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Front Line Demonstrations on Trellis and Mulching Technology in Tomato with Sequential Extension Methodology by Krishi Vigyan Kendra, Nizamabad

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ABSTRACT

Tomato is a major vegetable crop grown in the Nizamabad district of Telangana State. The average productivity of tomato crops in India is quite low when compared with other nations and the world average of 34 MT ha-1 and there exists a good scope to improve its average productivity in Telangana as well as in India to fulfill both domestic and national needs. One of the major constraints for low productivity of this vegetable may be due to the partial adoption of recommended package of practices and post-harvest losses due to poor crop management at the field level by the tomato growers. The present study was conducted in Kotagir Mandal, Nizamabad district of Telangana State during Kharif 2017-18 and 2018-19 in 10 locations of farmer fields each location with 1 acre in cluster mode with an objective of studying the impact on change in the area of tomato cultivation with trellis and mulching technology after successfully conducting Front Line Demonstrations by KVK Nizamabad using sequential extension methodology. The Front Line Demonstration resulted in fruit yields of 890 and 795 q ha-1 with an incremental percent of 58.92 and 70.96 during 2017-18 and 2018-19 respectively producing a significant positive result providing an opportunity to demonstrate the production potential and profitability of the latest technology (intervention) under the real farming situation. This could circumvent some of the constraints in the existing transfer of technology systems in the Northern Telangana Zone. The productivity gain of 330 q ha-1 under FLD over existing practices of tomato cultivation has created greater awareness and motivated the farmers of the zone to adopt the trellis technology for tomato production. The effort of KVK, Nizamabad in conducting FLDs on Trellis technology with mulching in Tomato with the appropriate strategy for improving farmer's income by following Sequential Extension Methodology integrating the Technology helps in enhancing farmer's income indirectly.

Keywords: *Tomato, Trellis, Mulching, Fertigation, FrontLine Demonstration, Technology gap, Extension gap, Yield, Sequential Extension Methodology.*

INTRODUCTION

A balanced diet with plenty of Vegetables provides not only energy but supply vital protective nutrients like minerals and vitamins. Vegetables form a key component in farm diversification strategies providing a promising economic opportunity for alleviating rural poverty and unemployment in developing nations, proving to be mankind's most affordable source of vitamins and minerals needed for good health.

India stands second in the production of vegetables contributing 12-14% of the global vegetable production only next to china in both area and production followed by the USA and Turkey. More than 70 types of vegetables are grown but the maximum emphasis has been given to popular vegetables like tomato, eggplant, chili, cauliflower, cabbage, okra, onion, radish, carrot, garden peas, and a few common cucurbits but with low productivity levels. To ensure the nutritional security of the burgeoning population of the country, it is estimated that up to 2020, the country's vegetable demand would be around 196.97 million tonnes. To achieve this target, it is the sine qua non to integrate the various technologies right from production to post-harvest.

Tomato (Lycopersicon esculentum Mill.) is one of the most important vegetable crops grown almost throughout the world including tropical and temperate regions. It is a rich source of vitamins A and C and Lycopene that imparts red color to ripe tomatoes and is reported to possess anti-cancerous properties. It also serves as a natural anti-oxidant as the Beta-carotene functions to prevent and neutralize free radical chain reactions and ascorbic acid is an effective scavenger of superoxide, hydrogen peroxide, singlet oxygen, and other free radicals [4].

In India, during 2017-18 it was cultivated in a 0.079-million-hectare area with a production of 19.76 million metric tonnes. In Telangana, its area and production were 0.0415 hectares and 1.17 million metric tonnes respectively with a productivity of 28.24 MT ha-1 [1]. The average productivity of tomato crops is

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quite low when compared with other nations and the world average of 34 MT ha-1 and there exists a good scope to improve its average productivity in Telangana as well as in India to fulfil both domestic and national needs. The growth, yield, and fruit quality of tomatoes are largely dependent on the number of interacting factors like macronutrients, and micronutrients which are equally significant in plant nutrition. There is a need to go for balanced fertilization of both macro and micronutrients since micronutrients play a profound role in various metabolic functions of the plant. Zinc is an essential component of a number of enzymes i.e. dehydrogenase, aldolase, isomerize, proteinase, peptidase, and phosphohydrolase [10]. It is directly involved in the synthesis of Indole Acetic Acid and proteins.

