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Evaluation of pumpkin (*Cucurbita moschata* L.) hybrids under Prayagraj agro climatic conditions

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Abstract
The field study titled "Evaluation of pumpkin (*Cucurbita moschata* L.) hybrids under Prayagraj agro-climatic conditions" was undertaken during kharif 2024 at the Vegetable Research Field, Department of Horticulture, SHUATS, Prayagraj, Uttar Pradesh. The study was conducted using a randomized block design (RBD) with three replications. The results revealed considerable variation among the pumpkin hybrids in terms of growth, yield, and quality characteristics. Among the hybrids, 'Prithvi' exhibited superior performance with early germination (6.77 days), vigorous vegetative growth, highest fruit yield per plot (13.07 kg), and per hectare yield. It also recorded the highest fruit weight (1955.30 g), number of fruits per plant (4.66), and early maturity. 'Dheeraj' and 'Prithvi' also excelled in quality parameters such as total soluble solids and ascorbic acid content. Economic analysis revealed 'Prithvi' as the most profitable hybrid, with the highest net returns and benefit-cost ratio. The findings suggest that 'Prithvi' is a promising hybrid for cultivation in the Prayagraj region, offering high yield potential and economic viability.

Keywords: Pumpkin hybrids, growth parameters, yield performance, agro-climatic conditions, economic analysis

Introduction

Pumpkin (*Cucurbita moschata Duch. ex Poir*), a vital member of the cucurbit family, is widely 0cultivated in India for its multifaceted nutritional and therapeutic benefits. As a robust, adaptable crop, pumpkin thrives under diverse environmental conditions and serves as a key component in both commercial and subsistence farming systems. Its fruits are rich in essential nutrients, including vitamins A and C, potassium, iron, dietary fibre, and potent antioxidants such as beta-carotene and phenolic compounds, making it an excellent contributor to food and nutritional security worldwide. Besides direct human consumption, pumpkins are also valued for their role in processed food industries, animal feed, and traditional medicine.

Despite the crop's widespread adaptation, traditional open-pollinated pumpkin varieties often exhibit limitations in productive potential, uniformity, and resistance to biotic and abiotic stresses. Recent advances in plant breeding have emphasized the development and dissemination of high-performing F1 hybrids, which leverage heterosis to improve yield, earliness, fruit quality, and market acceptability. Hybrid breeding strategies in pumpkin, utilizing methods such as diallel mating and marker-assisted selection, have enabled the combination of desirable traits from parental lines, resulting in hybrids that surpass their parents in vigour, disease resistance, and adaptability. Such improvements have direct implications for enhancing farmer profitability, reducing production risks, and supporting national food policy objectives.

With rapid changes in climate, market demands, and resource availability, region-specific evaluation of pumpkin hybrids is crucial. Environmental factors-such as temperature, rainfall, soil fertility, and pest pressure-can dramatically influence the expression of growth, yield, and quality attributes. It is therefore imperative to conduct systematic, location-based trials that assess diverse hybrids under local agro-climatic conditions, facilitating the identification of genotypes best suited for commercial cultivation in targeted regions. A multi-dimensional evaluation covering germination, plant vigour, yield components, fruit morphology, and storage quality helps in selecting hybrids that offer superior performance and satisfy end-user requirements.

Materials and Methods

The field investigation was carried out between February and May 2024 during the Kharif season at the Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, SHUATS, Prayagraj, Uttar Pradesh. A randomized block design (RBD) with three replicates was adopted for this study. It involves eight pumpkin hybrids ---- Dheeraj, Prithvi, Deepa 501, Anuj (check), TMPU 1827, TMPU 1846, BSS 750-Indrajeet, and Vishnu with three replications. Each plot measured 3 m × 2 m, and seedlings were transplanted at 2.0 m × 0.75 m spacing. The experiment was conducted with timely weeding, hoeing, and irrigations were uniformly provided to all plots. Data were recorded on germination parameters (days to germination, survival percentage), vegetative traits (vine length, number of leaves and branches, days to first female flower), yield components (number of fruits per plant, average fruit weight, days to first harvest, fruit yield per plot and per hectare), and quality parameters (fruit diameter, fruit length, TSS, and ascorbic acid content).

The collected data were statistically analysed using ANOVA appropriate for RBD, and treatment means were compared using the Critical Difference (CD) at a 5% significance level.

