



# Performance Evaluation of Tomato Hybrids Arka Samrat and Arka Abedh in Alluri Sitarama Raju District of Andhra Pradesh, India

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## Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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## ABSTRACT

Krishi Vigyan Kendra (KVK), Pandirimamidi, DR. YSRHU conducted on farm trials from 2019-20 to 2021-22, in four selected villages involving eighteen farmers covering an area of 4.5 acres. The principal objective of this study was varietal assessment of high yielding tomato hybrids i.e. Arka Abedh (multiple disease resistant) and Arka Samrat (triple disease resistant) for ascertaining and recommending the cultivars best suited for the region. The results showed that tomato hybrid Arka Abhed (T<sub>2</sub>) (528.23 q/ha, 564.65 q/ha and 589.78 q/ha) proved to be the best in yield followed by Arka Samrat (T<sub>3</sub>) (501.24 q/ha, 538.67 q/ha and 558.75 q/ha) and INDAM - Rashmi hybrid (T<sub>1</sub>)

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(402.72 q/ha, 434.55 q/ha and 455.45 q/ha) for the three consecutive years of the study. The net returns increased steadily in the demonstration plots ranged from Rs. 2,54,261/- to Rs. 3,38,074/- in tomato hybrid Arka Abhed, whereas tomato hybrid Arka Samrat recorded Rs. 2,35,368/- to Rs. 3,13,250/- from 2019-20 to 2021-22. An Extension gap of 125.51 to 134.33 q/ha and 98.52 to 103.30q/ha were recorded in Arka Abhed and Arka Samrat respectively. Technology Index for tomato hybrids observed as i.e. INDAM - Rashmi (13.24%), Arka Abhed (18.65%) and Arka Samrat (30.15%).

**Keywords:** On farm trails; arka abedh; arka samrat; yield; extension gap; technology index.

## 1. INTRODUCTION

Tomato, scientifically known as *Solanum Lycopersicon* L., has attained the esteemed status of being the world's popular vegetable crop due to its remarkable adaptability to a wide range of agro-climatic conditions. Tomatoes are highly regarded as a protective food crop due to their rich content of essential minerals, vitamins, and organic acids. They serve as a vital source of lycopene, ascorbic acid, and carotene, all prized for their contributions to color, flavor, and antioxidant properties. Lycopene presence in plasma in tomato is valued for its anti-cancer property [1]. At present India ranks second in area next to China by producing 19.37 million tonnes of tomato from an area of 0.78 million ha. However, in terms of productivity, India ( $25 \text{ t ha}^{-1}$ ) stands in tenth position, whereas India is the fourth largest tomato producer in the world after China, USA and Turkey accounting for about 6.5% of the world tomato production [2]. Tomato is grown extensively throughout India including Andhra Pradesh, where the total area of the crop is 54160 ha with a production of 24.37 MT i.e. third largest producer of tomato, behind Madhya Pradesh and Karnataka. The hastening consumption of tomatoes has elevated its status as a high-value crop, providing a significant income source for farmers. It holds great importance from both production and industrial perspective, necessitating the need to enhance productivity per unit area in order to meet the growing demand within limited arable land [3,4].

Tomato is one of the most important vegetable crops cultivating in Alluri Sitarama Raju District of Andhra Pradesh including tribal areas where the climate and soil are congenial for the crop. However, farmers are getting low yields as the cultivating varieties prone to several diseases. Farmers also lacks knowledge regarding the proper selection of high yielding, multiple disease resistant varieties, adoption of improved

cultivation practices like proper seed treatment, protray nursery raising, integrated nutrient management and plant protection measures. It is imperative to advise the tomato growers about high yielding cultivars and demonstrate the right technology for getting higher yield, net returns right in their own fields and through their own hands. In the light of all such aspects, an on-farm trial (OFT) was undertaken in farmers' fields of selected villages by Krishi Vigyan Kendra, Pandirimamidi, Dr. YSRHU in Alluri Sitarama Raju District of Andhra Pradesh with the principal objective of varietal assessment of high yielding tomato hybrids for ascertaining and recommending the cultivars best suited for the region. The OFTs were conducted for three consecutive years to assess the performance of the cultivars with improved practices and convince the farmers for adopting improved farming practices for enhancing their economic livelihood.

