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Evaluation of tomato hybrid Arka Rakshak for growth and yield at farmer's field

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Abstract

An on-farm trail (OFT) on Arka Rakshak, a triple disease-resistant F1 hybrid tomato, was tested at different farmer fields under the KVK Banaskantha-II Jurisdiction area from 2019–20 to 2021–22. The results on farmer fields revealed that an average plant height of (93.94 cm) was recorded in Arka Rakshak, while in the local check, it was (80.50 cm). However, 47% more branches were recorded in Arka Rakshak compared to the Cheak. Flower initiation and first fruit picking were 1.33 and 11.53 days earlier in Cheak compared to Arka Rakshak, respectively. However, the maximum number of fruit pickings was 9.07 in Arka Rakshak. The maximum average number of fruits per plant was found to be higher in Arka Rakshak (39.87) and lowest in the local check (26.10). Maximum fruit weight was recorded in Arka Rakshak (84.96 g) compared to local check (71.80 g), whereas maximum fruit yield per plant was recorded in Arka Rakshak (3.39 kg) and minimum in local check (1.90 kg). The maximum average fruit yield was recorded at 609.51 q/ha in Arka Rakshak, which was 80.6% higher than the local check. There was no bacterial blight incidence in the Arka Rakshak hybrid, whereas 16.6% bacterial blight incidence was recorded in the local Cheak during the flowering and fruit setting periods. The incidence of tobacco leaf curl virus was observed to be very low (1.71%) in the Arka Rakshak compared to the local Cheak (14.9%). However, the infestation of early leaf blight was found to be 1.08% as compared to the local check of 20.1%. The maximum average income of Rs. 735260/ha was obtained from Arka Rakshak, compared to the local check of Rs. 347938/ha. Further, the net profit and B:C ratio were found to be the maximum (Rs. 608027/ha and 5.9) compared to the local check (Rs. 250023/ha and 4.3), respectively.

Keywords: Tomato, arka rakshak, local check, disease incidence

Introduction

The tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae and originated in Mexico. It is the second-most important vegetable crop in the world after potatoes (Quinet, 2019) [8]. It is a highly consumed vegetable due to its status as a basic ingredient in a large variety of raw, cooked, or processed foods (OECD, 2017) [6]. It is an important source of essential nutrients and antioxidants. It has been found to be effective in preventing several diseases due to the presence of lycopene phenols and antioxidants (Ntonifor *et al.*, 2013) [5]. India is the second-largest producer of tomatoes after China, with an area of 8.65 lakh ha and production of 210.56 lakh MT, with an average productivity of 24.3 t/ha (Anonymous, 2022) [1]. The productivity of tomatoes is comparatively low in India compared to other producing countries in the world (Keshavareddy *et al.*, 2018) [2]. In India, Madhya Pradesh contributes the highest in area and production of tomatoes, accounting for about 11.89 and 14.11 percent, respectively. This is followed by Odisha (10.85), Tamil Nadu (9.59), Karnataka (7.74), and Andhra Pradesh (7.12%) in area. However, Tamil Nadu and Andhra Pradesh have the 2nd and 3rd rank in production after Madhya Pradesh. However, Gujarat was in a fourth position in terms of productivity, about 28.8 tons/ha, after Andhra Pradesh, Karnataka, and Madhya Pradesh (Anonymous, 2022) [1]. In Gujarat, tomato was cultivated on 0.66 lakh ha with an annual production of 18.77 lakh MT. The important tomato-growing districts of Gujarat were Anand, Kheda, Gandhinagar, Dang, Dahod, Narmada, Panchmahal, Banaskantha, Vadodara, Valsad, Sabarkantha, and Bhavnagar (Rathod *et al.* 2019) [10]. The productivity enhancement of tomatoes is a major concern for the growers in the area. Due to the incidence of diseases such as bacterial wilt, leaf curl virus, and blight, the area and productivity have decreased, and the cost of cultivation has also increased. In recent times, varietal diversity in tomatoes has increased. Improved varieties of tomatoes can enhance yield through various genetic and trait-based methods. Varieties with larger, more uniform fruit sizes can lead to higher marketable yields. This is especially important for commercial production.