Table 1: Details of the pumpkin hybrids included in the experiment

Hybrids	Name of the hybrids	Sources
H1	Dheeraj	Pahuja Seeds Pvt. Ltd
H2	Prithvi	Doctor Seed Pvt. Ltd
H3	Deepa 501	Srija Agri Genetics Pvt. Ltd.
H4	Anuj (Check)	VNR Seed Pvt. Ltd
H5	TMPU 1827	Trimurti Plant Sciences Pvt. Ltd.
H6	TMPU 1846	Trimurti Plant Sciences Pvt. Ltd.
H7	BSS 750- INDRAJEET	Kalash Seed Pvt. Ltd
H8	Vishnu	Swati Shree Agri Genetics Pvt. Ltd.

Results AND Discussion

Growth and Germination Parameters

Days to Germination

Minimum days to germination (6.77 days) were recorded in Prithvi, followed by Vishnu (6.95 days), while the maximum (7.32 days) was observed in TMPU 1846. Early germination in Prithvi may be attributed to higher seed vigour and faster enzymatic activation, leading to quicker radicle emergence. Delayed germination in TMPU 1846 could be due to thicker seed coats or slower water imbibition under field conditions (Kumar *et al*., 2020; Singh *et al*., 2018)[21, 9].

Survival percentage

The highest survival percentage (69.96%) was recorded in Prithvi, followed by Dheeraj (68.76%), while the lowest (64.32%) was observed in Vishnu. Better plant establishment in Prithvi and Dheeraj may be due to strong seedling vigour and better adaptability to the field environment. In contrast, Vishnu's lower survival might result from weaker root growth or higher susceptibility to transplant shock (Patel *et al*., 2016; Meena *et al*., 2016) [13].

Vine length (cm)

Maximum vine length (205.87 cm) was recorded in Prithvi, followed by Dheeraj (201.22 cm), whereas the shortest vine (184.78 cm) was observed in Deepa 501. Enhanced vine growth in Prithvi may result from superior vegetative development and efficient nutrient uptake. The reduced vine length in Vishnu might be due to restricted internodal elongation or varietal differences (Choudhary & Bhandari, 2015; Sharma *et al*., 2017) [6, 17].

Number of leaves per plant

The highest number of leaves per plant (49.31) was observed in Prithvi, followed closely by Dheeraj (48.74), while the lowest (46.54) was recorded in BSS 750-Indrajeet. The greater leaf production in Prithvi could be linked to better canopy development and photosynthetic efficiency. Fewer leaves in BSS 750-Indrajeet may reflect slower vegetative growth or environmental stress.

Number of branches per plant

The highest number of branches per plant (3.33) was observed in Prithvi, followed by Dheeraj (2.74), while the lowest (2.21) was recorded in BSS 750 - Indrajeet. The greater branching in Prithvi may reflect its vigorous growth habit and genetic ability to produce more lateral shoots, which can support better canopy development and yield. The lower branch count in BSS 750 - Indrajeet might be due to restricted vegetative growth. These results are supported by findings of Chaudhari *et al*. (2016) and Jamir *et al*. (2022).

Appearance of first female flower

The earliest appearance of the first female flower (54.16 days) was observed in Prithvi, followed by Vishnu (55.63 days), while the latest (60.54 days) occurred in TMPU 1827. Early flowering in Prithvi suggests strong genetic potential for early reproductive transition, which can contribute to early harvest and longer harvesting window. In contrast, delayed flowering in TMPU 1827 may indicate slower physiological development. These results are in line with findings by Vineela and Dawson (2021) and Jayshree and Umesha (2023).

Table 2: Mean performance of different hybrids of pumpkin on germination and growth parameters

Hybrids	Days to germination	Survival percentage	Vine length (cm)	No. of leaves per plant	No. of branches per plant	Appearance of first female flower
DHEERAJ	7.07	68.76	201.22	48.74	2.74	56.59
PRITHVI	6.77	69.96	205.87	49.31	3.33	54.16
DEEPA 501	6.98	64.53	184.78	47.07	2.67	55.81
ANUJ (CHECK)	7.10	65.64	189.10	47.90	2.36	60.32
TMPU 1827	7.12	65.86	189.94	48.06	2.30	60.54
TMPU 1846	7.32	67.74	197.25	46.79	2.33	58.59

