

Original Research Article

Performance of Tomato Hybrids ArkaAbhed and ArkaSamrat in Visakhapatnam District of Andhra Pradesh.

Abstract

An on-farm trial (OFT) for three consecutive years (2020-21, 2021-22) was conducted by ICAR- ANGRAU, Krishi Vigyan Kendra, Kondempudi directly in the farmers' fields of five selected villages viz. Bangurumeta, Adduru, Thotakurapalem, Pottidorapalem, Jaithavaram and Chedikada in Visakhapatnam district of Andhra Pradesh to evaluate the performance of two very promising tomato hybrids viz. ArkaAbhed and ArkaSamrat with regard to yield and economic analysis *vis a vis* the farmers' practice variety Laxmi. A total of twenty-five farmers actively participated in the OFT covering an area of 7.5 acres. As regards fruit yield, the tomato hybrid ArkaAbhed proved to be the best followed by ArkaSamrat and Laxmi hybrid for all the three years of the study with fruit yields of 587.32, 569.13 and 409.14 q/ha, respectively. During the years of the trial, the fruit yields of ArkaAbhed and ArkaSamrat improved from 27.44 to 30.33% and 24.57 to 28.11%, respectively. Average cost-benefit ratios for three years for ArkaAbhed, ArkaSamrat and Laxmi hybrid were 1:2.30, 1:2.16 and 1:1.58, respectively. The Extension gap was between 111.18 to 183.86 and 129.08 to 202.83 q/ha for ArkaSamrat and ArkaAbhed, respectively. Results on Technology Index viz. 15.25, 19.47 and 28.83% for Laxmi (farmers' practice), ArkaAbhed and ArkaSamrat, respectively, revealed that for both the tomato hybrids, there is viability of the demonstrated technology in the area of the OFT viz. Visakhapatnam district and the surrounding areas of north coastal Andhra Pradesh.

Key words: Tomato, ArkaAbhed and ArkaSamrat. [On farm trials](#), Extension parameters

Comment [a1]: Hybrids

INTRODUCTION:

Tomato (*Lycopersicon esculentum* Mill.), a member of the Solanaceae family and the second most popular vegetable crop, next only to potato (FAOSTAT, 2007), is grown extensively throughout India including Andhra Pradesh, where the total area under the crop is 8.31 lakh ha (NHB, 2021-22). India is the second largest producer of tomato and ranks only after China. Among the Indian states, Andhra Pradesh with a total and per ha average

yield of 203.12 tones and 24.42 q is the third largest producer of tomato, behind only Madhya Pradesh and Karnataka.

The fruits of the crop are in high demand for both fresh market needs and post-harvest processing by the food processing industries. Tomato regarded as a 'protective food' is a significant source of antioxidants, lycopene, vitamin C, and vitamin A. Though tomato is primarily a warm season crop, it is grown in cool climate too (10°C to 30°C , optimum being $21\text{-}24^{\circ}\text{C}$). Frost and high levels of humidity prove damaging for the crop. The intensity of the light affects fruit colour, fruit set, and pigmentation. There is thus much to modulate these factors for a higher yield and larger profit.

Tomato is grown over extensive areas in North coastal Andhra Pradesh including Visakhapatnam district where the climate and soil are ideal for the crop. However, yields are poor due to lack of proper knowledge among the tomato growers regarding the selection of the high yielding and multiple disease resistant varieties, proper seed treatment, nursery raising, Integrated Nutrient Management (INM), and plant protection measures. It is imperative to advise the tomato growers for high yielding cultivars and hybrids, and demonstrate the right technology for a higher yield and net money return right in their own fields and through their own hands. However, before such recommendation, it is pertinent to evaluate the cultivars with emphasis on the aspect of phenotypic and genotypic suitability and yield, more so because varietal performance of tomato varies from place to place due to varied climatic conditions. In the light of all such aspects, a non-farm trial (OFT) was undertaken in farmers' fields of selected villages by ICAR- ANGRAU, Krishi Vigyan Kendra, Kondempudi located in Visakhapatnam district of north coastal 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. There were twenty-five participant farmers selected from six villages viz. Bangurumeta, Adduru, Thotakurapalem, Pottidorapalem, Jaithavarm and Chedikada. The field area was 7.5 acres and the tomato hybrid varieties were multiple disease resistant Arka Abhed and triple disease resistant Arka Samrat (released by IIHR, Bengaluru). The OFTs were conducted in a very systematic way for three consecutive (2020-21, 2021-22 and 2022-23) to assess the performance of the cultivars with improved practices and convince the farmers for adopting improved farming practices for enhancing their economic livelihood.

