Impact of Front Line Demonstrations on Yield Enhancement of Ginger (var.Nadia) Raised Single Node Seedlings through Pro tray Technology in Tribal Area of Alluri Sitaramraj District of Andhra Pradesh.

Abstract

ICAR-ANGRAU, Krishi Vigyan Kendra, Kondempudi conducted Front Line Demonstrations (FLD) in five selected villages, namely Paderu, Peddabayula, Hukumpeta, Dumbriguda, and Aruku mandals of Alluri Sitaramraj district (ASR) of Andhra Pradesh, for three years (2019–20, 2020–21, and 2021-22). The purpose of the FLD was to showcase the superior performance of single node raised seedlings of the ginger variety Nadia raised through portray technology compared to normal farmer practice variety Nadia.The single-node ginger (Var.Nadia) seedlings cultivated using technological demonstration of yield and economic analysis in contrast to farmers' practices 50 farmers participated actively in the FLD, which covered 20.5 acres. In terms of production, pooled fresh rhizome yields of 139.57 and 120.02 q/ha, respectively, showed that single-node grown seedlings of ginger var. Nadia raised by modern technology were superior over farmer practice. Single-node ginger (var. Nadia) seedlings grown by this technique exhibited an upsurge in fresh rhizome output from 10.28 to 20.39 percent over the course of the demonstration years.Average cost-benefit ratios for the three years for demonstration plots and farmer practice were 1:3.18, 1:3.26, and 1:3.61, and 1:2.09, 1:2.08, and 1:2.01, respectively. The extension gap of three years (2019–20, 2020–21, and 2021–22) was 27.71, 16.1, and 14.84 q/ha in demonstration plots, respectively. Results on the Technology Index ranged between 12.07 to 6.62% and 20.78 to 5.17% for single-node ginger (var.Nadia) seedlings raised through pro tray technology and farmers' practices, respectively. All three years of study revealed that for single-node ginger (var.Nadia) seedlings raised through portray technology, there is much significance and scope for up scaling the demonstrated technology in tribal agency areas of Alluri Sitaramraj district, Andhra Pradesh.

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Key words: Single node ginger seedlings through portray technology, Front line demonstration (FLD), Extension Gap, Technology Gap, Technology Index, Demo plots and Cost of cultivation.

INTRODUCTION:

Ginger (*Gingiber officinale* L.), a member of the Gingiberaceae family, is a universal spice crop with immense economic significance. The crop is commercially cultivated by tribal farmers as a spice, condiment, culinary supplement, and medicine for their livelihoods (Sial and Tarai 2017). Ginger and its preparations are used as ingredients to add more flavor, and eating ginger can cut down on fermentation, constipation, and other causes of bloating and intestinal gas. It contains antioxidants. These molecules help manage free radicals, which are compounds that can damage cells when their numbers grow too. In India, ginger is cultivated in an area of 116.90 thousand ha; average production was 529.30 thousand MT, and average

Comment [S3]: enter research objectives productivity was 4.30 MT/ha. Madhya Pradesh state in India is the largest producer of ginger, followed by Karnataka and Assam in 2022 (NHB, 2022). But the tribal farmers are using a high seed rate of 800-1000 kg/acre; they are doing partial harvesting of ginger 3 months after planting, which practices lead to an increase in the incidence of rhizome rot disease. Due to that reason, over the last 15 to 20 years, the crop has been severely affected, resulting in a decline in the yield (Gurung and Gurung 2006). However, yield in Alluri Sitaramraj district and surrounding areas of tribal areas of Andhra Pradesh Yield loss under real farming conditions can be attributed to several biotic and abiotic factors; important among them are poor field drainage, the non-practice of raised bed systems, and the incidence of rhizome rot disease in ginger (Mukhopadhyay *et al.*, 1996; Arora, 2006; and Ashok Kumar *et al*., 2012). Despite favourable climate and soil due mainly to lack of knowledge and technology adoption regarding the selection of the right variety, seed treatment, portray technology, Integrated Nutrient Management (INM), and plant protection measures,. Technology transfer refers to the spread of new ideas from originating sources to ultimate users (Prasad *et al.*, 1987; Ashok Kumar *et al*., 2012). Keeping these gaps in mind, front-line demonstrations (FLDs) were undertaken right in farmers' fields by ICAR-Angrau, Krishi Vigyan Kendra,Kondempudi for demonstrating to the farmers the ginger variety Nadia with raised single-node ginger seedlings through portray technology for this used seed rate of 350 kg/acre, which is better suited than theirs along with other agronomic practices. Twenty-five participant farmers drawn from five villages viz.Paderu, Peddabayula, Hukumpeta, Dumbriguda, and Aruku mandals of AlluriSitaramraj district (ASR) of Andhra Pradesh **(**7.5-acre field area with ginger variety Nadia) raised single-node ginger seedlings through portray technology (seed rate 350 kg/acre) against farmer practice (1000 kg/acre) and participated in the FLDs for three consecutive years viz. 2019-20, 2020-21, and 2021-22.

