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The tomato hybrid "Arka Rakshak" for economic and yield analysis in Balaghat district of Madhya Pradesh

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Abstract
Varietal demonstration in tomato for yield and economic analysis at the farmers' fields of two Talukas, namely Balaghat, Waraseoni district, Krishi Vigyan Kendra Balaghat (Madhya Pradesh) did a front line demonstration during Rabi season of 2019 and 2020. Ten farmers actively participated in covering a 1 ha area with FLDs during the course of these two years of research. During the two years of the study, the average fruit output increased by 70 to 80 percent, from 425 q/ha in 2019 to 440 q/ha in 2020. The technological gap is between 255 and 240 q/ha while the extension gap is between 175 and 220 q/ha. The technology index dropped from 37.5% in 2019 to 35.9% in 2020, demonstrating the viability of the technology used in this area.

Keywords: Tomato, extension gap, front line demonstration and technology index

Introduction
One of the most significant vegetables, the tomato (Lycopersicon esculentum Mill.), a member of the solanaceae family, is grown extensively over the world for both fresh market supply and processing. After potatoes, tomatoes are the second most popular vegetable consumed. After maize, rice, wheat, potatoes, soybeans, and cassava, the tomato ranks seventh in terms of global production, producing around 160 million tons on nearly 4.8 million hectares of land in 2011.

The tomato is a popular annual vegetable crop that is widely grown all over the world and is thought of as a "protective food." It is a significant source of lycopene, vitamin C, and vitamin A, all of which are strong antioxidants. It is raised year-round. It is farmed in India on an area of 8.94 lakh hectares, producing 196.96 lakh tons annually with an average yield of 28 t/ha. The crop's production is viewed as average because of causes or limits such the lack of sufficient disease-resistant seed material, poor farming techniques, and the prevalence of pests and diseases that restrict crop growth. The most destructive tomato diseases in the state are thought to be Bacterial Wilt (BW), Alternaria Leaf Blight (ALB), and Tomato Leaf Curl Virus (TLCV). Numerous approaches to manage these diseases have been devised, but many of them have limited applicability due to socioeconomic constraints or site-specificity. Although host resistance is the most efficient form of management, it is challenging to find cultivars with long-lasting resistance across regions in the tropics and subtropics due to high temperatures and humidity. Additionally, it is challenging and time-consuming to breed for disease resistance to multiple conditions. However, there are tomato varieties and hybrids that consistently respond as numerous illnesses resistant kinds. In this study, an attempt was made to evaluate the performance of a hybrid named "Arka Rakshak" created by the Indian Institute of Horticultural Research (IIHR), Bangalore, for its response to three major diseases in the Jagatsinghpur district of Odisha during the Rabi season of 2016–17: Bacterial Wilt, Alternaria Leaf Blight, and Tomato Leaf Curl Virus. Additionally, the hybrid's yield in the farmers' fields was evaluated and contrasted with the dominant hybrids. The study also aimed to determine how the district's farmers and markets felt about the fruit's quality, size, and shape.

The goal of the current experiment was to determine how the hybrid "Arka Rakshak" responded to three major diseases that were common in the district and to discover an easy-to-implement, eco-friendly approach to manage all of these life-threatening illnesses for which farmers were spending a lot of time and money. Although it is a warm season crop, tomatoes need both warm and temperate climates. Frost and high levels of humidity are not good for tomato plants. The intensity of the light has an impact on fruit color, fruit set, and

pigmentation. Tomato plants do well in temperatures ranging from 10 °C to 30 °C, with the ideal range being 21-24 °C. Tomato cultivation is best suited to sandy loam soil with a high amount of organic content. High acidity soils are unsuitable for growing tomatoes.