## 2. MATERIALS AND METHODS

Tomato hybrids i.e. INDAM-Rashmi (farmers' practice - Check), Arka Abhed (multiple disease resistant) and Arka Samrat (triple disease resistant) both released by ICAR- IHR, Bengaluru were selected as treatments for assessing the yield and economic analysis in rabi season in a field area of 4.5 acres for the three consecutive years from 2019-20 to 2021-22. Eighteen participant farmers selected from four villages viz. Rajampalem, Indukurupeta, Gangavaram and Parimithadaka. Before conducting the field trial, the list of the participant farmers was prepared very meticulously. The skill trainings focused on the selection of quality of seeds, seed treatment, nutrient management, irrigation schedule, plant protection measures and right harvesting methods.

### Treatments:

- T<sub>1</sub>: INDAM-Rashmi (farmers' practice – Check)
- T<sub>2</sub>: Arka Abhed (multiple disease resistant)
- T<sub>3</sub>: Arka Samrat (triple disease resistant)

**Table 1. Weather details of Alluri Sitarama raju district of A.P during on-farm trails from 2019-20 to 2021-22**

Month	2019-20				2020-21				2021-22			
	Temp. (°C)		Rainfall (mm)		Temp. (°C)		Rainfall (mm)		Temp. (°C)		Rainfall (mm)	
	Max.	Min.	N	A	Max.	Min.	N	A	Max.	Min.	N	A
October	34.2	24.1	206.7	259.0	34.5	23.2	206.7	350.7	34.4	25.2	206.7	119.2
November	33.9	20.2	88.4	4.7	34.1	20.3	88.4	152.7	32.2	22.4	88.4	179.2
December	30.3	19.7	10.3	1.3	30.2	18.5	10.3	0.1	31.1	19.3	10.3	2.5
January	31.1	18.9	8.7	8.3	32.4	20.2	8.7	2.0	30.7	18.9	8.7	16.3
February	34.5	22.4	11.0	6.2	34.1	19.3	11.0	1.3	32.4	20.5	11.0	0.3

N: Normal Rainfall to be received, A: Actual Rainfall received

**Table 2. Particulars showing the details of tomato cultivation under existing farmer practices and through on-farm trails**

S. No.	Particulars	Existing practices	Improved practices demonstrated through on-farm trail
1	Variety/Hybrids	F <sub>1</sub> hybrid i.e. INDAM -Rashmi from market	Arka Abedh (Multiple disease resistant) and Arka Samrat (Triple disease resistant) from ICAR –IIHR, Bengaluru
2	Seed treatment	Improper methods were followed	carbendazim @ 2g/kg of seed
3	Raising of seedlings	Broadcasting of seed on Raised bed	Raised in pro trays filled with media (Cocopeat + perlite)
4	Fertilizer application	Improper management i.e. Application of Urea, DAP	Recommended Dose of Fertilizers (RDF) FYM @ 15 tonnes/ha N:P:K@ 120:60:60 Kg/ha
5	Intercultural operations	Staking followed	Staking followed
6	Diseases and Pest management	Over doses of fungicides and pesticides used	As both the hybrids are multiple and triple disease resistant, very limited usage of fungicides and needed pesticides.

Improved practices demonstrated through on-farm trails as mentioned in Table 2. Seed treatment was done with carbendazim @ 2g/kg of seed [3] for preventing fungal diseases. Seeds were sown in pro trays for ensuring better germination and seedlings were transplanted at 25 days old into the main field at a spacing of 90 x 60 cm. The spacing so used facilitated easy intercultural operations. The fields received FYM @ 15 tonnes/ha well before the sowing time. A recommended dose of fertilizers i.e. N, P and K @ 120, 60 and 60 kg/ha were applied [4] at required growth phases. Proper staking practices were followed and at maturity stage, picking was done at five days interval. Performance and yields of Arka Abhed (multiple disease resistant) and Arka Samrat (triple disease resistant) were compared against INDAM-Rashmi (farmers' practice - check).