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MATERIALS AND METHODS

The list of the participant farmers was prepared very meticulously based on the response and interest evinced in group meetings and interaction sessions with scientists. The skill training in the demos focused on the selection of quality of seed, seed treatment, raising of ginger single node seedlings through portray technology, manure schedule and nutrient management, plant protection measures, and fresh rhizome harvesting at the right stage and at the right time, as suggested by Choudhury (1999). Prior to commencing the demos, soil pH, electrical conductivity, and available potassium were determined by standard methods (Jackson, 1973). Available nitrogen and phosphorus were determined by the alkaline permanganate method (Subbaiah and Asija, 1956) and the colorimetric method (Bray and Kurtz, 1945), respectively. The ginger variety Nadia rhizome was selected as seed material and raised into single-node ginger seedlings through pro tray technology (seed rate 350 kg/acre), and the seedlings transplanted in raised beds against farmer practice and reference checks (seed rate 1000 kg/acre) were selected for demonstrations for assessing the yield and economic analysis. Due to the high cost of seed material, the selected healthy rhizome was cut into 15–20 g with 2 buds, then immediately put into a seed treatment solution (*Trichodermaviride* at 10 g/litre) for 30 minutes to avoid rhizome rot disease. The treated rhizome pieces were sown in protrays to ensure better germination. The single-node

Comment [S5]: It's best to include climate data seedlings, when 40 days old, were transplanted to the main field. The spacing (45 cm x 30 cm) in the raised bed facilitated better rhizome development while also avoiding rhizome rot disease. The fields received well-decomposed organic manures FYM 25–30 t/ha and Neem cake 2 t/ha at last ploughing. Top dressing of organic manures Vermi compost, 2 t/ha; ash, 0.5 t/ha Soil low in K-Sulphate of Potash Supplementation 50 kg during 45^{th} and 90^{th} DAP. Foliar spray of micronutrient/IISR ginger booster at 5 g/l water (3–4 kg/ha) at 60th and 90th DAP. Spraying of Neem oil at 5 ml/l (1500 PPM) for control of shoot borer and drenching of *Trichoderma viride* at 5 g/liter for control of rhizome rot.

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Fresh rhizomes harvested at maturity stage were done at a seven-day interval. Performance and yields of raised single-node ginger seedlings through portray technology were compared against normal farmer practice. The extension parameters such as Extension Gap, Technology Gap, and Technology Index were calculated by formulae suggested by Samui *et al. (2000)*, Renbomo and Pijush Kanti (2016), and Kale *et al*. (2020) to study the impact of front-line demonstrations over traditional practices by farmers.

