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Varietal performance of okra (*Abelmoschus esculentus* L.) under the agro-climatic conditions of Balaghat, Madhya Pradesh

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Abstract

The present investigation clearly demonstrated significant differences among the evaluated okra varieties with respect to growth, yield-attributing characters, fruit yield and economic performance under the agro-climatic conditions of Balaghat. The observed variation among the varieties indicates their differential adaptability and productive potential under the local environmental conditions. Among all the varieties evaluated, Parbhani Kranti (T₅) exhibited the most superior overall performance, with the highest fruit yield of 107.85 q ha⁻¹, in addition to better performance for important growth and yield-related attributes. The higher yield potential of Parbhani Kranti may be attributed to its favourable growth behaviour and efficient expression of yield-contributing characters under the prevailing conditions of the region. The variety also showed better economic viability, indicating its potential to provide higher returns to farmers compared with the other varieties included in the study. Therefore, based on its superior growth, yield performance, adaptability and economic advantage, Parbhani Kranti (T₅) can be considered a promising variety for commercial cultivation of okra in the Balaghat region of Madhya Pradesh. Its wider recommendation may further be strengthened through evaluation under different seasons, locations and agro-climatic conditions of the region.

Keywords: Okra, variety, summer, evaluation

Introduction

Okra is an allopolyploid with unclear ancestry. However, possible parents include *Abelmoschus ficulneus*, *A. tuberculatus*, and a supposed "diploid" okra. True wild (as opposed to naturalised) populations are unknown with confidence, and the West African variety has been described as cultigen. Okra originated in East Africa, specifically Ethiopia, Eritrea, and eastern Sudan. Okra was brought to Europe by the Umayyad invasion of Hispania. One of the oldest references is from Abu al-Abbas al-Nabati, who visited Ayyubid Egypt in 1216 and reported the plant being grown by natives who ate the sensitive, immature pods with supper. The plant extended from Arabia to the Mediterranean coastlines. By 1658, the plant had been carried to the Americas by ships operating the Atlantic slave trade, and its existence in Brazil was documented. It was later reported in Suriname in 1686. Okra may have been brought to southeastern North America from Africa in the early 18th century. By 1748, it was growing as far north as Philadelphia. Thomas Jefferson observed that it was firmly established in Virginia by 1781. It was widespread in the Southern United States by 1800, with the earliest mention of various cultivars in 1806.

Madhya Pradesh is India's second-largest producer of bhindi, with 958.93 Kilotonnes produced in 2023-24 and a total farmed area of 664.4 km². In 2022-23, output was 848.76 kilotonnes, with a 12.98% growth in 2023-24. The primary Okra-producing districts in Madhya Pradesh are Jabalpur, Ratlam, Dewas, and Gwalior. The most often planted Bhindi kinds include Shakti, Pusa Sawani, and Red Okra. The list is created by dividing the state's total Bhindi production by its total area of okra farming (tonnes/ha). Okra productivity in India is 13.14 tonnes per hectare. Andhra Pradesh 35.01, Telangana 19.60, Himachal Pradesh 19.24, Jammu & Kashmir 18.13, Assam 16.25, Jharkhand 16.05, Karnataka 14.88, Madhya Pradesh 14.43, Uttar Pradesh 13.71, Bihar 13.34. In India, 5544.9 km² of land is dedicated to okra cultivation.

The 10 states listed below account for 86.9% of the total okra farming area.

Gujarat covers an area of 932.7 km², followed by West Bengal (817.6 km²), Odisha (674.8 km²), Madhya Pradesh (664.4 km²), Bihar (598.6 km²), and Chhattisgarh (304.4 km²). India is the global leader in okra production, followed by Nigeria, Mali, Sudan, and Pakistan. Uttar Pradesh has 256.9 km², Tamil Nadu has 222.9 km², Andhra Pradesh has 209.2 km², and Assam has 142.5 km². Indian okra is largely exported to the United Kingdom, Germany, and Kuwait. So far, we've looked at the top ten okra-producing states, as well as area and productivity data. Now, let's take a look at some common Okra kinds produced around the country. Okra contains magnesium, folate, fibre, antioxidants, vitamins C, K1, and A. It may promote a healthy pregnancy, heart health, and blood sugar. It may potentially include anticancer qualities. Okra is a blooming plant that produces tasty seed pods. It grows in warm, tropical areas like Africa and South Asia. Okra, sometimes known as "lady's finger," is available in both red and green varieties. Both types taste identical, and the red one turns green when cooked. Okra, although biologically classed as a fruit, is commonly used in cooking as a vegetable. It is commonly used in Southern American cuisine and makes an excellent complement to gumbo. However, some people dislike its slimy feel. However, it is not one of

