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Assessment of performance of Tomato varieties under agro climatic conditions of Tinsukia district of Assam

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Abstract

A field experiment was conducted during 2020–21 and 2021–22 to evaluate the growth, yield, fruit quality and economic performance of four tomato hybrids under the agro-climatic conditions of Tinsukia district, Assam. The experiment comprised of Arka Abhed, Arka Rakshak, Arka Samrat and Rocky and was conducted in farmers' fields. Arka Abhed exhibited superior vegetative growth, recording the maximum plant height (108.7 cm), number of branches (14.5), fruit clusters per plant (19.5) and no of fruits per cluster (7.1). It was also the earliest to attain 50% flowering (33.5 days) and first harvest (73.10 days). Arka Abhed recorded the highest pericarp thickness (6.78 mm), fruit diameter (7.60 cm), average fruit weight (98.56 g), number of fruits per plant (65.45) and fruit yield (5.04 kg plant⁻¹) and highest B: C ratio.

Keywords: Tomato, hybrid variety, yield attributes and Tinsukia district

1. Introduction

Tomato (*Solanum lycopersicum* L.) is a dominant vegetable crop in Tinsukia district mainly cultivated in Rabi season. valued for fresh consumption and processing. It belongs to the family Solanaceae and originated in South America. The plant is herbaceous annual with the chromosome number 2n=24 that reproduces sexually by seed. Tomatoes have high nutritional value with good quantity of vitamins A and B. It is also an excellent source of vitamin C (Sarmah *et al.*, 2023) [5]. Though tomato is adaptable to a wide range of climatic conditions, the plant thrives best in well drained soils and the optimum night temperature for fruit setting of tomato is 15°-20°C (Anon., 2020) With a productivity of 24.2 MT/ha and production of 203.31 lakh MT in an area of 8.6 lakh ha India ranks second, next to China (Singh *et al.*, 2023) [6].

In Assam, the productivity of tomato is quite low as compared to other states of India due to various biotic and abiotic factors. Tomato yield loss has been reported up to 70-100% due to Tomato Leaf curl Virus, depending on the stage of attack whereas, bacterial wilt has been reported to cause yield loss up to 70% and 50-60% yield loss has been reported by early blight. High rainfall coupled with high relative humidity make these diseases very prevalent in Assam. (Anon., 2011). Lack of high yield varieties is another factor adding to the low productivity of tomato in this region. Thus, nonavailability of improved tomato hybrids, use of non-descriptive seeds, high prevalence of disease and insect pest as well as poor management may be identified as some of the major bottle necks for tomato cultivation in Assam including Tinsukia district. So, adoption of hybrid varieties with desirable traits viz high yield, early yield, better nutritional quality, better post-harvest life, resistant to insect pest and

diseases etc can be considered as an effective strategy to enhance tomato production.

Several research institutes and private companies have developed tomato hybrids tailored to diverse agro-climatic conditions of India and adoption of these hybrids for cultivation holds promise for improving tomato production in Assam including Tinsukia district. But as this region, grapples with a warm, humid climate which gives rise to various biotic and abiotic stress challenges, the identification and promotion of hybrids is a crucial factor. Keeping that in view, a study was conducted to assess the performance of various tomato hybrids suitable for cultivation in Tinsukia district.

2. Materials and Methods

The varieties selected for the study were Arka Abhed, Arka Rakshak, Arka Samrat and Rocky.

Arka Abhed is a semi-determinate F1 hybrid developed for multiple-disease resistance, including resistance to early blight, late blight, bacterial wilt and tomato leaf curl disease. Arka Rakshak as well as Arka Samrat are also widely recognized tomato variety with resistant to early blight, tomato leaf curl and bacterial wilt while Rocky is a private commercial hybrid.

The study was carried out in the year 2020-21 and 2021-22 in farmers field of Barekuri, Matiakhana and Gutibari in Randomized Block Design. Healthy disease-free seedlings of 25 days were transplanted in the main field.