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Varieties that have a higher rate of fruit set and mature uniformly allow for more efficient harvesting. This leads to higher yields and reduces labor costs associated with multiple harvests. The conduct of on-farm trials to validate the new innovative technologies and specify the location specificity of the technology is a mandatory activity of KVKs. On-farm trials play a significant role in the validation of agricultural technologies. On-farm trails ensure the relevance of technologies developed on station to the priorities and problems of resource-poor farmers, who are usually the potential adopters. Therefore, the on-farm trail on tomato arka rakshak was planned to evaluate the growth and yield performance in the local environment and field situation.

2. Materials and Methods

An On Farm trail (OFT) on Arka Rakshak a triple disease (Bacterial wilt, early blight and Leaf curl virus) resistant F1 Hybrid of tomato released from Indian Institute of Horticultural Research (IIHR), Bengaluru was tested at different farmers fields under KVK Banaskantha-II Jurisdiction area. A total of 15 trials were conducted in the villages Chekhla and Ratanpura of Kankrej Taluka, village Ranpur and Jandi tharad Taluka, and village Malsan and Antrol of Vav Taluka during the Rabi seasons of 2019–20 to 2021–22 in a total area of 4.0 ha. The 30-day-old seedlings were supplied to the farmers for planting each farmer was supplied with 4065 seedlings of the "Arka Rakshak" hybrid for transplanting in his trial plot. The transplanting was done in the 1st week of November during all three years at a spacing of 90 x 65 cm. As a result, the plant population was around 18000 per ha. The selected farmers also grew their regular varieties and hybrids in nearby plots for comparison. The crop was supplemented with 25 MT of FYM and a total of 150:75:75 kg N: P₂O₅: K₂O per ha. Nitrogen was split into two equal doses; half of the dose was given during planting and the other half was applied at flower initiation, whereas

full doses of phosphorus and potassium were applied at the time of transplanting. Two sprayings of micronutrient mixtures of grade IV were also done at 40 and 65 days after transplanting for a better result. In each trial plot, hoeing, weeding, and other intercultural operations were frequently done. The farmers' practice plots with regular varieties or hybrids were also given the same treatments. The observation was taken from of 5.0 m² area. The disease incidences for bacterial wilt (BW), Alternaria leaf blight (ALB), and tomato leaf curl virus (TLCV) were observed by zig-zag marking of 5.0 m² area in each plot at farmers' field. The observation was taken as a number of infected plant in and total number of assessed plants in each variety plot and the disease incidence was estimated using formula Percentage disease incidence number infected plants /total number of assessed plant x 100. The farmer's feedback was also recorded to refine the technology if needed.

3. Results and Discussion

3.1 Growth Performance

The results on average plant height, numbers of branches, days taken to flower, days taken to first picking, and number of pickings were compared between the hybrid Arka Rakshak and local check, as depicted in Table 1. The results revealed that an average plant height of (93.94 cm) was recorded in Arka Rakshak, while in the local check; it was (80.50 cm). However, 47% more branches were recorded in Arka Rakshak compared to the Check. The more branches in tomato hybrids might be due to the suitability of particular hybrids in agro-climatic conditions and the high growth characteristics of hybrids (Prasad and Bahadur 2019) [7]. The flower initiation and first fruit picking were 1.33 and 11.53 days earlier in Check compared to Arka Rakshak, respectively. However, the maximum number of fruit pickings was 9.07 in Arka Rakshak. The findings coincide with Kumar *et al.* (2022) [3], Singh *et al.* (2013) [11].

Table 1: Performance of tomato hybrid Arka Rakshak over the check variety on growth charters at farmer's field

Years	Plant height (cm)		No. of Branches		Days taken to flower		Days taken to first picking		No. of pickings	
	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak
2019-20	84.16	96.38	7.2	12.60	30.40	32.60	61.00	74.00	6.20	9.20
2020-21	82.60	94.17	7.6	10.40	30.60	31.40	62.80	71.40	6.60	8.60
2021-22	77.74	91.28	8.2	11.00	31.60	32.00	60.00	73.20	6.40	9.40
Mean	81.50	93.94	7.67	11.33	30.87	32.20	61.27	72.80	6.40	9.07