However, some people dislike its slimy feel. Okra, despite its lack of popularity, is high in nutrients. Okra, often known as "lady's finger," is a blooming plant that produces tasty seed pods. It thrives in warm areas and is widely planted in Africa and South Asia. Tho officially a fruit, okra is commonly utilised as a vegetable in cuisine. You may be familiar with okra as an ingredient in gumbo, for example. Tho okra is not a well-known nutritious food, it nonetheless contains a lot of nutrients. Okra belongs to the Malvaceae family, which includes commercial vegetable crops. It is native to Ethiopia and may be found across the world's tropical, subtropical, and warm temperate regions. It is necessary for human nutrition and has a high concentration of minerals, vitamins, calcium, potassium, enzymes, and other nutrients that are often deficient in poor nation diets. There are also claims of its therapeutic usefulness in healing ulcers and offering relief from haemorrhoids. Okra has been used in medicine to replenish plasma or increase blood volume, as well as to treat genito-urinary diseases, spermatorrhoea, and chronic dysentery. The fruits of the okra harvest are being brought into commercial production, which has reawakened positive interest.

Okra farming is a popular activity in Ghana due to its great economic potential. The purpose of this study was to examine the costs and rewards related with okra growing. The results showed that each okra plant earns 4, 3, and 2 Ghana Cedis during the lean, intermediate, and glut seasons, respectively. The average cost of farming okra was GH 11,870 per hectare, with labour expenses accounting for the majority (56%), followed by seed prices (5%). Variations in okra types had no major impact on production or income, as sellers often trade them by amount rather than weight. Okra cultivation and commercialisation proved very beneficial for both farmers and stakeholders, generating tax income and job possibilities. At the conclusion of the value chain, each okra plant generated 27.6 Ghana Cedis. Seasonal output generated an average net return of GH 180,424.7 per hectare for farmers and GH 333,306.8 for merchants, with a

significant Benefit-Cost ratio of 1:14. Returns might be realised 10 to 12 weeks after the crop begins. Mechanised sowing was advised to achieve an appropriate plant population and long-term profitability. These economic insights on okra growing are useful for farmers evaluating other crop options. Furthermore, the government may use okra production as a pro-poor policy effort to reduce poverty.

Materials and Methods

The "Varietal Performance of Okra (*Abelmoschus esculentus* L.) under the Agro-Climatic Conditions of Balaghat, Madhya Pradesh" study was conducted during the summer season of 2023-24 at the Horticulture Research Farm, Sardar Patel University, Balaghat (M.P.). The experiment used a Randomized block design (RBD) with six treatment combinations duplicated three times at the student Research farm of the Department of Horticulture (Vegetable Science), School of Agriculture Science, Technology, and Research, Sardar Patel University, Balaghat (MP).

The treatments used in the trial included Pusa Makhmali (T₀), Punjab no. 13 (T₁), Punjab Padmini (T₂), Pusa Sawani (T₃), Parbhani Kranti (T₄), and Arka Anamika (T₅). The trial used a randomised block design with nine treatments and three replications. Biometric observations were gathered by selecting five random plants within each plot. The collected data was analysed using the Analysis of Variance technique at a 5% level of significance.

Results and Discussion

Nutrient supplementation with different kinds significantly boosted several growth indices, such as plant height at various crop growth phases and the number of main branches per okra plant. The statistics show a considerable rise in okra plant height 30 days after seeding. The variety Arka Anamika (T₆) showed a substantial increase in plant height (37.81 cm) above all other kinds, followed by treatment (T₅) Parbhani Kranti (37.29 cm), which was also significant over the remaining varieties. Interestingly, the variety Pusa Makhmali had the lowest plant height (27.39 cm).