MATERIALS AND METHODS

The present study was conducted in Kotagir Mandal, Nizamabad district of Telangana State during Kharif 2017-18 and 2018-19 in 10 locations of farmer fields each location with 1 acre in cluster mode. The temperatures ranged from between 27 - 42 ºC & with average normal rainfall of 856 mm. With continuous rainfall during Kharif of both years, and due to the lack of trellis technology in the study area, fruits and foliage touched the ground and were prone to diseases resulting in low yields and poor quality of fruit. Hence the scientists recommended the farmers to cultivate healthy seedlings of tomato cultivar US - 440 The farmers were trained on good practices in Tomatoes like choosing high high-yielding varieties, seed treatment, spacing, trellising and mulching, strategic planting time, nutrient management including micronutrients, growth hormones, and pest and disease management and on other aspects as a main objective of Front Line Demonstration (FLD). The field was prepared by deep ploughing and harrowing. The seedlings were transplanted into the main field maintaining row spacing of 60 cm and within a row spacing of 45 cm. Farmers applied the recommended dose of manures and fertilizers. Farmers also used the recommended weed management practices through mulching and need-based plant protection chemicals to manage the weed problem.

A field day was conducted at the economic part development stage i,e. fruit development stage involving Public and Private extension officials, Department of Horticulture officers, experts who provided trellis technology, experts from Agriculture Technology Application Research Institute (ATARI), Zone X, Hyderabad, demonstration and neighbouring farmers, press and media, etc. for horizontal expansion of promising results of proven technology. In order to have a better impact of the demonstrated technology on farmers and field-level extension functionaries, Front Line Demonstrations was conducted at farmer's field, in a systemic manner, to showcase the high-yielding new varieties, to convince them about the potential of improved production technology to enhance the yield of tomato. A technology index was prepared to test technical feasibility due to the implementation of Front Line Demonstrations in tomato. To estimate the technology gap, extension gap, and technology index the following formula was used given [12] [13].

The data on the adoption and horizontal spread of technologies was collected from the farmers following the interaction method. Data were subjected to suitable statistical methods. The following formulae were used to assess the impact on different parameters of tomato crops.

$$\textbf{Per cent increase in yield} = \left\{\frac{\text{Demonstration yield} - \text{Farmers practice yield}}{\text{Farmers practice yield}}\right\} \times 100$$

$$\textbf{Technology Gap} = \text{Pi (Potential Yield)} - \text{Di (Demonstration Yield)}$$

$$\textbf{Extension Gap} = \text{Di (Demonstration Yield)} - \text{Fi (Farmers yield)}$$

$$\textbf{Technology index} = \left\{\frac{\text{Potential Yield} - \text{Demonstration yield}}{\text{potential yield}}\right\} \times 100$$

$$\textbf{Impact of yield} = \left\{\frac{\text{Yield of demonstration plot} - \text{yield of control plot}}{\text{Yield of control plot}}\right\} \times 100$$

$$\textbf{Impact on adoption (\% change)} = \left\{\frac{\text{No. of adopters after demonstration} - \text{No. of adopters before demonstration}}{\text{No. of adopters before demonstration}}\right\} \times 100$$

$$\textbf{Impact on horizontal Spread (\% change)} = \text{After area (ha)} - \text{Before area (ha)}$$

Sequential Extension Methodology and Technology

A model of Sequential Extension Methodology and Technology concerning the sources of growth and strategies for improving the farmer's income through good practices of tomato cultivation was used. Different need and situation-based extension methods before the implementation of FLDs and during the implementation of FLDs in various crop stages integrating crop technologies were used as shown in Figure No.1.

Before the Implementation of FLD: The groundwork was done for identifying the following areas

Sources of Growth in Farmers' Income in terms of

- Improving tomato production,
- Increasing resource use efficiency,
- Saving cost of cultivation and
- Increasing tomato cropping intensity was kept in mind before implementing FLD.