1. Technologygap=Potentialyield – Demonstratedyield

2. Extension gap = Demonstrated yield – Yieldunderexistingpractice

3. TechnologyIndex = $\frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential yield}}$ X 100

4. Technology Index = $\left(\frac{\text{Potential yield} - \text{Demonstrated yield}}{\text{Potential yield}}\right) \text{x } 100$

5. Percent increase over farmers practices = Improved practices – Farmers practices / farmers practices x 100

6. Per cent increase yield = Demonstration yield - Farmer practice yield x 100/Farmer practice yield.

RESULTS AND DISCUSSION

Physicochemical properties of the soils, viz. pH 6.13, electrical conductivity 0.05 dS m^{-1}, and available N, P, and K at 199.47, 42.12, and 99.57 kg ha-1, respectively, indicated the soils to be ideal for commercial cultivation of ginger. Fresh ginger rhizome yield (q/ha) of the three-year treatments increased substantially from 2019–20, 2020–21, and 2021–22 over farmer practice in all three years (Table 1 and Fig. 1). The substantial increase in yield might be due to the better rhizome development in single-node ginger seedlings due to the possibility of better tiller production of ginger and also the favourable microclimate around the root zone created by mulching, which helps suppress the growth of *Phythiummyriotylum* fungus, the rhizome rot disease, and a raised bed that facilitates excess water drained out. And also avoidance of rhizome rot incidence due to application of neem cake at 2 t/ha and also single-time harvesting at the right maturity stage. A similar result has been reported in Sarmah *et al*. (2018), Borah *et al.* (2014),and Sial and Tarai (2017). Shah and Zala (2006) obtained an average yield of ginger (133 q/ha) under Gujarat conditions, while Babu *et al*.

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(2015) obtained an average yield of 12–15 tonnes/ha. But according to Singh and Dhillon (2015), the yield of ginger on average worked out to be 1467 kg/ha. Farmers believed that application of neem cake at 2 t/ha as a basal dose helped reduce the incidence of soft rot in ginger and thereby increase the yield.

The severe incidence of rhizome rot, which might be caused by partial or frequent harvesting after 3-5 months of ginger planting with infected implements, and the lack of a congenial microclimate surrounding the rhizosphere zone are possible causes of the significant decrease in fresh rhizome yield in farmer practice in all three years. Some of these authors opined the decline in yield in a similar pattern to be due to the incidence of rhizome rot caused by the *Phythiummyriotylum* fungus, which causes poor yield. The results of the study are in line with those of Ali *et al*. (1995) and Dorhoo*et al*. (1990), who earlier reported total failure (100%) of the crop loss due to the attack of rhizome rot disease. Rahman *et al*. (2009) observed a decline in ginger yield from a 1:8 ratio (seed rhizome to harvested rhizomes) to 1:4 in the states of north-east India due to the infestation of crops with rhizome rot disease. Bandyopadhyay and Bhattacharya (2012) and Yadav et al. (2023) reported that gingersoft rot causes a yield decline of between 50 and 90%. Yield-wise performance in the FLD showed that the single-node seedlings of the pro-trays technology were superior to those of the farmers' practice, which could be due to the genetic superiority of the former.

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For ginger var. (Nadia) single-node seedlings in 2019–20, 2020–21, and 2021–22, the percentage increase in yield over farmers' practices was 10.2, 11.61, and 20.39, respectively. The significant increase in yield may be attributed to improved rhizome development in single-node ginger seedlings, which may lead to improved tiller production. Additionally, mulching the root zone creates a favourable microclimate that inhibits the growth of the Phythiummyriotylum fungus, rhizome rot disease, and raised beds that allow excess water to drain out.And also avoidance of rhizome rot incidence due to application of neem cake at 2 t/ha and also single-time harvesting at the right maturity stage. A similar result has been reported in Sarmah *et al*. (2015), Borah *et al. (2014)*, and Odisha by Sial and Tarai (2017). Yield enhancement in crops in frontline demonstrations is well documented by various authors (Haque, 2000; Sagar and Ganesh, 2003; Mishra *et al.*, 2009; Kumar *et al.*, 2010; Poonia and Pithia, 2011; and Singh and Sharma, 2004). The results of the present studies convincingly establish the superiority and technology of single-node ginger seedlings over the existing farmers' practices in this region of tribal agency areas in the Alluri Sitaram Raj district of Andhra Pradesh.