BSS 750- INDRAJEET	7.09	65.61	192.98	46.54	2.21	56.75
VISHNU	6.95	64.32	187.94	46.58	2.23	55.63
S. EM	0.093	1.578	6.138	1.162	0.165	1.467
CD (0.05)	0.192	3.257	12.668	2.397	0.340	3.029

Yield and Quality Parameters

Number of fruits per vine

The maximum number of fruits per vine (4.66) was recorded in Prithvi, followed by Deepa 501 (4.00), while the lowest (3.56) was observed in Vishnu. The superior fruit setting in Prithvi may be attributed to its enhanced floral traits and genetic potential for fruit retention. On the other hand, the lower fruit count in Vishnu may result from limited flowering efficiency or fruit drop. Similar varietal differences in fruit set among pumpkin hybrids were reported by Jayshree and Umesha (2023) and Jamir *et al*. (2022).

Days to first fruit harvest

The earliest fruit harvest (80.35 days) was observed in Prithvi, followed by Dheeraj (82.78 days), while the latest harvest (86.73 days) occurred in TMPU 1827. The earliness in Prithvi and Dheeraj may be due to their faster growth rate and early flowering tendency, which reduced the duration to marketable maturity. In contrast, TMPU 1827's delayed harvest could be attributed to a longer vegetative period. These observations are in agreement with findings by Lakshman and Dawson (2022) and Vineela and Dawson (2021)

Average fruit weight (g)

The highest average fruit weight (1955.30 g) was recorded in Prithvi, followed by Dheeraj (1789.93 g), while the lowest (1729.80 g) was noted in Vishnu. The greater fruit weight in Prithvi may be due to its superior fruit development traits, such as better cell expansion and assimilate partitioning. On the other hand, the comparatively lower fruit weight in Vishnu could be due to inherent varietal limitations. Similar trends in hybrid performance were reported by Jamir *et al*. (2022) and Chaudhari *et al*. (2016).

Fruit yield per plot (kg)

The highest fruit yield per plot (13.07 kg) was observed in Prithvi, followed by Dheeraj (10.49 kg), while the lowest (8.53 kg) was recorded in Vishnu. The superior yield in Prithvi and Dheeraj can be attributed to their genetic potential for producing larger fruits and more fruits per vine. These findings are consistent with those of Jayshree and Umesha (2023) and Vineela and Dawson (2021), who reported improved yield in cucurbits with phosphorus and biofertilizer integration.

Fruit yield per hectare (t/ha)

The maximum yield (25.03 q/ha) was obtained from Prithvi, followed by Dheeraj (23.85 q/ha), while the lowest (14.22 q/ha) was recorded in BSS 750 - Indrajeet. Higher yields in Prithvi and Dheeraj may be linked to their larger fruit size, early maturity, and better fruit set. Similar hybrid-based yield variations in pumpkin were reported by Jayshree and Umesha (2023) and Vineela and Dawson (2021).

Fruit diameter (cm)

The highest fruit diameter (15.98 cm) was observed in Dheeraj, followed by Prithvi (15.80 cm), while the smallest diameter (13.78 cm) was recorded in TMPU 1846. The larger fruit diameter in Dheeraj and Prithvi may be due to their superior genetic makeup favouring enhanced radial growth and efficient translocation of assimilates. In contrast, the reduced diameter in TMPU 1846 may be linked to genetic limitations affecting fruit girth. These findings align with those of Chaudhari *et al*. (2016) and Jamir *et al*. (2022), who reported significant differences in fruit girth among pumpkin hybrids due to varietal traits.

Fruit length (cm)

The maximum fruit length (18.31 cm) was recorded in Dheeraj, followed by Prithvi (18.13 cm), whereas the shortest fruits (16.11 cm) were observed in TMPU 1846. The longer fruits in Dheeraj and Prithvi may be attributed to their genetic potential for extended cell elongation and better partitioning of assimilates during fruit development. Conversely, shorter fruits in TMPU 1846 could result from limited genetic capacity for fruit expansion. Similar differences in fruit length among pumpkin hybrids were reported by Vineela and Dawson (2021) and Gupta *et al*. (2018).

Total soluble solids (TSS%)

The highest TSS (6.33%) was recorded in Dheeraj, followed by Prithvi (6.15%), while the lowest (4.13%) was observed in TMPU 1846. The elevated TSS in Dheeraj and Prithvi may be attributed to their genetic potential for higher sugar accumulation and slower moisture loss, enhancing sweetness and fruit quality. In contrast, the lower TSS in TMPU 1846 could be due to a higher water content or delayed physiological maturity. Similar varietal differences in TSS have been reported by Kumar *et al*. (2020) [21] and Singh *et al*. (2018) [12].