Strategy for Improving Farmer's Income

- Conducting Front Line Demonstrations by recommending improved variety & and demonstrating the promising results of proven technology like trellis technology with mulching in Tomato
- Developing and using a model of Sequential Extension Methodology and Technology in different crop stages.

Crop stages identified

- Pre sowing
- Nursery Stage
- Seedling stage
- Early vegetative and establishment stage
- Growth Phase
- Flowering and Fruiting stage
- Fruit maturity
- Harvesting stage

Technologies developed along with Farmers Practices and Extension Gap identified

The tomato cultivation practices, improved varieties, and technologies demonstrated through FLD during 2017-18 and 2018-19 were identified in consultation with the University Head, Department of Horticulture, Principal Scientists, and Experts from SAU & ICAR and thoroughly reviewing the literature based on extension gaps identified as shown in table 1

Later the literature was developed on the crop in the local language and distributed to the farmers.
During the field, day efforts were taken to involve all the stakeholders including the press and media for the horizontal expansion of technological advancements and measures to fulfil extension gaps as per table 1 in tomato cultivation.

Fig. 1a. Sequential Extension Methodology and Technology Used Fld in Trellis Technology With Mulching in Tomato

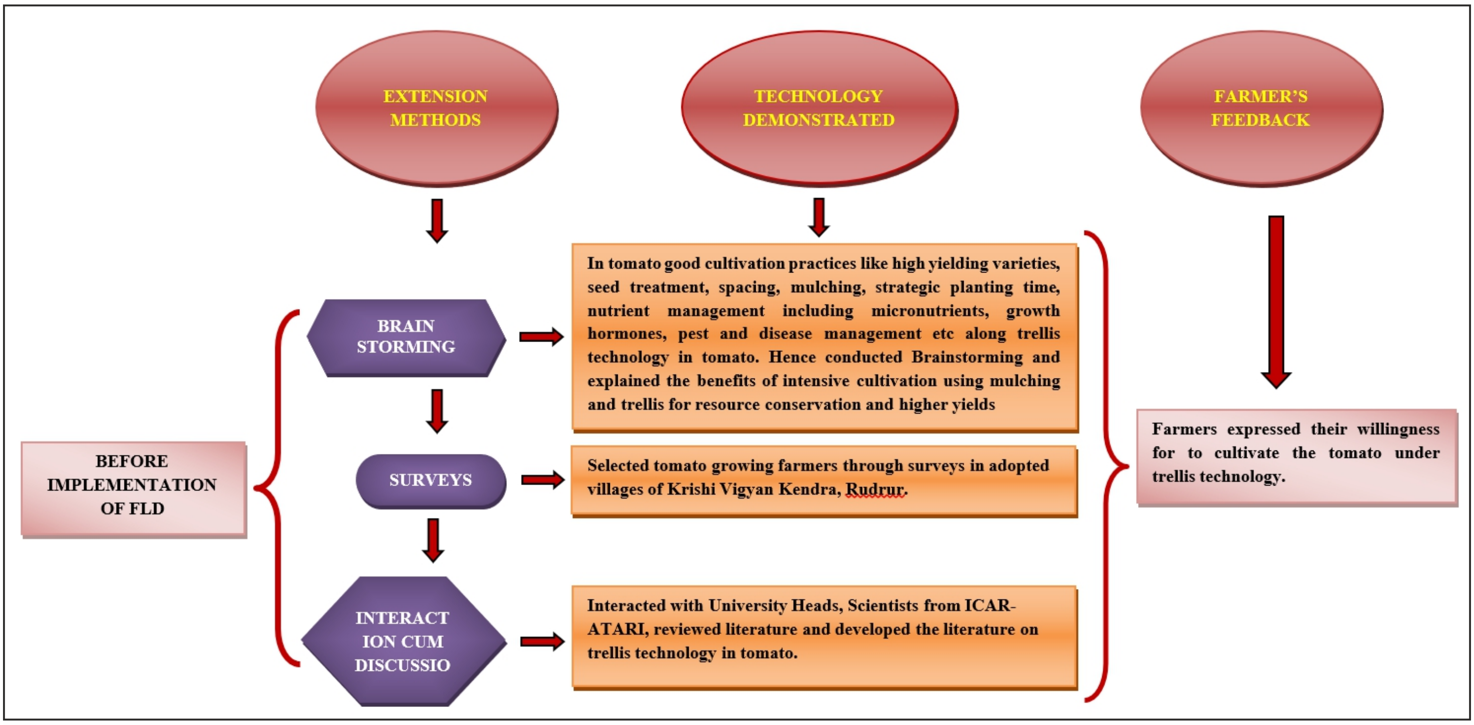

Fig. 1b. Sequential Extension Methodology and Technology Used Fld in Trellis Technology With Mulching in Tomato