With planted single-node ginger seedlings, the extension gap varied from 27.71 to 16.10 q/ha, as shown in Table 2 and Fig. 6. The outcomes agree with Hiremath and Nagaraju's (2010) and Kale *et al.* (2020) findings. The extension gap will decrease with the usage of high-yielding varieties and the latest production technology. To plug this large extension gap, farmers must be educated on the importance of choosing a high-yielding variety that is appropriate for the region and the adoption of modern technology. This can be done through a variety of extension methodologies, such as field days, convergence meetings with line departments, kisan melas, front-line demonstrations, and cluster front-line demonstrations. These initiatives and marketing certainly will convince farmers to stop using their outdated approaches and adopt the latest technology suggested by visiting Scientists

The technology gap consistently decreased in all three years of study with raised single-node ginger (Var.Nadia) seedlings through pro-trays technology varieties during the three years of study from 2019–20 to 2021–22. The technology gap with raised single-node ginger (Var.Nadia) seedlings through pro tray technology ranged from 18.66 to 10.23 q/ha, respectively. The gap may be attributed to variations in inherent soil fertility, adopted new practices, and weather conditions (Mukherjee, 2003; Renbomo and Pijush Kanti, 2016). Variety-wise, location-specific trials and recommendations are required for minimising the technology gap in yield in different situations. The technology gap results revealed that the FLD farmers, after observing the high yields in the first, second, and third years, enthusiastically implemented the package of practices for conducting cluster front line demonstrations (CFLDs) for upscaling ginger single node seedling technology. Similar findings were also recorded by Ashok Kumar *et al*. (2012), Kale *et al*. (2020), Singh *et al.* (2019), and Chapke (2012). There was decrease in Technology Index parameter from 2019-20 to2021-22 (Table 2 and Fig. 7). The technology Index for single node ginger pro tray technology 2019-20 and 2021-22 was 12.07 and 6.62, while the farmer practice for the years was 20.78 and 5.17, respectively. LowerthevalueofTechnologyIndexmoreisthefeasibilityofintroducing a technology to reach a desired target.There is thusmuch scope for demonstratedtechnologyingrowing ginger in these tribal agency high altitude regions of Alluri Sitaram Raj District of Andhra Pradesh for improving its yield. Similar resultshave earlier beenreportedin mustard byJeengar*et al.* *(*2006), Renbomo and Pijush Kanti, (2016), Kale*etal.*(2020), Katare*etal.*(2011),Keshavareddy*etal.*(2018)andDayanand(2012) and Ashok Kumar *et al.* (2012)

Table 2 and Fig. 5 show the results for economic analysis factors such the benefit-cost (B:C) ratio, net return, gross return, and cost of cultivation. The cost of cultivation grew over time, with farmer-practice plots observing a greater cost due to higher input costs from high seed rates (1000 kg/acre) and labour wages. Reduced cultivation costs in demonstration plots as a result of using a lower seed rate (350 kg/acre).The cost of cultivation of demonstration plots ranged from Rs. 1,69,137.5 in 2020–21 to Rs. 1,80,960/ha in 2021–22, while the cost of farmer practice ranged from Rs 2,41,437.5 in 2020–21 to Rs 2,46,912.5/ha in 2021–22. The net return too increased steadily in the demo plots and ranged from Rs 3,96,120/ha during 2020–21 to Rs 4,42,142/ha during 2021–22 (pro tray technology). However, the net returns decreased in all three years of study in farmer practice plots during 2019–20 (Rs. 2, 70,807.5/ha), 2020–21 (Rs. 2, 67,812.5/ha), and 2021–22 (Rs. 2, 67,812.5/ha), which might be due to the incidence ofrhizome rot disease and the high seed rate.A similar result have been reported by Prasanta *et al*. (2018), Ali *et al.* (1995), Dorhoo (1990), and Rahman *et al*. (2009) due to the incidence of ginger rhizome rot disease. Net returns were higher in the demo plots in all three years of study (Fig. 4). The results corroborate those of Santosh Kumar *et al.* (2018), Hiremath *et al.* (2009), Renbomo and Pijush Kanti (2016), Kale *et al*. (2020), Mokidue*et al*. (2011), and Keshavareddy*et al*. (2018) in various crops . The cost-benefit ratio was higher in the demo plots in all three years of study (Table 2 and Fig. 5).