The parameters such as Yield (q/ha), Cost of cultivation (Rs/ha), Gross Returns (Rs/ha), Net Returns (Rs/ha), Cost Benefit ratio were recorded according to Babu et al., [4]. Other parameters like extension Gap and

technology Index were calculated by formulae suggested by Singh et al. [5] and [6] to study the impact of on farm trails over the selected farmers.

- Extension gap = Demonstrated yield - Yield under existing practice
- Technology Index = Potential Yield – Demonstrated Yield / Potential Yield \* 100

### 3. RESULTS AND DISCUSSION

Results on yield (Table 3) revealed that all the three tomato hybrids recorded the highest yield in 2021-22 (455.50, 589.50 and 558.75 q/ha for INDAM-Rashmi, Arka Abhed and Arka Samrat respectively). Tomato hybrid Arka Abedh (T<sub>2</sub>) recorded an increase of 31.16%, 29.93% and 29.49% whereas Arka Samrat (T<sub>1</sub>) recorded an increase of 18.65%, 18.43% and 17.51% in yield over the farmers' practice (INDAM-Rashmi) during 2020-21, 2021-22 and 2022-23 respectively. The higher in yield per plant of tomato hybrids was due to higher fruit set and higher retention of matured fruits per plant. This

could be due to multiple disease resistance (Early leaf blight, late leaf blight, bacterial blight and leaf curl) of tomato hybrid Arka abhed and triple disease resistance (Early leaf blight, Bacterial blight and leaf curl) of Arka samrat. Similar results were reported by Babu et al., [4], Surendra et al., [2], Mishra et al., [7], Kale et al., [8] and Prasanna Lakshmi et al., (2021). The results revealed the positive effects of Arka Abhed and Arka Samrat over the existing farmers' practice viz. INDAM-Rashmi.

The outcomes of the economic analysis of Arka Abhed and Arka Samrat over the farmers' practice are shown in Table 3. Economic variables such as the cost of cultivation, net return and B:C ratio were calculated to determine the economic viability of demonstration relative to the control (farmers' practice - check). The cost of cultivation per hectare for the both the tomato hybrids Arka Abhed and Arka Samrat ranged from Rs. 1,15,500 /- in 2019-20 to Rs. 1,33,750 /- in 2021-22 whereas the demonstration plots ranged from Rs. 1,06,500 /- in 2019-20 to Rs. 1,23,000 /- in 2021-22. This might be due to increased costs of inputs like seed, fertilizers, more number of labour days required for harvesting. These results were in

accordance with Babu et al., [4] and Sahoo et al., [9].

The net returns too increased steadily in the demonstration plots ranged from Rs. 2,54,261/- to Rs. 3,38,074/- from 2019-20 to 2022-23 in tomato hybrid Arka Abhed, whereas tomato hybrid Arka Samrat recorded Rs. 2,35,368/- to Rs. 3,13,250/- from 2019-20 to 2021-22. The net returns were substantially higher in the demonstration plots over the control with farmers' practice plots i.e. Rs. 1,75,404/- (2019-20) to Rs. 2,41,360/- (2021-22). The results corroborate those Babu et al., [4], Kale et al., [8], Mokidue et al., [10] and Keshava reddy et al., [11]. Cost benefit ratio was recorded higher in the Arka Abhed (1:2.20, 1:2.31, 1:2.53) and Arka Samrat (1:2.04, 1:2.15, 1:2.34) than farmers' practice – INDAM Rashmi (1:1.65, 1:1.71, 1:1.96) in the three years of study from 2019-20 to 2021-22 respectively (Table 3 and Fig. 4). This finding complies with the observation of Devi et al., [3] that the wide variation in net return and benefit-cost ratio in tomato cultivation was due to high yield differences. And, also reported that a higher yield and 15% higher return was found with the tomato variety Arka Rakshak than Arka Samrat [12].