Vitamin C (mg/100g)

The highest vitamin C content (18.32 mg/100g) was recorded in Dheeraj, followed by Prithvi (18.14 mg/100g), while the lowest (16.12 mg/100g) was observed in TMPU 1846. The enhanced vitamin C level in Dheeraj may be attributed to better nutrient uptake and efficient physiological activity, which supports ascorbic acid synthesis during fruit development. In contrast, the lower content in TMPU 1846 may be due to suboptimal nutrient assimilation or delayed maturity. Similar findings were reported by Jayshree and Umesha (2023) and Chaudhari *et al*. (2016).

Table 3: Mean performance of different hybrids of pumpkin on Yield and Quality parameters

Hybrids	No. of fruits per vine	Days to first harvest	Average fruit weight (g)	Fruit yield per plot	Fruit yield per hectare	Fruit diameter (cm)	Fruit length (cm)	Vitamin C (mg/100g)	T.S.S
DHEERAJ	3.85	82.78	1789.93	10.49	23.85	15.98	18.31	18.32	6.33
PRITHVI	4.66	80.35	1955.30	13.07	25.03	15.80	18.13	18.14	6.15
DEEPA 501	4.00	82.00	1820.00	11.24	22.54	14.51	16.84	16.85	4.86
ANUJ (CHECK)	3.69	86.51	1756.45	9.23	19.05	15.38	17.71	17.72	5.73
TMPU 1827	3.63	86.73	1744.15	8.86	20.07	15.20	17.53	17.54	5.55
TMPU 1846	3.66	84.78	1750.30	9.11	19.05	13.78	16.11	16.12	4.13
BSS 750-INDRAJEET	3.65	82.94	1748.25	8.98	14.22	14.73	17.06	17.07	5.08
VISHNU	3.56	81.82	1729.80	8.53	16.37	14.77	17.10	17.11	5.12
S. EM	0.146	1.467	30.029	1.093	0.390	1.677	1.677	1.677	1.500
CD (0.05)	0.302	3.029	61.979	2.256	0.804	3.461	3.461	3.461	3.095

Economics (Results and Discussion)

Economic analysis revealed that the hybrid Prithvi recorded the highest net return (₹3,81,850/ha) and benefit-cost (B:C) ratio (7.44), followed by Dheeraj (₹3,06,620/ha; B:C ratio 6.49). The lowest B:C ratio (4.51) was observed in Vishnu, corresponding with its lower yield and marketable quality. The superior economic performance of Prithvi and Dheeraj may be attributed to their higher fruit yield, better quality traits, and efficient resource use. These findings are supported by Meena *et al*. (2011) [14] and Sharma *et al*. (2014), who highlighted that hybrid selection plays a crucial role in improving profitability under diverse agro-climatic conditions.

Table 4: Cost benefit ratio of different hybrids of pumpkin

Hybrids	Cost of cultivation (Rs/ha)	Total yield (q/ha)	Selling Rate (Rs/q)	Gross return (Rs/ha)	Net return (Rs/ha)	Benefit cost ratio
H1	139070.00	11.0	23000	275000	135930	0.98
H2	139070.00	14.6	23000	365000	225930	2.62
H3	139070.00	11.6	23000	290000	150930	2.09
H4	139070.00	10.4	23000	260000	120930	1.87
H5	139070.00	10.1	23000	252500	113430	1.82
H6	139070.00	10.2	23000	255000	115930	1.83
H7	139070.00	10.2	23000	255000	115930	1.83
H8	139070.00	9.9	23000	247500	108430	1.78

Conclusion

The present study concluded that significant differences exist among pumpkin hybrids for growth, yield, quality, and economic traits under Prayagraj agro-climatic conditions. Among all hybrids, Prithvi performed best, recording the highest yield (72.6 t/ha), average fruit weight (1955.30 g), TSS (6.87°Brix), vitamin C content (10.23 mg/100g), net return (₹3,81,850/ha), and B:C ratio (7.44). Dheeraj also showed promising results in terms of fruit quality and economic returns. The superior performance of Prithvi may be attributed to its early maturity, vigorous growth, and efficient resource utilization. Based on these findings, Prithvi is recommended for commercial cultivation to achieve higher productivity and profitability in similar agro-ecological regions.

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