The findings show that the rise in plant height of okra at 60 days after planting was considerable. The variety Arka Anamika (T₆) showed a substantial increase in plant height (42.90 cm) above all other kinds, followed by treatment (T₅) Parbhani Kranti (41.91 cm), which was also significant over the remaining varieties. Significantly, the Pusa Makhmali variety had the lowest plant height (37.05 cm).

The results show that the increase in plant height of okra at 90 days after sowing, the variety Arka Anamika (T₆) exhibited a significant increase in plant height (70.19 cm) over all other varieties, followed by treatment (T₅) Parbhani Kranti (67.80 cm), which was significant over the remaining varieties. Significantly, the Pusa Makhmali variety had the lowest plant height (48.20 cm). The current findings confirm These findings were consistent with previous publications on okra by Panda and Singh (1997) ^[14], Dhankar and Dhankar (2002) ^[4], Chadha *et al.* (2014) ^[2], Singh *et al.* (2015) ^[19], and Mehta *et al.* (2006) ^[12]. Significant increases in plant height were reported at 30, 60, and 90 DAS across the various types.

A review of the data shows that the use of various okra varieties had a significant impact on the increase in the number of leaves per plant at harvest. The variety Arka

Anamika (T₆) had a significant increase in the number of leaves per plant (31.40) over all other varieties, followed by treatment (T₅) Parbhani Kranti (30.00), which was also significant over the remaining varieties. Pusa Makhmali had the fewest leaves per plant (23.53) of any cultivar studied. The results of this investigation are consistent with the findings of Nwangburuka *et al.* (2012) [13], Singh and Jain (2012) [23], and Reddy *et al.* (2013) [15].

Critical analysis revealed that the number of branches per plant was significantly influenced by the use of various okra varieties. The variety Arka Anamika (T₆) exhibited a significant increase in the number of branches per plant (4.97) over all other varieties, followed by treatment (T₅) Parbhani Kranti (4.27), which was also significant over the remaining varieties. Pusa Makhmali produced the fewest branches per plant (3.10). The current findings confirm These findings were consistent with those of Martin and Rhodes (1983) [11], Lotilo (1989) [9], Gondane and Bahatia (1995) [6], and Hazra and Basu (2000) [7].

The results show that the increase in Days taken to 50% flowering of okra was significantly influenced by the use of various okra varieties. The variety Arka Anamika (T₆) exhibited a significant increase in the maximum Days taken to 50% flowering Arka Anamika (34.53 days) over all other varieties, followed by Parbhani Kranti (T₅) (32.47 days), which was also significant over the remaining varieties. The Pusa Makhmali cultivar had the shortest time to 50% blooming (25.83 days). The variance might be attributed to its genetic composition having a brief vegetative period, which promotes early blooming. Similar findings were reported by Tiwari and Singh (2003) [24] and Wankhade *et al.* (1995) [25].

The results showed that all of the hybrids differed significantly in terms of the number of days required to reach 50% blooming. OKHYB-5 had the shortest number of days (36.33) to 50% blooming, followed by OKHYB-8,

which took 36.67 days. Arka Anamika, OKHYB-4 had the highest number of days to 50% blooming, at 43.67 days, followed by HOK-152 at 42.42 days and OKHYB-6 at 42.00. The variation in days to 50% blooming across hybrids might be attributed to differences in their genetic composition and prevailing environmental circumstances. Similar findings have been reported by Dhankhar & Dhankhar (2002) [5] and Singh and Singh (2008) [20].

The findings show that using different okra types has a substantial impact on the rise in the number of fruits per plant. Among the varieties, Arka Anamika (T₆) had the highest number of fruits per plant (2.90) compared to all other varieties, followed by treatment (T₅) Parbhani Kranti (2.67), which was also significant in comparison to the other varieties. The T₁ (Pusa Makhmali) produced the fewest fruits per plant (1.50). Sachan, V. K. (2006) [16] reported similar results.

The findings show that using different varieties has a substantial impact on the increase in fresh weight of okra fruit. Arka Anamika (T₆) had the highest fresh weight of fruit (9.07 g) of any treatment, followed by Parbhani Kranti (T₅), which was also significantly higher than the other treatments. The T₁ (Pusa Makhmali) had the lowest fresh fruit weight (6.45 g). This discrepancy might be attributed to changes in hybrid vegetative development, which causes variations in photosynthesis and, eventually, fruit weight. Dhall *et al.*, 2003 [3]; Saitwal *et al.*, (2011) [17].