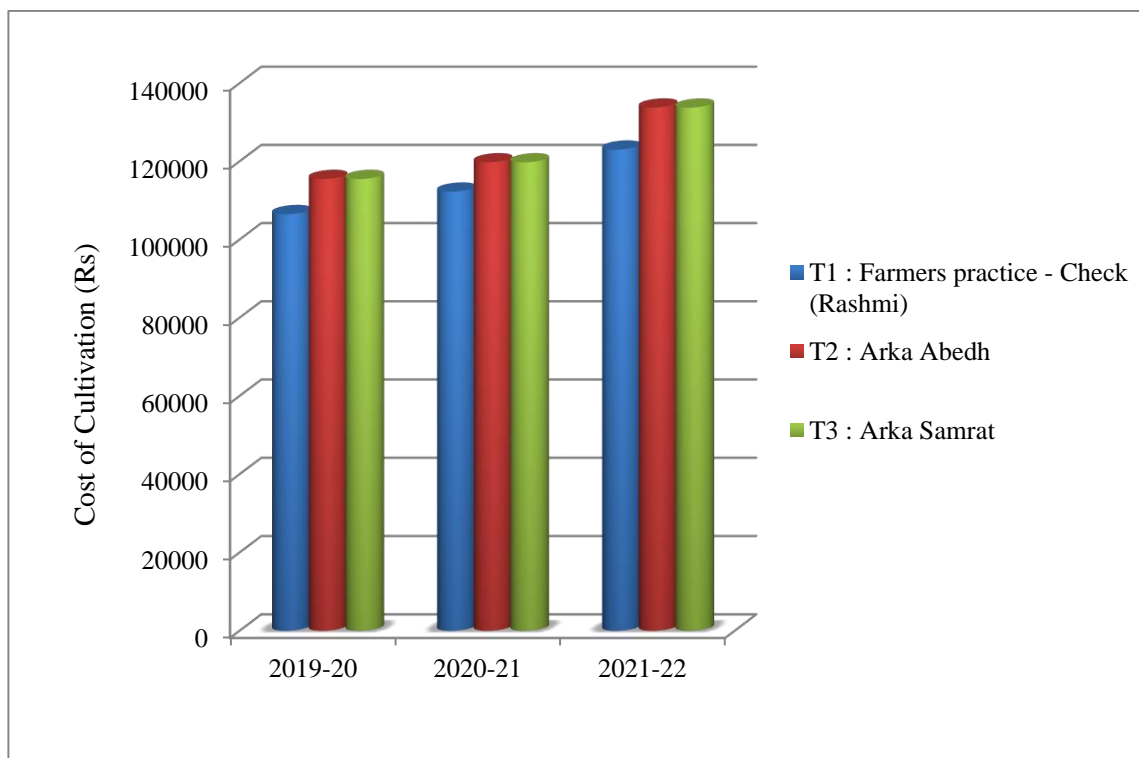


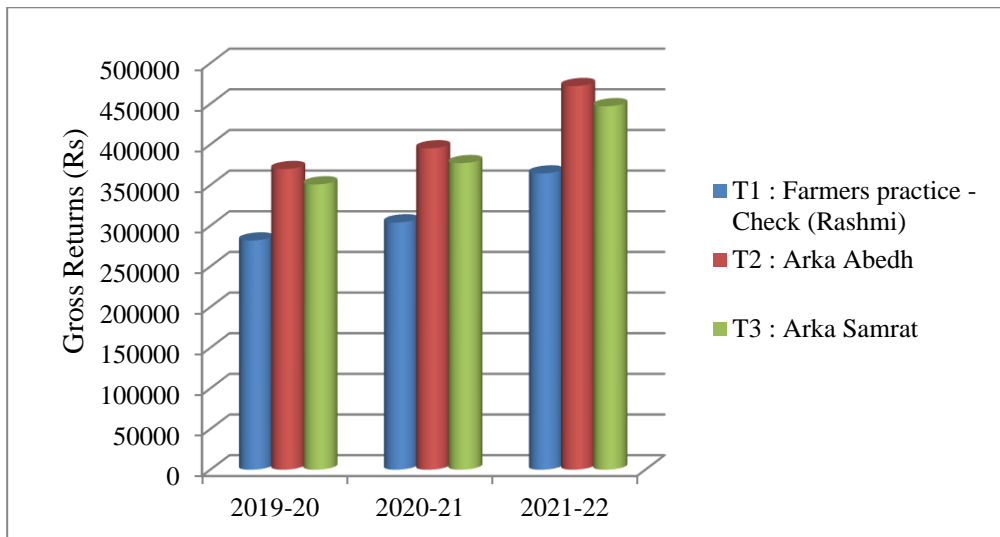
Fig. 1. Cost of cultivation of tomato hybrids over farmers' practice