MATERIALS AND METHODS

Before conducting the field trial, the list of the participant farmers was prepared very meticulously. A number of group meetings were conducted and those evincing keen interest were picked up from the lot followed by imparting required specific skill training to such selected farmers. The skill training focused on the selection of quality of seeds, seed treatment, fertilizer schedule and nutrient management, irrigation schedule, plant protection measures, and fruit picking at right stage and right time. Soil pH, electrical conductivity, and available potassium were determined by following standard methods (Jackson, 1973). Available nitrogen and phosphorus were determined by alkaline permanganate method (Subbaiah and Asija, 1956) and colorimetric method (Bray and Kurtz, 1945), respectively. Tomato hybrids of ArkaAbhed and ArkaSamrat, and Laxmi (farmers' practice and reference check) were selected as treatments for assessing the yield and economic analysis. Due to small seed size and high cost, the seeds were sown in protrays for ensuring better germination and 25-day old seedlings were transplanted in the main field during the month of October of the years at a spacing of 90 x 60 cm. The spacing so used facilitated easy weeding operation with power weeder for reducing the cost of labour. Seed treatment for preventing fungal diseases was done with metalaxyl @ 3 g/kg of seed. The fields received FYM @ 6 tonnes/acre well before the sowing time. N, P and K @ 48, 24 and 24 kg/acre were applied through commercial fertilizers. Besides, 10 kg of Borax and 10 kg of Zinc sulphate/acre were applied for preventing fruit cracking. Planofix @ 1ml/4 liter was applied as a foliar spray for prevention of fruit drop. Plants were irrigated by drip system. At maturity stage, picking was done at five days interval. Performance and yields of ArkaAbhed (multiple disease resistant) and ArkaSamrat (triple disease resistant) were compared against Laxmi (farmers' practice and reference check). The extension parameters such as Extension Gap, Technology Gap, and Technology Index were calculated by formulae suggested by (Sutharet *et al.*, 2016) to study the impact of front-line demonstrations over the selected farmers.

Technology gap = Potential yield - Demonstrated yield

Extension gap = Demonstrated yield - Yield under existing practice

$$\text{Technology index} = \frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential yield}} \times 100$$

RESULTS AND DISCUSSION

Chemical characteristics of the soils from the chosen OFT farmers included Soil reaction (pH) of 6.47, Electrical Conductivity (dsm-1) of 0.05, Available N (kg ha-1) 176.42, Available P (kg ha-1) 24.75, and Available K (kg ha-1) 89.72, which indicated that the soils were suitable for tomato crop cultivation. As contrast to the Available N (kg ha-1), Available P (kg ha-1), Moreover, the available P (kg ha-1) ranges were low, medium, and low, respectively.

Results on fruit yield (Table 1 and Figure 1) revealed that the yield of all the three treatments increased steadily over the three years of study. All the three varieties recorded the highest yield in 2022-23 (409.14, 569.13 and 587.32 q/ha for Laxmi, ArkaSamrat and ArkaAbhed, respectively). Per cent increase in fruit yield over the farmers' practice (Laxmi) were 27.44, 26.47 and 30.33 for ArkaAbhed, and 24.57, 21.93 and 28.11 during 2020-21, 2021-22 and 2022-23, respectively. Similar results were reported by Kale *et al.*, (2020). The results revealed the positive effects of ArkaAbhed and ArkaSamrat over the existing farmers' practice in Visakhapatnam district of Andhra Pradesh.

The Extension Gap with ArkaAbhed and ArkaSamrat ranged between 129.08 to 202.05 and 111.18 to 183.86 q/ha during the three years of the study (Table 2 and Figure 6). There is thus need to educate the farmers for the adoption of improved varieties along with modern technology through various extension methodologies viz. front-line demonstrations, cluster front line demonstrations, field days and convergence meeting with line departments. The trend of Technology Gap gradually decreased in all the three tomato hybrids during the three years of study. The Technology Gap with ArkaAbhed and ArkaSamrat ranged from 254.6 to 367.68 and 382.5 to 265.87 q/ha which reflected that the OFFT farmers implemented the practices of the demonstration fields with encouraging results in all subsequent years. Similar findings were also recorded by Kale *et al.*, (2020), Singh *et al.*, (2016) and Chapke (2012).