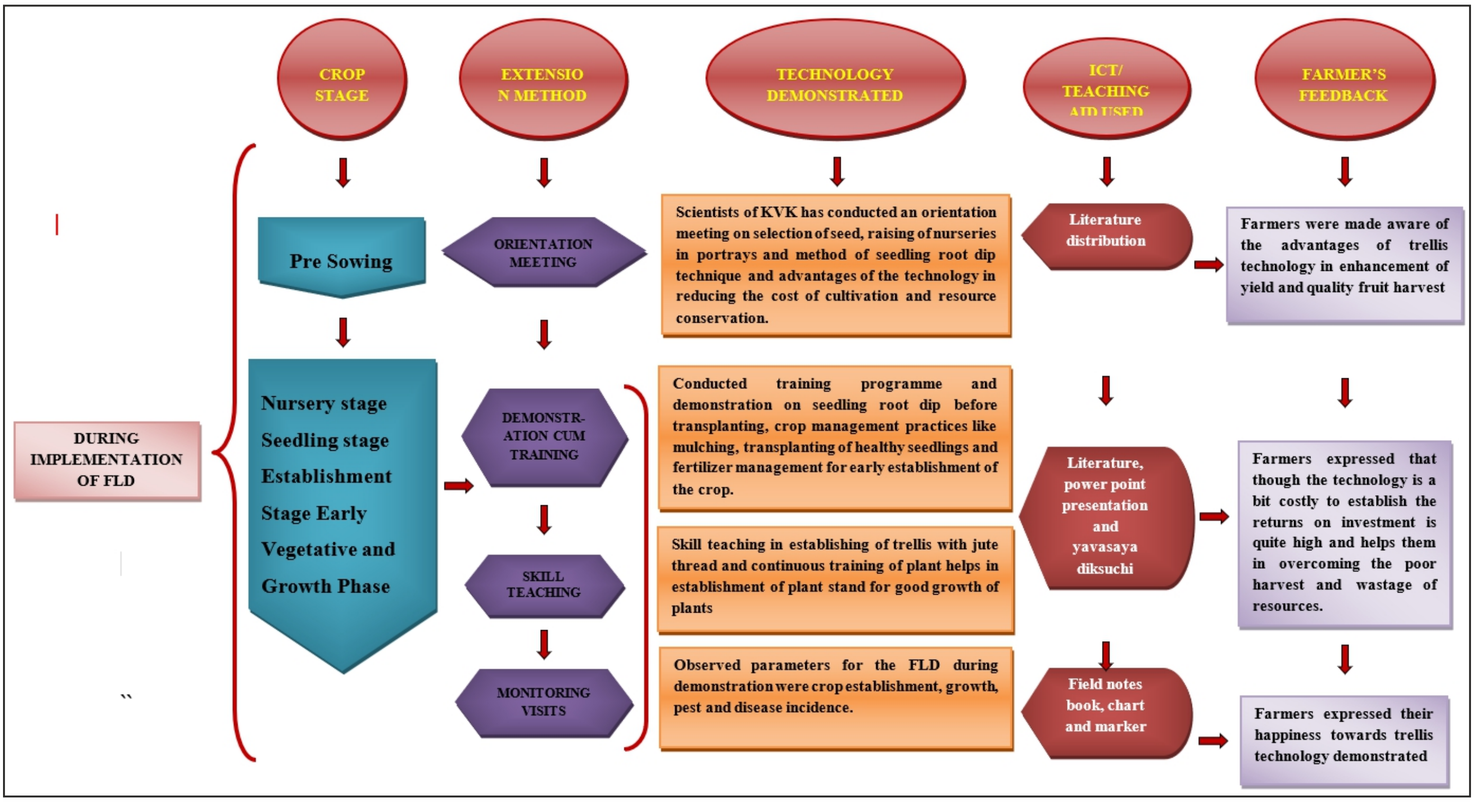

Fig. 1c. Sequential Extension Methodology and Technology Used Fld in Trellis Technology With Mulching in Tomato

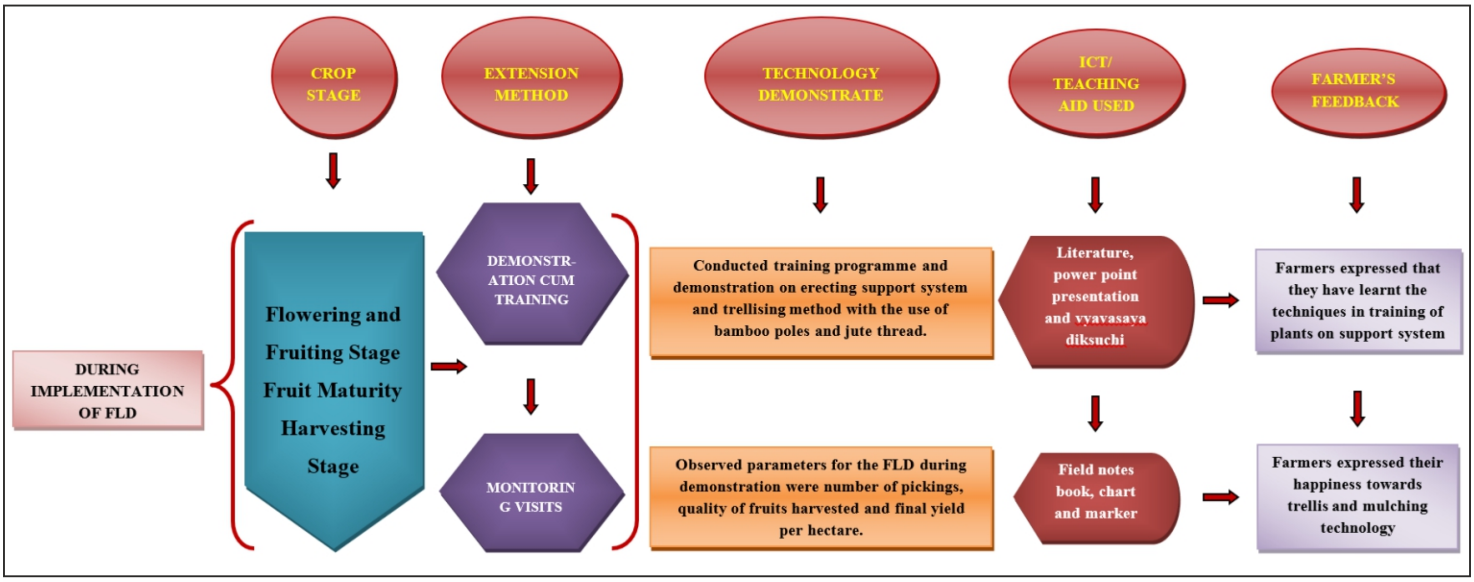

Table 1: Technologies developed along with Farmers Practices and Extension Gap identified

Particulars of Technology	Technological intervention	Farmer practices	Extension Gap
Variety	US – 440	US – 440	Nil
Seed rate	150 g per hectare	200 - 250 g per acre	Partial gap (High Seed rate)
Nursery Raising	Raising of Nursery in Portrays	Raising of nursery on Raised beds	Partial Gap
Fertilizer dose	NPK: 165: 150: 60 kg/ha	N:P:K (150 : 60: 60 kg/ha)	Partial Gap (Imbalanced use of fertilizers)
Weed Management	Mulching with underlying Drip	Flood Irrigation and Use of herbicides Metribuzin and Quizalopopethyl	Partial Gap
Plant protection	Installing pheromone traps and use of need-based chemicals.	Excessive use of pesticides	Full gap
Supporting Structure	Erection of Bamboo Trellis	No trellis technology is followed	Full Gap