Because of a lack of understanding about the cultivars most suited to the agro-climatic conditions, the tomato's potential is not fully realized. Prior to recommending any cultivars as suited for the area, it is important to assess cultivars with a focus on genotypic suitability and yield. Because of the various environmental circumstances, tomato varieties perform differently from place to place. Given the aforementioned information, it was deemed necessary to conduct an experiment on the genotype performance of the Arka Rakshak tomato cultivar in the Kalyan Karnataka region in order to identify and suggest cultivars that would be best suited to the agroclimatic conditions of the Yadagir district. The zones show where dry land agriculture that depends on rain is most prevalent. The district receives 1400 mm of rain on average.

In order to demonstrate the recently released tomato variety Arka Rakshak on farmer's fields, the KVK-Balaghat arranges front line demonstrations (FLDs). KVKs are advising various stakeholders, including farmers, farm women, rural youths, and extension workers, as well as providing strategic technology support. Utilizing technologies that are inexpensive and efficient in terms of inputs can improve front-line demonstration and, to some extent, close the yield gap. Tomatoes need both a warm and a cool temperature to grow successfully, but they are a warm season crop. This is necessary to showcase the high yielding new cultivars. The tomato plant cannot resist frost, so it is important to persuade growers of the possibility of more advanced production techniques to increase tomato yield. Frontline demonstrations were conducted methodically on farmer's fields to highlight the benefits of new techniques and persuade the farmers to incorporate them into their farming system.

Materials and Methods

In the first fortnights of October 2019 and 2020, nursery beds for the seedlings were raised in the KVK, Balaghat seedling production unit with a seed rate of 250 gm/ha. Seeds were sowed in the raised beds after being treated with Vitavax Power (Carboxin + Mancozeb) at 2g/kg of seed. For transplantation in his trial plot, the farmer received 2,500 "Arka Rakshak" hybrid seedlings. The transplanting was done in the first two weeks of November 2016 at a 75 x 60 cm spacing, thus there were roughly 25,000 plants per acre. In adjoining plots, the benefiting farmers also grew their standard kinds and hybrids for comparison. 20 MT of FYM and a total of 120:100:120 kg N: P_2O_5: K_2O per hectare were added to the crop as supplemental fertilizer. At the time of transplanting, all of the phosphorus, 1/3 of the nitrogen, and 1/3 of the potash were provided. At 30 and 60 days after transplanting, two equal portions of the remaining fertilizers were applied. For a better outcome, two sprayings of micronutrient solutions were also carried out at 30 and 60 days following transplanting. Hoeing, weeding, and other cross-cultural tasks were often carried out in each trial plot. The same treatments were also applied to the farmers' practice or test plots of ordinary types or hybrids. Both the check and the trial plots lacked any plant protection measures. In order to prepare the field, thorough plowing and harrowing were used. In a raised bed that had been well-prepared, the seeds were planted in September. Farmers applied their usual procedures (local variety) in the check (control) plot. When the crop reached maturity, it was harvested.

Results and Discussion

Analyzing the data (Table 2) reveals that in demonstration plots, tomato yield rose year after year. In the two years of the study, the average fruit output increased by between 70 and 80 percent, from 425 q/ha in 2019 to 440 q/ha in 2020.

The research period's extension gap, which ranged from 175 to 220 q/ha, highlights the necessity for farmers to be educated about adopting improved agricultural production practices in order to buck the trend of a huge extension gap. The farmers' collaboration in carrying out such demonstrations, which led to optimistic outcomes in following years, was reflected in the trend of the technology gap, which ranged between 255 and 240 q/ha. The difference in weather and soil fertility status may be the cause of the observed technological gap. Both Singh *et al*. (2016) [6] and Chapke (2012) [1] reported findings that were in line with one another.

The technology index demonstrated the viability of the upgraded technology in the agricultural setting. The more feasible a technology is, the lower its value on the technology index is. As a result, the decline in the technology index from 37.5% in 2019 to 35.29% in 2020 indicated the viability of the technology that had been demonstrated in this area. In mustard, Katare *et al*. (2011) [3], Keshavareddy *et al*. (2018) [4], and Dayanand (2012) [2] reported similar findings.