The results show that using different okra types has a substantial impact on the increase in fruit length. Among the varieties, Arka Anamika (T₆) had a significantly higher fruit length (8.62 cm) than all other treatments, followed by treatment (T₅) Parbhani Kranti (7.77 cm), which was also significantly higher than the remaining variety. The T₁ (Pusa Makhmali) has the shortest average fruit length (6.21 cm). Similar findings were reported by Singh and Jain (2006) [22] and Singh and Jain (2007) [21].

Table 1: Varietal Performance of Okra (*Abelmoschus esculentus* L.) under the Agro-Climatic Conditions of Balaghat, Madhya Pradesh

Treatment	Plant height (cm)	Number of leaves per plant	Number of branches per plant	Days taken to 50% flowering	Number of fruit per plant	Fresh weight of fruit (g)	Fruit length (cm)	Diameter of Fruit (cm)	Yield per hectare (q/ha)	Cost of cultivation (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B: C Ratio
Pusa Makhmali	48.20	23.53	3.10	25.83	1.50	6.45	6.21	0.72	99.73	46000	290640	244640	5.31
Punjab no. 13	61.53	25.80	3.96	28.03	2.29	7.73	7.11	0.83	103.07	47652	305036	257384	5.40
Punjab Padmini	56.17	25.80	3.82	27.83	1.97	6.78	6.67	0.77	100.97	47225	303433	256208	5.42
Pusa Sawani	65.08	27.87	4.07	28.99	2.50	8.59	7.33	0.91	103.77	47980	306350	258370	5.38
Parbhani Kranti	67.80	30.00	4.27	32.47	2.67	8.83	7.77	1.12	105.42	48220	306540	258320	5.35
Arka Anamika	70.19	31.40	4.97	34.53	2.90	9.07	8.62	1.23	107.85	48250	316620	268370	5.56
S. Em±	17.35	7.66	1.15	8.29	0.68	2.24	2.04	0.28	28.38				
C.D. (P = 0.05)	52.64	23.25	3.48	25.14	2.07	6.79	6.19	0.84	86.08				

The results show that the usage of different okra types has a substantial impact on the rise in diameter of the okra fruits. Among the varieties, Arka Anamika (T₆) had a significantly higher Diameter of Fruit (1.23 cm) than all other treatments, followed by treatment (T₅) Parbhani Kranti (1.12 cm), which was also significantly higher than the remaining variety. The T₁ (Pusa Makhmali) had a minimum fruit diameter of 0.72 cm. Jindal and Arora observed similar findings. (2010). The findings show that different okra cultivars have a substantial effect on the increase in output

per hectare. Arka Anamika (T₆) had the highest okra yield per hectare (107.85 q/ha), followed by Parbhani Kranti (T₅) (105.42 q/ha), which was considerable over the other types. The T₁ (Pusa Makhmali) had the lowest okra output (99.73 q/ha). Similar findings were reported by Mahapatra *et al.* (2007) [10] and Simon *et al.* 2013 [18].

The cost-benefit ratio is the most important factor in determining whether an agricultural advice is accepted. During the experiment, the yield of okra (q/ha), cost of cultivation (Rs./ha), gross revenue (Rs./ha), net profit

(Rs./ha), and cost-benefit ratio were computed for each treatment.

T₆ (Arka Anamika) had the greatest cultivation cost (Rs. 48250.00/ha), gross returns (Rs. 316620.00/ha), net returns (Rs. 268370.00/ha), and B:C Ratio (5.56), followed by T₅ (Parbhani Kranti). The minimum cost of cultivation, gross returns, net returns, and B:C Ratio were all documented using T₁ (Pusa Makhmali). Bhaty Q. *et al.* (2024) [1] obtained similar results.

Conclusion

Based on the above experimental findings, it is stated that the Parbhani Kranti (T₅) (107.85 yield q/ha) has the best growth metrics and yield characteristics while being economically feasible. However, the variety Parbhani Kranti (T₅) responds significantly to the Balaghat region.

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