Technologies Index results (Table 2 and Figure 7) revealed that there was decrease in the parameter from 2020-21 to 2022-23. The lower the value of Technology Index, the more is the feasibility of the technology. As such the reduction in Technology Index with ArkaAbhed was from 35.11% during 2020-21 to 18.99% during 2022-23, while with ArkaSamrat, it was from 45.80% during 2020-21 to

31.84% during 2022-23. 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 Kale *et al*, (2020), Katara *et al.*, (2011), Keshavareddy *et al.*, (2018) and Dayanand (2012) in mustard.

The outcomes of the economic analysis and benefit-cost (B:C) ratio of Arka Abhed and Arka Samrat over the farmers' practice are shown in Table 2 and Figure 5. Economic variables, such as the cost of cultivation, net return, and B:C ratio were calculated to determine the demonstration technologies' economic viability relative to the control (farmers' practice, check). 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. The expense of cultivation rose steadily (Figure 3). In comparison to farmers' practice/check (Laxmi) demonstration plots, Arka Abhed and Arka Samrat had more expensive costs of cultivation which might be due to increased costs of inputs and higher labour wages. The higher costs of the demonstration plots were mostly due to the implementation of a trellis system, more vigorous and indeterminate growth characteristics, and greater harvest pickings. The cost per hectare for the cultivation of Arka Abhed in the demonstration plots ranged from Rs. 1,15,462 in 2020-21 to Rs. 1,38,288 in 2022-23. For Arka Samrat, the cost of cultivation ranged from Rs 1,15,462/ha in 2020-21 to Rs 1,38,288/ha in 2022-23. The net return too increased steadily in the demonstration plots ranged from Rs 2, 60,858/ha during 2020-21 and Rs 2, 86,808/ha during 2022-23 (Arka Abhed). The net returns were substantially higher in the demonstration plots over the control with farmers' practice plots (Figure 4). The results corroborate those Kale *et al*, (2020), Mokidue *et al.*, (2011) and Keshavareddy *et al.*, (2018). Cost benefit ratio was higher in the demonstration plots against farmers' practice in all the three years of study (Table 2 and Figure 5).

Cultivation of tomato following recommended technology shall definitely bridge the Technology Gap, thus leading to increased productivity of tomato in the region which in turn shall contribute to the rise in economic condition of the tomato growers of the region. Furthermore, extension agencies in the region need to provide proper technical knowledge and knowhow and support the tomato growers of the region through different educational and extension methods to plug the Extension Gap towards reaping higher tomato production in coupled with greater net economic return from cultivation.

CONCLUSION:

Tomato hybrids ArkaAbhed (multiple disease resistant) and ArkaSamrat (triple disease resistant) recorded substantially higher yields than farmers' practice (Laxmi). The net returns in demonstration plots of the hybrids were also higher over the farmers' practices variety. The results of the OFT amply demonstrated the superiority of the tomato hybrids ArkaAbhed and ArkaSamrat over the farmers' practice (Laxmi) in yield, cost: benefit ratio and net return. The participant farmers themselves could find the superiority of the tomato hybrids ArkaAbhed and ArkaSamrat over the farmers' practice (Laxmi) and the adoption of technology for realizing higher fruit yield and greater net return from the cultivation of tomato.

References:

- Bray, R. H. and Kurtz, L.T. (1945). Determination of total, organic and available forms of phosphorus in soils. *Soil Science*, **59**: 39-45.
- Chapke, R.R. (2012). Impact of Frontline Demonstrations on Jute (*Corchorusolitorius*). *J. Human Eco*, 38 (1): 37-41.
- Dayanand, VRK. and Mehta, S.M (2012). Boosting mustard production through front line demonstrations. *Indian Res. J. Ext Edu* 12 (3): 121-123.
- Jackson, M. L. (1973). *Soil Chemical Analysis*. Prentice Hall of India Private Limited, New Delhi.
- Kale, S.M., BarikarUmesh and Mahesh, C. 2020. Popularization of Tomato Hybrid (Arka Rakshak) for Yield and Economic Analysis in KalyanKarnatka Region. *Int.J.Curr.Microbiol.App.Sci.* 9(06): 1675-1679.
- Katare, Subhash, Pandey, S.K. and Mustafa, Mohd. (2011). Yield gap analysis of rape seed mustard through front line demonstration. *Agric. Update* 6: 5-7.
- Keshavareddy G., S. Kamala Bai, K. H. Nagaraj and Hanumantharaya B. G. (2018). Integrated Crop Management - A Way for Doubling the Income of Tomato Growers in Ramanagara District of Karnataka, India. *Int.J.Curr.Microbiol.App.Sci.* 7(06): 2161-2168.
- Mokidue, I., A. K. Mohanty and Sanjay, K. (2011). Correlating growth yield and adoption of Urdbean technology. *Indian. J. Extn. Edu.* 11(2): 20-24.

