainly due to fruit count, size, and genetic factors (Singh *et al.*, 2019; Kumar *et al.*, 2020).

Total Soluble Solids (TSS °Brix)

Significant variation in T.S.S. content was recorded among the cucumber hybrids under Prayagraj conditions, ranging from 4.24 to 5.52 °Brix. The highest T.S.S. was observed in Jingle-4048 (5.52 °Brix), followed by Saira 934 (5.40 °Brix), while the lowest was in Shaila (CU-1101) (4.24 °Brix). Moderate values were noted in Sanya and TMCU 3112. Jingle-4048 and Saira 934 showed better sugar accumulation, indicating their promise for improved taste.

Economic Parameters

The total cost of cucumber cultivation ranged from ₹1,34,309 to ₹1,34,354/ha, with a fixed cost of ₹1,31,625/ha. Jingle-4048 recorded the highest benefit-cost ratio (3.16), followed by Saira 934 (3.13) and SW 216 (3.06), indicating higher profitability. The lowest B:C ratio was observed in Shaila (2.46). Jingle-4048 emerged as the most economically viable hybrid for Prayagraj conditions.

Table 1: Hybrids showed significant variation in flowering, vine growth, and fruit yield traits.

Hybrids	Days to first appearance of male flower	Days to first appearance of female flower	Node at which first male flower appears	Node at which first female flower appears	Number of male flower per vine	Number of female flower per vine	Vine length	Number of branches per vine	Number of fruits per vine
JINGLE-4048	31.33	31.67	7.53	9.13	195.33	32.67	190.73	16.33	17.10
SANYA	34.33	35.67	6.72	6.86	167.33	29.33	185.76	13.00	10.42
SARASWATI	37.00	37.33	6.17	5.91	158.67	27.67	177.73	11.67	9.30
SUCHITRA	38.33	39.67	5.83	5.37	155.33	27.33	176.33	11.33	8.81
SHAILA (CU-1101)	39.67	41.33	5.35	5.06	151.33	26.33	172.23	10.33	5.97
SW 216	34.33	34.67	7.08	7.25	177.00	30.33	181.43	13.00	13.31
TMCU 3112	34.67	36.67	6.48	6.41	167.00	29.00	185.27	12.33	10.28
SAIRA 934 (CHECK)	33.67	32.33	7.26	8.46	188.33	31.67	188.86	14.67	14.72
f-test	S	S	S	S	S	S	S	S	S
S.EM (±)	0.66	0.69	0.04	0.07	1.32	0.27	1.73	0.32	0.24
CD (P=.05)	1.99	2.08	0.13	0.21	4.00	0.82	5.24	0.98	0.72

Table 2: Hybrids differed in fruit size, weight, harvest time, yield, and sweetness.

Hybrids	Fruit Diameter	Fruit length	Fruit weight	Days to first fruit harvest	Fruit yield per vine	Fruit yield (t/ha)	T.S.S
JINGLE-4048	5.20	19.57	168.07	44.33	2.88	19.23	5.52
SANYA	4.40	16.10	151.77	46.33	2.48	18.22	4.81
SARASWATI	3.67	13.47	143.57	48.33	2.18	17.46	4.46
SUCHITRA	3.57	13.50	138.03	50.33	2.06	15.51	4.45
SHAILA (CU-1101)	3.43	13.47	134.40	51.33	1.55	14.65	4.24
SW 216	4.67	18.23	156.87	45.67	2.56	18.23	5.14
TMCU 3112	3.93	15.30	148.00	47.00	2.57	17.53	4.73
SAIRA 934 (CHECK)	4.97	19.17	161.73	44.67	2.80	19.04	5.40
f-test	S	S	S	S	S	S	S
S.EM (±)	0.07	0.40	0.99	0.55	0.55	0.40	0.06
CD (P=.05)	0.20	1.22	3.01	1.68	1.68	1.20	0.17

Conclusion

The varietal evaluation of eight cucumber hybrids under Prayagraj agro-climatic conditions revealed significant differences in growth, yield, and quality traits. Among the tested hybrids, JINGLE-4048 emerged as the most promising cultivar due to its early flowering, vigorous vine growth, higher fruit number, superior fruit size and weight, and better quality parameters such as total soluble solids. Economically, JINGLE-4048 also proved to be the most profitable hybrid, offering the highest net returns and benefit-cost ratio. These results suggest that JINGLE-4048 is well-suited for commercial cultivation in the Prayagraj region and can contribute to increasing cucumber productivity and farmers' income. Adoption of this hybrid can help overcome the limitations posed by traditional local cultivars and improve overall crop performance. Further research on its adaptability in other agro-climatic zones and

under varying management practices is recommended to validate these findings.

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