The findings indicate that growing ginger (var. Nadia) in the demo plots of this study using single-node seedlings of ginger pro tray technology will help bridge the technology gap, assist the tribal area region's ginger growers in achieving higher yields, and significantly enhance their standard of living and economic standing. It is crucial to emphasise that the region's Krishi Vigyan Kendras and agricultural extension organisations have to perform this responsibility in the appropriate integrity and spirit.

CONCLUSION:

In the demonstration plots, a high-yielding ginger variety (Nadia) with single-node seedlings of ginger pro tray technology produced yields that were significantly higher than those of farmer techniques. When compared to farmers' practices, the demo plots' net returns and benefit-cost ratios were similarly greater. With the farmers' active participation, scientists carried out front-line demonstrations in their fields to highlight the importance of new varieties, seed treatment, single-node pro-trading technology, and the adoption of recommended packages of practices like timing the application and scheduling of manures, irrigation, botanical pesticides, and harvesting at the right time to achieve an abundant yield of ginger. A highly sought-after spice crop in trade and the global market is ginger.However, the region's ginger growers are unaware of the scientific benefits of cultivating ginger and even wary of adopting new technologies. More FLDs of this kind would allow farmers to witness firsthand how technology might increase production in their own fields. Furthermore, a bigger yield means more revenue and a better quality of life for the tribal farmers in Andhra Pradesh's Alluri Sitram Raj District.

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Table 1. Yield, Technology Gap, Extension Gap and Technology Index of single node ginger seedlings (Var.Nadia) raised through pro tray technology over farmers' practice.

Particulars	fresh ginger yield (q/ha)			Pooled ginger yield (q/ha)	Potential yield (q/ha)	% Increase in fresh ginger rhizome yield over farmers' practice			Technology Gap(q/ha)			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**	**2019-20**	**2020-21**	**2021-22**
T1: Farmers' practice – Normal planting	108.13	122.5	129.43	120.02	136.5	---	-----	---	28.37	14.0	7.07	---	-----	----	20.78	10.25	5.17
T2: planted single node ginger seedlings raised through pro tray technology	135.84	138.6	144.27	139.57	154.5	10.28 %	11.61 %	20.39%	18.66	15.9	10.23	27.71	16.1	14.84	12.07	10.29	6.62

Table 2. **Economic analysis of single node ginger seedlings raised through pro tray technology over farmers' practice**

Particulars	Cost of Cultivation (Rs/ha)				Gross Returns(Rs/ha)				Net Returns (Rs/ha)				Cost Benefit Ratio		
	2019-20	**2020-21**	2021-22	**Pooled**	**2019-20**	**2020-21**	2021-22	**Pooled**	**2019-20**	**2020-21**	2021-22	**Pooled**	**2019-20**	**2020-21**	2021-22
T1: Farmers' practice	241437.5	246687.4	246912.5	**245012.4**	486585	514500	517720	**506268.3**	241437.5	267812.5	270807.5	**260019.1**	1:2.01	1:2.08	1:2.09
T2: Pro tray technology	169137.5	178236.3	180960	**176111.2**	611280	582120	577080	**59160**	442142.5	403883.6	396120	**414048.6**	1:3.61	1:3.26	1:3.18