Comment [a2]: The references are written in a different system to the approved journal system

Singh.D.V., Mukhi, S.K. and Mohapatra, M.R. (2016). Yield Gap Analysis of Toria (*Brassica campestris*) through Front Line Demonstration in Kandhamal District of Odisha, *Indian J. Ext. Edu*, 52 (3& 4), 167-17.

Subbaiah, B.V. and Asija, G. L. (1956). A rapid procedure for the determination of available Nitrogen in soils. *Current Science*, **25**: 256 – 260.

UNDER PEER REVIEW

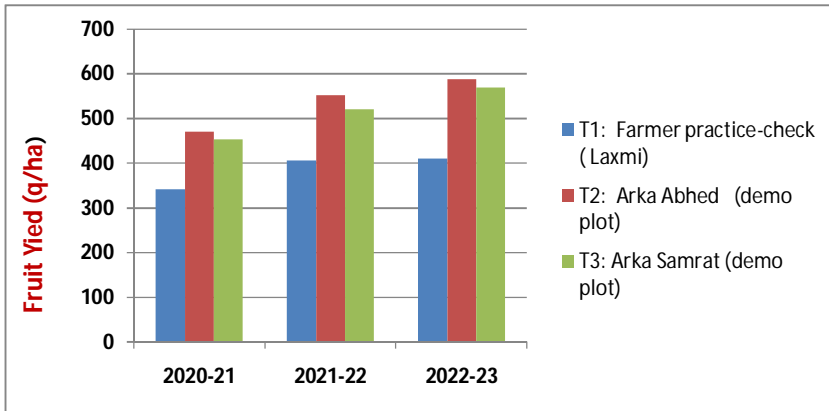


Fig. 1. Yield of tomato hybrids

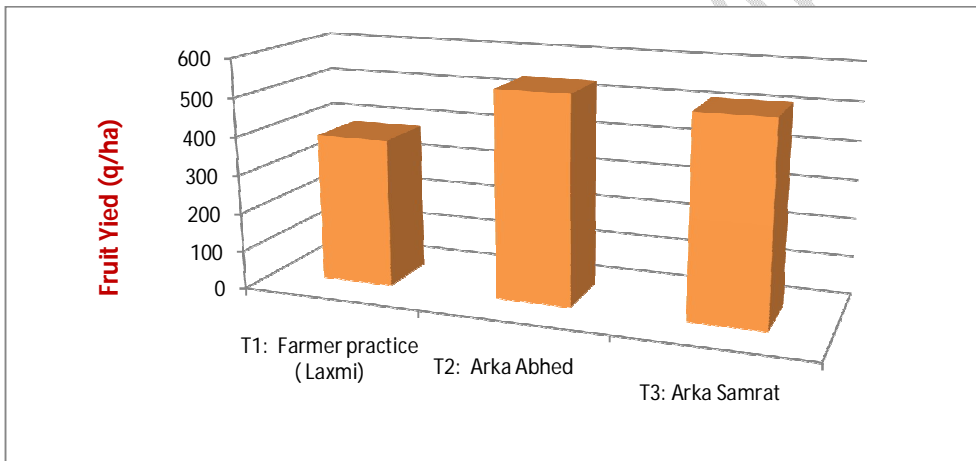


Fig. 2. Pooled yield of tomato hybrids

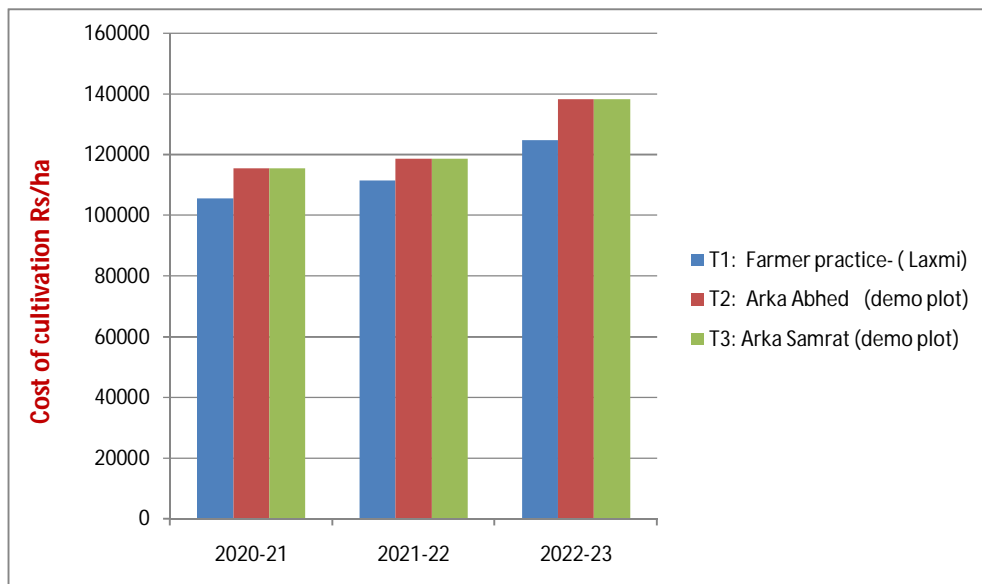


Fig. 3. Cost of cultivation of tomato hybrids over farmers' practice



Fig. 4. Net returns of tomato hybrids over farmers' practice

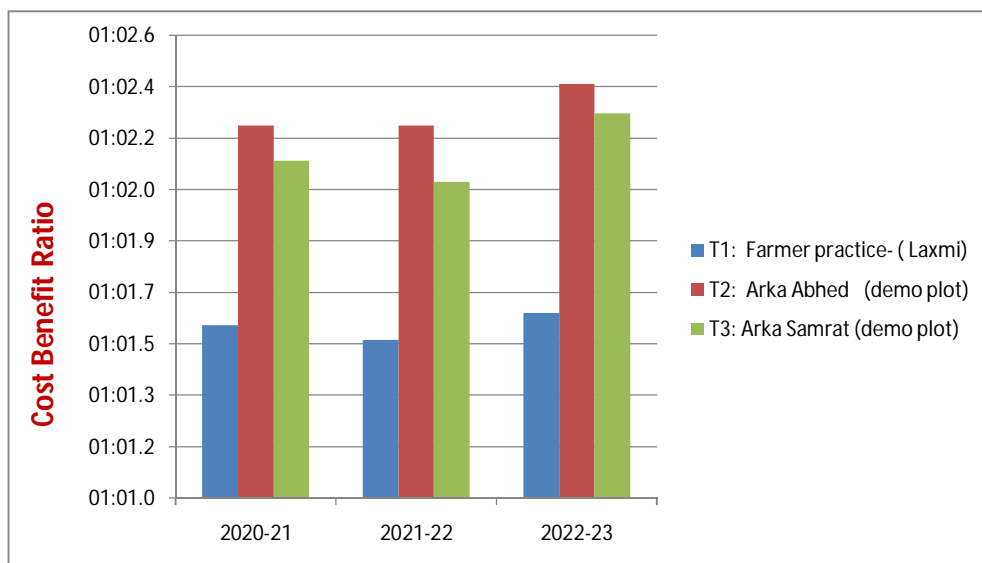


Fig.5. Cost benefit ratio of tomato hybrids over farmers' practice