Table 1: Productivity, technology gap, technology index and extension gap in Trellis technology with mulching under FLD

Year	Area (ha)	No. of farmers	Yield (q ha^{-1})			% Increase in yield	Technology gap (q ha^{-1})	Extension gap (q ha^{-1})	Technology index (%)
			Potential	Demonstration	Control				
2017-18	4	10	920	890.0	560.0	58.92	30.0	330.0	3.26
2018-19	4	10	920	795.0	465.0	70.96	125.0	330.0	13.58
Average	-	-	920	842.5	512.5	64.94	77.5	330.0	8.42

Table 3: Comparative C:B analysis of Trellis technology with mulching in tomato under FLD and Farmers Practice

Year	Cost of Cultivation		Gross return (Rs./ha)		Net Returns (Rs./ha)		B:C Ratio	
	Demo	Control*	Demo	Control*	Demo	Control*	Demo	Control*
2017-18	101850	49300	222500	112000	120650	62700	2.18	2.27
2018-19	106500	54000	178875	93000	72375	39000	1.72	1.68
Average	104175	51650	200688	102500	96513	50850	1.95	1.98

Table 4: Impact of Front-Line Demonstration (FLDs) on horizontal spread of Trellis technology with mulching in tomato

Technology	Area (ha)		Change in area (ha)	Impact (% Change)
	Before demonstration	After demonstration		
Trellis with Mulching in tomato	15	35	20	133.33

RESULTS AND DISCUSSIONS

Productivity, technology gap, technology index, and extension gap in Trellis technology with mulching in tomato under FLD

Technology gap

As per the observation recorded in Table 2, the average technology gap was 77.5 q ha-1. Based on the yield gap between demonstrated technology and the potential yield observed, the extension centers like Krishi Vigyan Kendras need to put efforts to minimize it by conducting FLDs like how Krishi Vigyan Kendra, Rudrur conducted front-line demonstrations in trellis in Tomato. The variation if any in technology gap during the demonstration years may vary due to soil fertility, the climatic condition of the area, and management practices implemented by the farmers. Hence, more location-specific recommendations and precise use of technology in the fields are necessary to bridge the technology gap as supported by others [2] [15]. Similarly, yield enhancement in different crops in Front Line Demonstrations was documented earlier [3] [7] [9].

Extension Gap

The average extension gap (330 q ha-1) between demonstrated technology and the local check was mostly due to the lack of adoption of improved production technology. The results are in conformity with the findings [17], which stated the progressive use of improved crop production technologies with high-yielding varieties will subsequently change this alarming trend of galloping extension gap. It is directed to educate and emphasize the farmers for the adoption of demonstrated technologies so as to bridge the extension gap by planning and implementing of technologies through various means of extension. The results are in agreement with the research worker [11], who stated that location-based problem identification and thereby specific interventions may have great implications in the enhancement of crop productivity.

Technology Index

The average technology index reported was 8.42 %. This actually depicts the feasibility in conducting a demonstration. However, farmer perception towards the technology involving high initial costs and adverse climatic conditions resulted in the increasing trend of technology index values during the demonstration years. This is a long run over the years and more penetration at the field level may result in decreasing trend of the technology index with précised use of demonstrated technologies in the field and suitable climatic conditions during the demonstration period. As the technology index denotes the gap between technology generated at research farms and farmer's field, the lower the technology index more feasible will be the technology [6] [12].