Benefit- Cost (B: C) ratio

Some economic metrics, such as the cost of cultivation, net return, and B: C ratio, were calculated in order to determine the economic viability of the demonstration technologies over and above the control. Based on current input and output cost prices, the economic viability of upgraded technology was estimated and represented in terms of the B: C ratio (Table 3).

The cost of producing the tomato used in the presentation was discovered to range between Rs 125,000 and Rs 135,000/ha. The demonstration's increased costs were mostly brought about by the higher costs associated with balanced fertilizer, the purchase of better hybrids, and IPM techniques. Data showed that compared to control plots, the demonstration's net return was significantly higher. The findings of Mokidue *et al*. (2011) [5] and Keshavareddy *et al*. (2018) [4] are supported by comparable results. During both research years, a greater B: C ratio was seen as compared to the control group.

The technology gap can be significantly closed by using scientific methods of tomato cultivation, which will raise the district's tomato production and, in turn, improve the producers' economic situation. Additionally, in order to close the extension gap and improve the district's tomato production, extension agencies in the area must offer farmers the required technical assistance using a variety of educational and extension methods. In conclusion, the study revealed that tomato growers' knowledge of disease-resistant and high-yielding hybrid tomatoes. The great output of the demonstration plots over farmers' fields raised awareness among tomato growers and encouraged other farmers to implement suitable advancements in production and protection techniques.

Table 1: Use of tomato technology in the study area and adoption gaps

Crop operations	Improved package of practices	Farmers practices	Gap
Variety	Arka Rakshak	locally adapted	Full void
soil analysis	have been completed everywhere	Not in practice	Full void
Seed rate	100 gm /ha	200 gm /ha	Full void
Treatment of seeds	Seed was treated with carbendazim at 1 g per kilogram of seed, captan at 2-3 g per kg of seed, and imidacloprid at 2.0 g per kg of seed.	Not in practice	Full void
Transplantation technique	Row to row planting on ridges is 90 cm long, and plant to plant is 75 cm long.	Plant to Plant 30 cm and Row to Row 60 cm in a flat bed	Full void
transplantation period	September	June	Full void
Fertilizer dose	POP 250:250:250kg (N:P:K)	Only N and P	Full void
Micronutrient	Arka Vegetable special (4 times)	uninformed about micronutrients	Full void
Weed management	Hand weeding 3-4 times	Hand weeding (2 times)	Full void
Plant protection	Integrated pest and disease management	Only chemical spray	Full void
Use of yellow sticky card	Installed 8-10 for acre	Not in practice	Full void
Marigold as intercrop	30 rows of tomatoes and 1 row of marigolds.	Not in practice	full void

Table 2: Yield of Tomato, technology gap, extension gap and technology index as influenced by improved practices.

Year	Fruit yield (t/ha)			% Increase	Technology gap (q/ha)	Extension gap (q/ha)	Technology index
	Demo (q/ha)	Check (q/ha)	Potential (q/ha)				
2019	425	250	680	70	255	175	37.5
2020	440	245	680	79	240	220	35.29

Table 3: Economic analysis of demonstration

Year	Cost of Cultivation (Rs/ha)		Gross Return (Rs/ha)		Net Return (Rs/ha)		Benefit Cost ratio B:C Ratio	
	Demo	Check	Demo	Check	Demo	Check	Demo	Check
2019	125000	105000	467940	222860	342940	117860	3:75	2:12
2020	135000	120000	480260	240680	345260	120680	3:55	2:00

Conclusion

The technology gap can be significantly closed by using scientific methods of tomato cultivation, which will raise the district's tomato production and, in turn, improve the producers' economic situation. Additionally, in order to close the extension gap and improve the district's tomato production, extension agencies in the area must offer farmers the required technical assistance using a variety of educational and extension methods. In conclusion, the study revealed that tomato growers' knowledge of disease-resistant and high-yielding hybrid tomatoes. The great output of the demonstration plots over farmers' fields raised awareness among tomato growers and encouraged other farmers to implement suitable advancements in production and protection techniques.

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