**Table 3. Economic analysis of tomato hybrids Arka Abhed and Arka Samrat over farmers' practice (INDAM -Rashmi)**

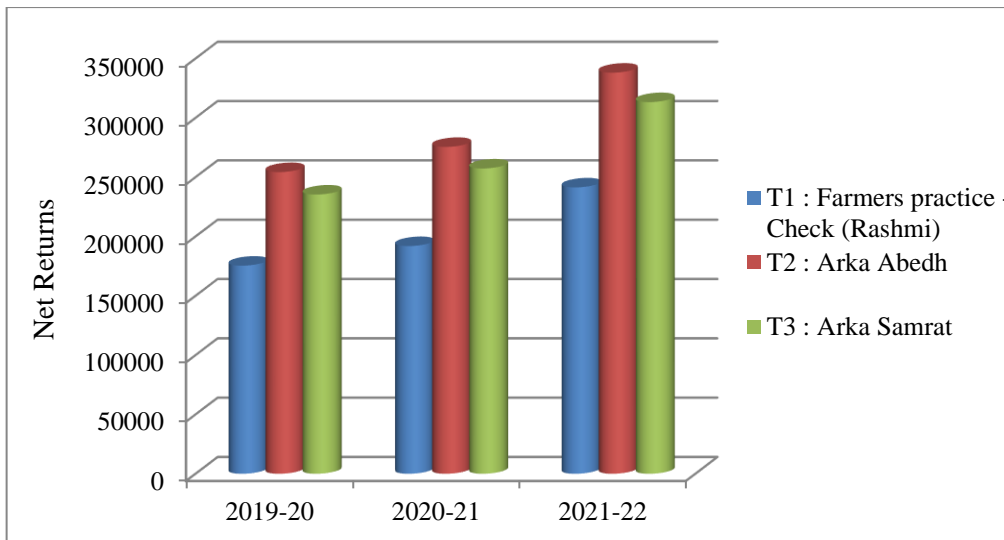
Particulars	Cost of cultivation (Rs/ha)				Gross Returns (Rs/ha)				Net Returns (Rs/ha)				Cost Benefit ratio			
	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean	2019-20	2020-21	2021-22	Mean
T <sub>1</sub> : Farmers practice - Check (INDAM-Rashmi)	106500	112250	123000	113917	281904	304185	364360	316816	175404	191935	241360	202900	1:1.65	1:1.71	1:1.96	1:1.77
T <sub>2</sub> : Arka Abedh	115500	119750	133750	123000	369761	395255	471824	412280	254261	275505	338074	289280	1:2.20	1:2.31	1:2.53	1:2.34
T <sub>3</sub> : Arka Samrat	115500	119750	133750	123000	350868	377069	447000	391646	235368	257319	313250	268645	1:2.04	1:2.15	1:2.34	1:2.17

**Table 4. Yield, Extension Gap and Technology Index of tomato hybrids Arka Abhed, Arka Samrat over farmers' practice (INDAM -Rashmi)**