Economic Analysis

The data obtained regarding the economic analysis for the demonstrated technology was presented in table 3. The data revealed that monetary returns were directly influenced by the market price of tomatoes and the cost of production during the successive years of demonstrations. During both, the years of demonstrations, the increased gross monetary returns and net monetary returns were obtained in the demonstrated technology over the check. An average net monetary return of Rs 96513 and B:C ratio of 1.95 was obtained in the demonstrated technology over check with net monetary returns of Rs 50850 and B:C ratio 1.98. The higher returns were due to higher yields with attractive fruit sizes and superior fruit quality over fruits from check plots. The results are in confirmation with the findings of earlier workers [5] [6] [14] [16].

Impact of Front-Line Demonstrations (FLDs) on the horizontal spread of Trellis technology with Mulching in tomato

The impact of Front-Line Demonstrations on the horizontal spread of trellis technology with Mulching in tomatoes conducted by KVK Rudrur in its operational area during the study period is quite visible in Table 4. The impact on change in the area of tomato cultivation with trellis and mulching technology after successfully conducting Front Line Demonstrations by KVK Nizamabad is 133.3 %. This impact could be attributed to addressing the identified Extension gaps with the advocation of the good practices and recommended technology in tomato cultivation apart from trellis and mulching technology as indicated in Table 4 in comparison to Farmer practice.

Generally, agricultural technology is not accepted by farmers as such in all respects. There always exists gap between the recommended technology by the scientist and its modified form at the farmer's level that hinders to increase in agricultural production in the country. It is the need of the hour to reduce this technological gap between the agricultural technology recommended by scientists or researchers and its acceptance by the farmers on their fields. The Front-Line Demonstrations undertaken in a systematic manner on the farmer's field proved successful to show the worth of Trellis technology with mulching and helped in convincing the farmers to adopt it in their farming system.

As a contributing way to the horizontal expansion of trellis technology with mulching, the Sequential Extension Methodology and Technology played a key role in improving the productivity of tomatoes, resource use efficiency, saving in cost of production, and increasing cropping intensity (Fig.1A). Variation in yields in tomato in Farmers practice during the study period as shown in Table 2 was due to lack of knowledge of farmers on trellis technology with mulching coupled with other good practices in resulting huge fruit damage as the fruits touched the ground. These FLDs helped the farmers to realize the benefits of getting high yields in comparison to Farmer's Practice and motivated them in spreading the technology in the district.

Proper Audio Visual Aid and ICT use, obtaining farmer's feedback at every crop stage and video films covering crucial crop management aspects imparted knowledge to the farmers for timely management of pests and diseases (Fig.1B and Fig. 1C). The Field Days conducted at economic part development stage (fruit development) with the involvement of demonstration holding farmers, neighbouring farmers, Scientists from SAU and ICAR-ATARI, Agriculture department officials, local extension functionaries with wide publicity using print and electronic media demonstrated the superiority of technology over farmers practice enabled to spread the technology in the district.. Enhancing the farmer's income cannot be focused on per se. Front Line Demonstrations conducted in farmers' field which are farm centric aimed at enhancing production and productivity in tomatoes provided the farmers a sense of income security.

CONCLUSION

The Front-Line Demonstration resulted in fruit yields of 890 and 795 q ha-1 with an incremental percent of 58.92 and 70.96 during 2017-18 and 2018-19 respectively producing a significant positive result providing an opportunity to demonstrate the production potential and profitability of the latest technology (intervention) under the real farming situation. This could circumvent some of the constraints in the existing transfer of technology systems in the Northern Telangana Zone. The productivity gain of 330 q ha-1 under FLD over existing practices of tomato cultivation has created greater awareness and motivated the farmers of the zone to adopt the trellis technology for tomato production.

The effort of KVK, Nizamabad in conducting FLDs on Trellis technology with mulching in Tomato with the appropriate strategy for improving farmer's income by following Sequential Extension Methodology integrating Technology might have contributed for enhancing farmer's income indirectly. As saying goes 'Research without Extension is only a hobby and Extension without Research is folly,' adopting Sequential Extension Methodology and Technology as per various technologies during different crop stages so as to reach research output to the farmers through Krishi Vigyan Kendras is the need of the hour. Successful implementation of extension activities like Front Line Demonstration through KVKs definitely contributes to envisioning the dream of the Extension division of ICAR to come true to enhance the farmers income and livelihood.

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