3. Results and Discussion

3.1 Growth and crop phenology

A significant difference among the tomato hybrids were

observed for growth, flowering, harvesting and fruiting characteristics. The maximum plant height (108.7 cm) as well as maximum number of branches per plant (14.5) was recorded in Arka Abhed representing its superior vegetative vigour while the lowest plant height was recorded in Rocky (Table 1). The disparity in plant height and branching may be

due to differences in the genetic constitution and growth habits of the hybrids and their interaction with the growing environment. Remzeena *et al.* (2023) ^[4] also reported similar significant variation in growth characteristics among tomato hybrids.

Table 1: Performance of hybrids for growth and yield attributing characters

Hybrid	Plant height (cm)	Number of branches (nos.)	Days to 50% flowering (days)	Days to first harvest (DAP)	Crop duration (Days)	No of fruits /cluster (Nos)	No of fruit clusters /plant(Nos)
Arka Abhed	108.7	14.5	33.5	73.10	128.9	7.1	19.5
Arka Rakshak	100.5	12.05	36.8	79.30	126.3	6.5	16
Arka Samrat	105.4	13.8	34.9	80.20	126.6	6.2	16.5
Rocky	95.8	12.5	39.7	82.04	132.4	5.9	15
Sed(±)	1.22	0.29	0.56	0.78	0.99	0.22	0.40
CD (5%)	2.81	0.66	1.28	1.80	2.28	0.50	0.91

Arka Abhed attained the 50% flowering stage at the earliest (33.5 days) followed by Arka Samrat (34.9 days), Arka Rakshak (36.8 days) and Rocky (39.7 days). The first harvest of the crop was found to be longest in Rocky (82.04 DAP), whereas the shortest first harvest was recorded in Arka Rakshak (79.30 DAP). The shortest crop duration was observed in Arka Rakshak (126.3 days) while Rocky (132.4 days) recorded the longest crop duration (Table 1). Remzeena *et al.* (2023) ^[4] and Mishra *et al.* (2024) ^[3] also reported significant variation in crop duration among tomato hybrids. Regarding fruiting behaviour, the highest number of fruits per cluster was recorded in Arka Abhed (7.1 nos) followed by Arka Rakshak (6.5 nos), Arka Samrat (6.2 nos) and Rocky (5.9 nos). Arka Abhed also recorded the maximum number of fruit clusters per plant (19.5), whereas Rocky recorded the minimum (15.0). Comparable varietal differences in fruit number and other yield-contributing traits have been documented in tomato by Remzeena *et al.* (2023) ^[4] and Devi and Rout (2023) ^[1].

3.2 Evaluation of hybrids for fruit and yield contributing traits

Among fruit characters, Arka Abhed recorded the lowest fruit shape index (0.97), signifying a nearly round fruits, while Arka Rakshak recorded the highest value (1.15) indicating comparatively elongated fruits. Arka Abhed also produced fruits with the maximum pericarp thickness (6.78 mm), while Arka Samrat (6.20 mm), Rocky (6.08 mm) and Arka Rakshak (5.99) mm were statistically at par with one another for pericarp thickness (Table 2). Greater pericarp thickness is considered as a desirable attribute for better fruit firmness which might help in enhancing the resistance to mechanical injury during handling and transportation (Remzeena *et al.*, 2023) ^[4]. The highest fruit diameter was recorded in Arka Abhed (7.60 cm), followed by Arka Samrat (7.12 cm), Rocky (6.24 cm) and Arka Rakshak (6.10 cm). There was a significant variation in fruit diameter in Arka Abhed and Arka Samrat and Rocky and Arka Rakshak were statistically at par. Similar varietal variation in fruit dimensions between Arka Rakshak and Arka Samrat were also reported by Devi and Rout (2023) ^[1].