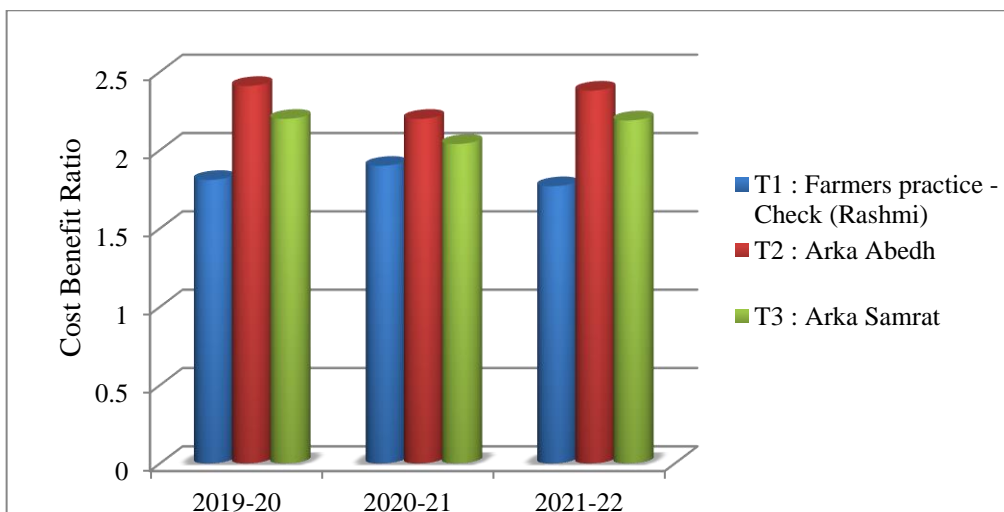
Particulars	Yield (q/ha)			Potential Yield (q/ha)	% increase in yield over farmers practice			Extension gap (q/ha)			Technology Index (%)		
	2019-20	2020-21	2021-22		2019-20	2020-21	2021-22	2019-20	2020-21	2021-22	2019-20	2020-21	2021-22
T <sub>1</sub> : Farmers practice - Check (INDAM-Rashmi)	402.72	434.55	455.45	525	-	-	-	-	-	-	23.29	17.22	13.24
T <sub>2</sub> : Arka Abedh	528.23	564.65	589.78	725	31.16	29.93	29.49	125.51	130.10	134.33	27.14	22.11	18.65
T <sub>3</sub> : Arka Samrat	501.24	538.67	558.75	800	18.65	18.43	17.51	98.52	104.12	103.30	37.34	32.66	30.15