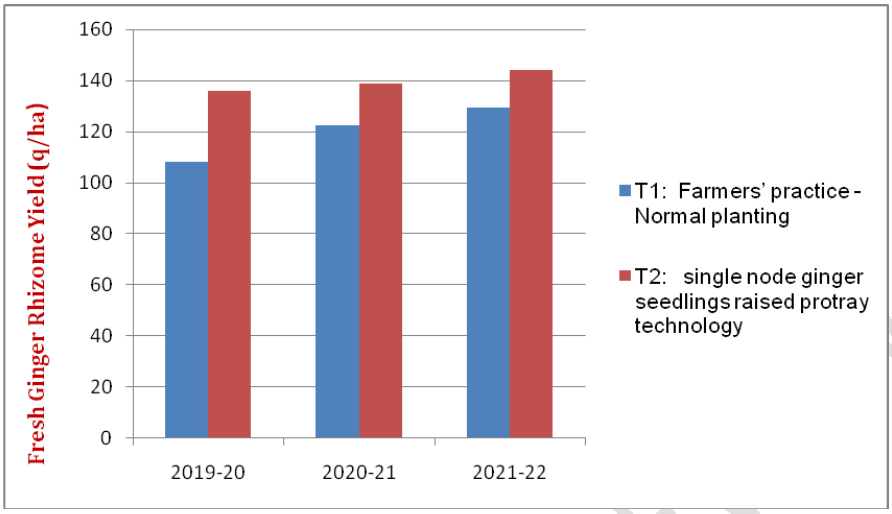


Fig. 1. Fresh rhizome Yield of ginger in demo plots and farmers' practice

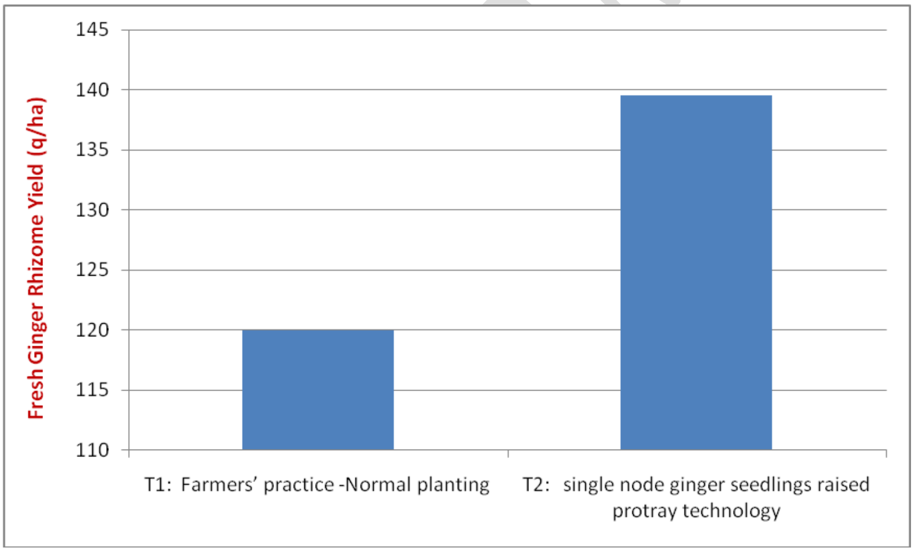


Fig. 2. Pooled Yield of ginger in demo plots and farmers' practice

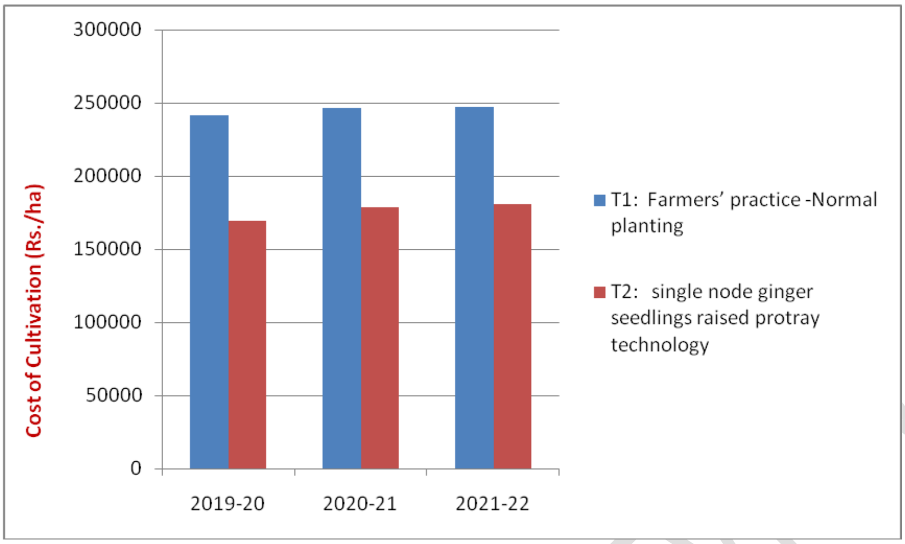


Fig. 3. Cost of cultivation of ginger

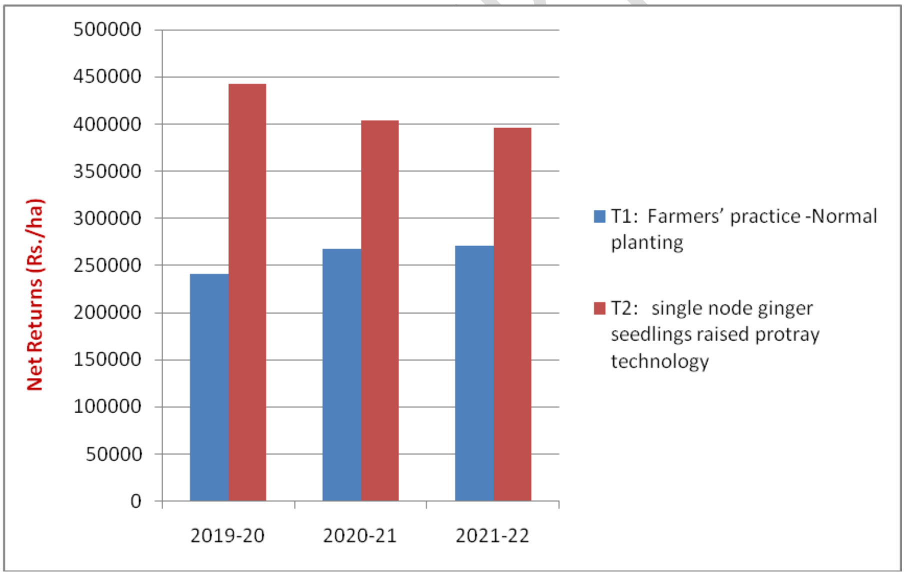


Fig. 4. Net returns of the cultivation of ginger

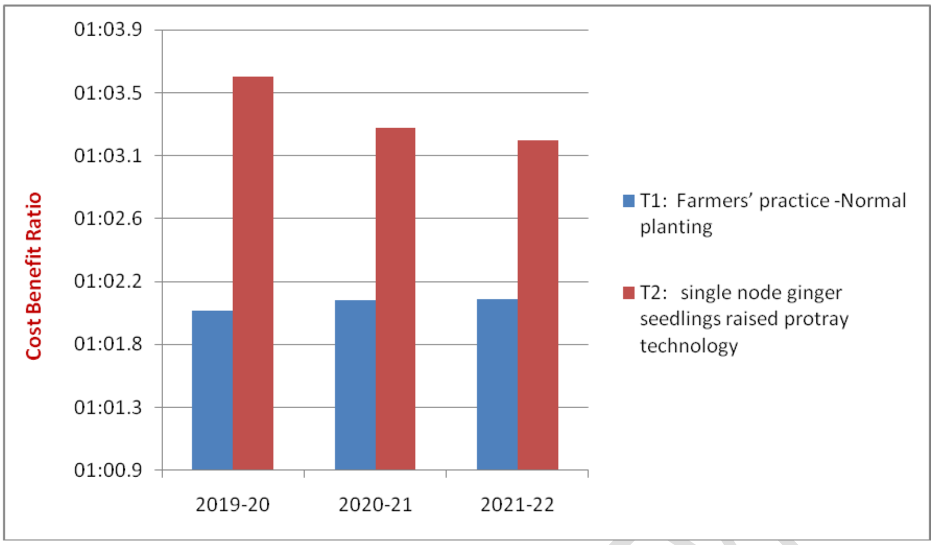