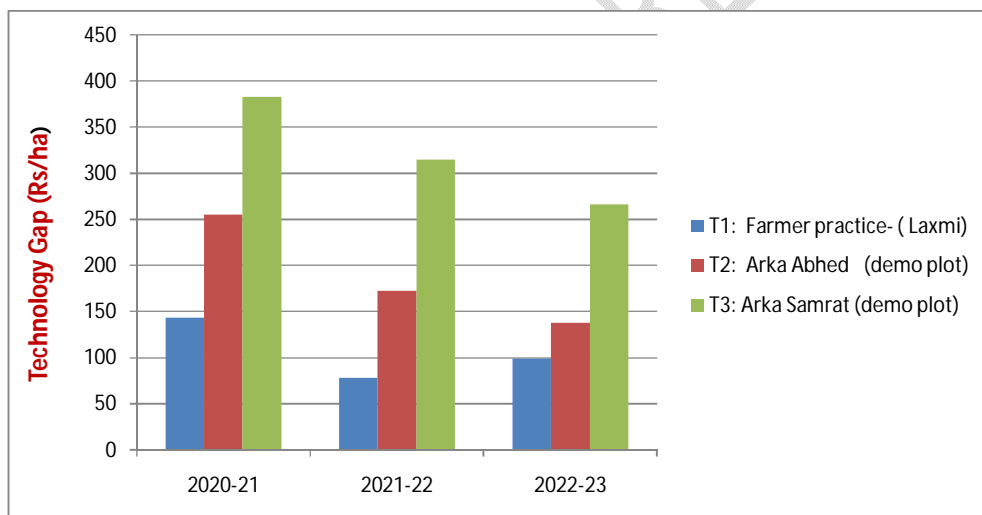


Fig. 6. Technology gap of tomato hybrids over farmers' practice

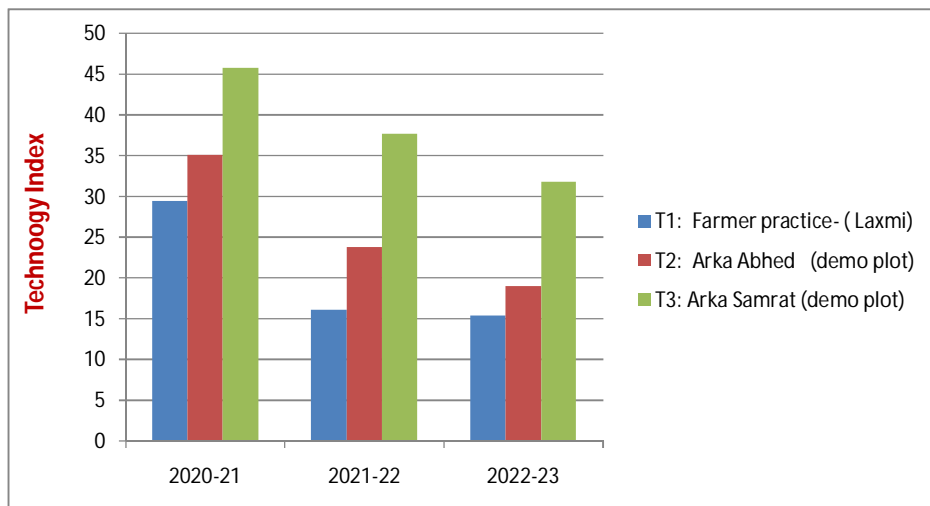


Fig. 7. **Technology Index of tomato hybrids over farmers' practice**

UNDER PEER REVIEW

Table 1. Yield, Technology Gap, Extension Gap and Technology Index of tomato hybrids ArkaAbhed, ArkaSamrat over farmers' practice (Laxmi)

Particulars	Fruit yield (q/ha)			Potential yield (q/ha)	% Increase in fruit yield over farmers' practice			Technology Gap(q/ha)			Extension Gap (q/ha)			Technology Index (%)		
	2020-21	2021-22	2022-23		2020-21	2021-22	2022-23	2020-21	2021-22	2022-23	2020-21	2021-22	2022-23	2020-21	2021-22	2022-23
T1: Farmers' practice-check (Laxmi)	341.32	406.25	409.14	484	---	-----	---	142.68	77.75	98.73	---	-----	----	29.47	16.06	15.46
T2: ArkaAbhed (demo plot)	470.4	552.5	587.32	725	27.44 %	26.47 %	30.33 %	254.6	172.5	137.68	129.08	146.25	202.05	35.11	23.79	18.99
T3: ArkaSamrat (demo plot)	452.5	520.4	569.13	835	24.57 %	21.93 %	28.11 %	382.5	314.6	265.87	111.18	114.15	183.86	45.80	37.67	31.84

Table 2. Economic analysis of tomato hybrids ArkaAbhed and ArkaSamrat over farmers' practice (Laxmi)

Particulars	Cost of Cultivation (Rs/ha)				Gross Returns(Rs/ha)				Net Returns (Rs/ha)				Cost Benefit Ratio		
	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23	Pooled	2020-21	2021-22	2022-23
T1: Farmers' practice-check (Laxmi)	105462	111425	124758	113881	273040	284375	327312	294909	160858	172950	202554	215454	1:1.58	1:1.53	1:1.62
T2: ArkaAbhed (demo plot)	115462	118750	138288	124166	376320	386750	469856	410975	260858	268000	331568	286808	1:2.25	1:2.25	1:2.39
T3: ArkaSamrat (demo plot)	115462	118750	138288	124166	362000	364000	455304	393768	246538	245250	317016	269601	1:2.13	1:2.06	1: 2.29