**Fig. 2. Gross returns of tomato hybrids over farmers' practice**



**Fig. 3. Net returns of tomato hybrids over farmers' practice**



**Fig. 4. Cost benefit ratio of tomato hybrids over farmers' practice**

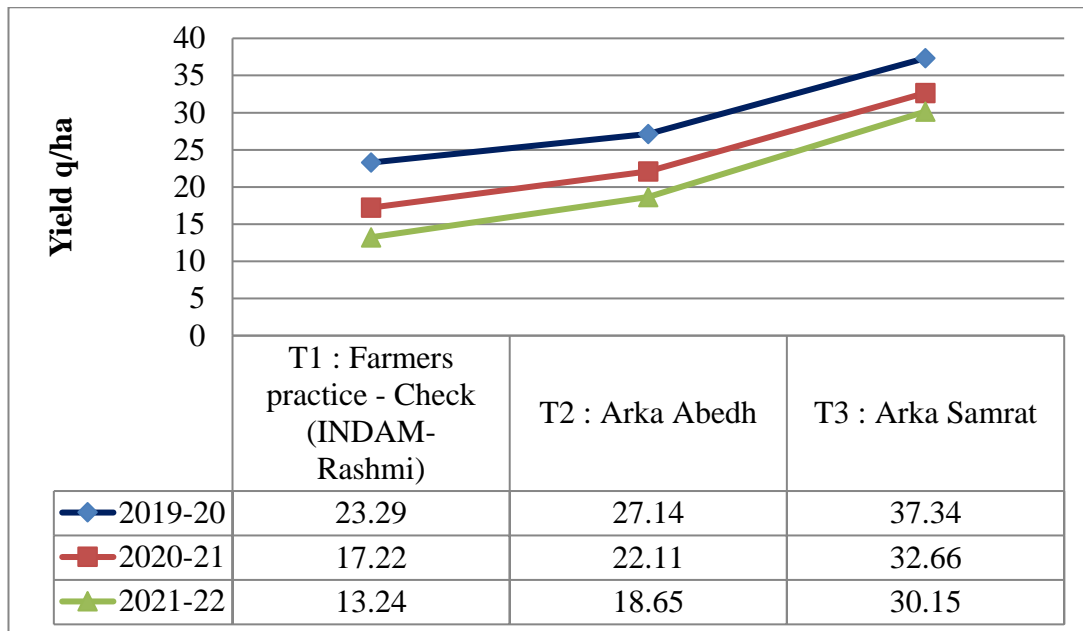


Fig. 5. Yield details of tomato hybrids over farmers' practice

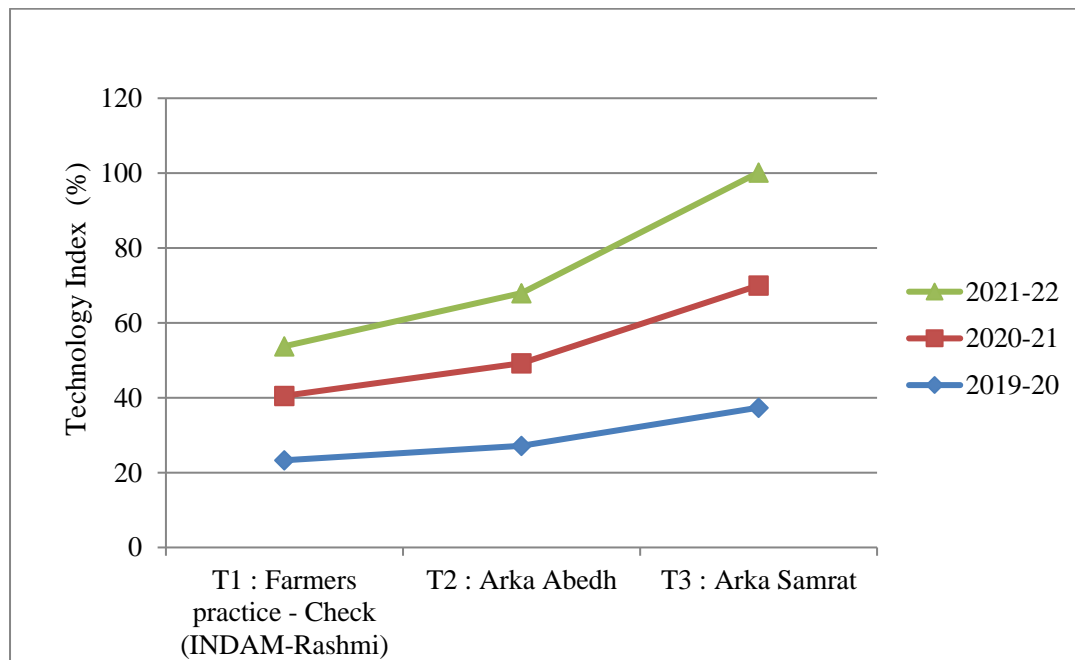


Fig. 6. Technology Index (%) of tomato hybrids over farmers' practice

The extension gap with Arka Abhed and Arka Samrat ranged between 125.51 to 134.33 and 98.52 to 103.00 q/ha during the years 2019-20 and 2021-22 of the study (Table 4). Thus there is a need to educate the farmers for the adoption of improved varieties along with modern technology through various extension methodologies viz. front-line demonstrations, cluster frontline demonstrations, field days and convergence meeting with line departments. It was evident

from (Table 4 and Fig. 6) that Technologies Index showed a decrease pattern in both the tomato hybrids i.e. Arka Abedh (27.14% to 18.65%) and Arka Samrat (37.34% to 30.15%) respectively from 2019-20 to 2021-22. The lower the value of Technology Index, the more is the feasibility of the technology. The results make it amply clear for the feasibility of the demonstrated technology in this region for improving the yield of tomato. Similar

results were reported by Babu et al., [4], Kale et al., [8], Keshavareddy et al., [11], Katare et al. [13], and Dayanand & Mehta [12] in mustard [14].



Plate 1. Operations from seedling raising to harvesting in Tomato hybrids



#### 4. CONCLUSION

Tomato hybrids Arka Abhed (multiple disease resistant) and Arka Samrat (triple disease resistant) recorded substantially higher yields than farmers' practice (INDAM - Rashmi). The net returns in demonstration plots of the hybrids were also recorded higher over the farmers' check. The results of the on farm trials amply demonstrated the superiority of the tomato hybrids Arka Abhed and Arka Samrat over the farmers' practice in yield, net returns and cost: benefit ratio. The participant farmers realized the superiority of hybrids over the check variety and adopted the technology. Hence, through these on-farm trails it has stated that the two tomato hybrids namely Arka Abhed and Arka Samrat have proved to be the promising to the Alluri Sita Rama Raju district of Andhra Pradesh.

#### DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

#### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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