Fig. 5. Cost benefit ratio of the cultivation of ginger

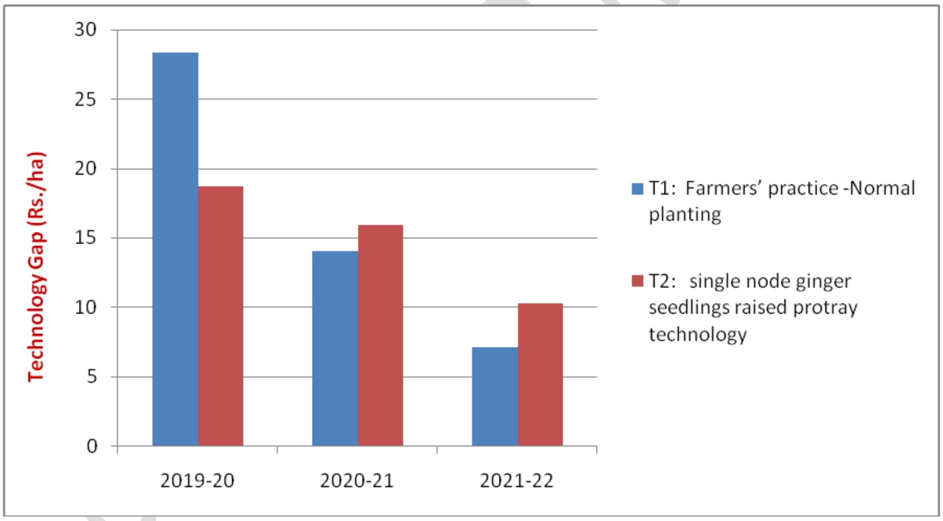


Fig. 6.Technology Gap in the cultivation of ginger

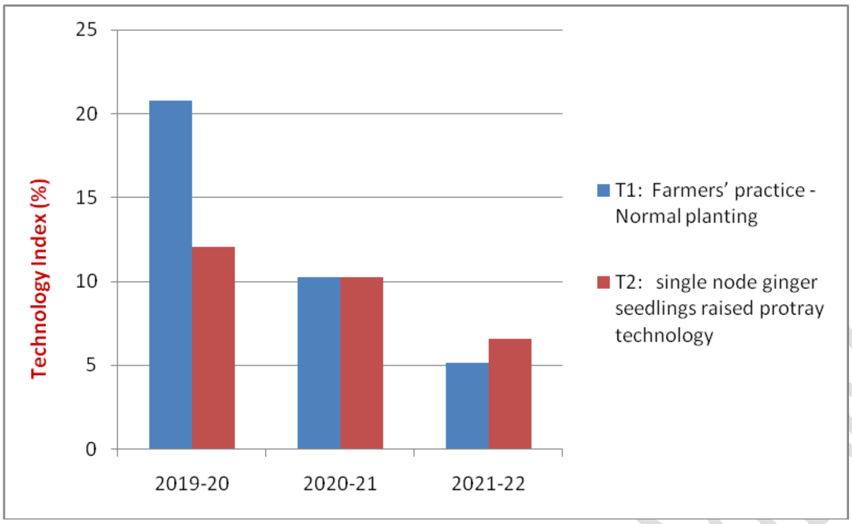


Fig. 7.Technology Index of the cultivation of ginger

		
Fig. 8 Mixing of *Trichoderma* and *Pseudomonas* into Vermicompost and cocopeat	Fig . 9 Single node ginger rhizomes	Fig .10 Filing of media into pro trays

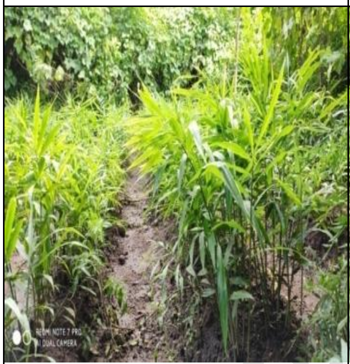
		
Fig .11 Seed treatment with *Trichoderma viride* @10g/kg of seed for 30 min	Fig.12 Application of water through rose can to pro trays	Fig. 13 40 days old single node ginger seedlings
 Fig.14 Raised bed system in ginger	 Fig.15 Main field view of ginger	 Fig. 16 Raised bed system in ginger

Fig. 17 **Field day in ginger at tribal farmer fields**

Fig. 18 **Field days**

Fig. 19 **Field days**

Fig. 20 **Farmer practice**

Fig. 21 **Demo plot**

Fig. 22 **Demo plot**