Table 2: Performance of hybrids for fruit and yield characters

Hybrids	Fruit shape Index	Pericarp thickness (mm)	Fruit diameter	Average fruit weight (g)	No of fruits /plant	Yield /plant (Kg)	TSS (°B)
Arka Abhed	0.97	6.78	7.6	98.56	65.45	5.04	4.63
Arka Rakshak	1.15	5.99	6.1	74.89	48.53	4.88	4.85
Arka Samrat	1.09	6.2	7.12	89.69	50.37	3.9	4.65
Rocky	1.05	6.08	6.24	75.26	34.22	2.8	4.84
S.Ed (±)	0.023	0.097	0.098	1.242	1.037	0.109	0.064
CD (5%)	0.052	0.223	0.225	2.863	2.391	0.251	0.147

The highest average fruit weight (98.56 g) was observed in Arka Abhed followed by Arka Samrat (89.69 g), Rocky (75.26 g) and Arka Rakshak (74.89 g). Arka Abhed and Arka Samrat were significantly superior to the other hybrids while Rocky and Arka Rakshak were statistically at par as summarized in Table 2 Differences in fruit weight among hybrids are generally associated with their genetic constitution, fruit dimensions, pericarp thickness and assimilate accumulation in developing fruits. Similar findings were also reported previously by Sharma *et al.*, 2024.

Significant variation was recorded in fruits per plant among the hybrids with Arka Abhed recording the maximum number of fruits /plant (65.45) followed by Arka Samrat

(50.37), Arka Rakshak (48.53) and Rocky (34.22). The greater number of fruits recorded in Arka Abhed might be associated with its higher number of clusters per plant and better fruit-setting ability. Consequently, Arka Abhed produced the highest fruit yield per plant (5.04 kg), followed by Arka Rakshak (4.88 kg), Arka Samrat (3.90 kg) and Rocky (2.80 kg). Although Arka Rakshak produced fewer fruits and had a lower average fruit weight than Arka Abhed, its relatively high number of fruits per cluster contributed to its greater yield (Table 2). The superior yield of Arka Abhed could be attributed to the combined effects of its higher number of fruits per plant, greater average fruit weight, larger fruit diameter and greater number of clusters per plant. Previous studies have similarly established that differences in

fruit number, fruit weight and fruit-setting ability are major causes of yield variation among tomato hybrids (Devi & Rout, 2023; Remzeena *et al.*, 2023) ^[1, 4]. The highest TSS content was recorded in Arka Rakshak (4.85 °Brix), closely followed by Rocky (4.84 °Brix), Arka Samrat (4.65 °Brix) and Arka Abhed (4.63 °Brix).

3.3 Economics: The economics of tomato varieties summarized in Table 3 exhibited a considerable variation among the tomato hybrids. Arka Abhed recorded the highest gross return (₹12,44,444 ha⁻¹), net return (₹10,52,444 ha⁻¹), and B:C ratio (6.48), representing its superior economic viability. It was followed by Arka Rakshak, with a gross return of ₹12,04,938 ha⁻¹, net return of ₹10,12,938 ha⁻¹, and B:C ratio of 6.28. Arka Samrat generated a comparatively lower net return of ₹7,70,963 ha⁻¹ and a B:C ratio of 5.02 with Rocky recorded the lowest gross return (₹6,91,358 ha⁻¹), net return (₹4,99,358 ha⁻¹), and B:C ratio (3.60).

Table 3: Economics of tomato hybrid varieties

Hybrids	Gross return (Rs ha ⁻¹)	Cost of cultivation (Rs)	Net return (Rs ha ⁻¹)	B:C ratio
Arka Abhed	12,44,444	192000	10,52,444	6.48
Arka Rakshak	12,04,938	192000	10,12,938	6.28
Arka Samrat	9,62,963	192000	7,70,963	5.02
Rocky	6,91,358	192000	4,99,358	3.60

4. Conclusion

The present study demonstrated significant variation among the evaluated tomato hybrids in their growth, crop phenology, yield attributes, fruit quality and economic returns under the agro-climatic conditions of Tinsukia district, Assam. Among the hybrids, Arka Abhed exhibited the best overall performance, with superior vegetative growth, earlier flowering and harvesting, greater fruit number, larger and heavier fruits and the highest yield per plant. It also generated the highest gross return, net return and benefit–cost ratio, confirming its superior economic viability. Arka Rakshak ranked second in yield and profitability, indicating its potential for producing fruits with better soluble-solids content. Though, Arka Abhed may be recommended as the most suitable tomato hybrid for commercial cultivation in Tinsukia district, followed by Arka Rakshak, further multilocation and multisession evaluations may be undertaken to confirm their performance and stability across the different tomato-growing areas of Assam.

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