3.2 Yield performance

The data perusal in Table 2 indicates that the maximum average number of fruit per plant was found to be higher in Arka Rakshak (39.87) and lowest in local check (26.10). Maximum fruit weight was recorded in Arka Rakshak (84.96 g) compared to local check (71.80 g), whereas maximum fruit yield per plant was recorded in Arka Rakshak (3.39 kg) and minimum in local check (1.90 kg). The maximum average fruit yield was recorded at 609.51 q/ha in Arka Rakshak,

which was 80.6% higher than the local check. These yield parameters might be due to better water and nutrient uptake capacity as well as the higher nutrient use efficiency and specificity of the hybrid. The data are in agreement with Rangnamei *et al.* (2014) [9]. The higher yield is co-related with the number of fruits and the weight of fruits per plant. It was apparent that the number of branches, fruit number, and fruit weight per plant showed a positive association with the fruit yield of tomatoes. Kumar *et al.* (2022) [3].

Table 2: Performance of Tomato Hybrid Arka Rakshak over the check variety on Yield charters at farmers field

Year	No. of Fruit /plant		Average fruit weight (g)		Fruit yield per plant (kg)		Fruit yield (q/ha)	
	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak
2019-20	27.00	41.40	73.80	84.20	2.00	3.48	358.10	626.54
2020-21	24.80	39.40	71.50	82.28	1.80	3.25	319.00	584.27
2021-22	26.60	38.80	70.00	88.40	2.10	3.43	335.59	617.72
Mean	26.10	39.87	71.80	84.96	1.90	3.39	337.50	609.51

3.3 Incidence of diseases

The data presented in Table 3 showed that there was no bacterial blight incidence in the Arkra Rakshak hybrid, whereas 16.6% bacterial blight incidence was recorded in the local check during the flowering and fruit setting periods. The incidence of tomato yellow leaf curl virus was observed to be very low (1.71%) in the Arka rakshak compared to the local

check at 14.9%. However, the infestation of early leaf blight was found to be 1.08% as compared to the local check of 20.1%. The data coincide with the findings of Mishra *et al.* (2019) [4]. The incidence of disease is varied by the local weather situation, vectors, seasonality, and growing conditions. Sseyewa *et al.* (2010) [12].

Table 3: Performance of Tomato Hybrid Arka Rakshak over the check variety on incidence of Diseases at farmer’s field

Year	Bacterial wilt (%)		Tomato yellow leaf curl virus (%)		Early leaf blight (%)	
	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak
2019-20	16.4	0.00	14.2	1.76	19.2	0.97
2020-21	18.5	0.00	14.2	1.84	22.2	1.17
2021-22	15.0	0.00	16.3	1.53	18.8	1.11
Mean	16.6	0.00	14.9	1.71	20.1	1.08

3.4 Economics

The data on gross return, net profit, and B:C ratio depicted in Table 4 shows that the maximum average income of Rs. 735260/ha was obtained from Arka Rakshak, compared to the local check of Rs. 347938/ha. Further, the net profit and B:C

ratio were found to be the maximum (Rs. 608027/ha and 5.9) compared to the local check (Rs. 250023/ha and 4.3), respectively. This could be because the Arka Rakshak tomato hybrid had more branches, more fruit per plant, more pickings, and a higher yield when compared to Local/check.

Table 4: Economics of Tomato Hybrid Arka Rakshak over Local Check

Year	Gross cost (Rs/ha)		Gross return (Rs/ha.)		Net return (Rs/ha)		B:C Ratio	
	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak	Local/check	Arka Rakshak
2019-20	94992	123382	340421	659017	245429	535635	4.3	6.4
2020-21	99302	128417	335455	743727	236153	615310	3.4	5.8
2021-22	99450	129900	367938	803036	268488	673137	3.7	5.4
Mean	97915	127233	347938	735260	250023	608027	3.8	5.9



Fig 1: Tomato Arka Rakshak Demonstration at farmer’s field

Conclusion

From the on-farm trial, the overall results of the Arka Rakshak hybrid indicate that this hybrid is best suited to the agro-climatic conditions of the district, and it was concluded that it can be a better option for tomato growers in the district to save on the additional cost of managing bacterial blight, leaf curl virus, and leaf spot diseases. Therefore, this hybrid can go for large-scale cultivation for a higher yield and return per unit area.

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