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Effects of Integrated Crop Management Practices on Tomato Yield and Economics in Anantapur District, Andhra Pradesh, India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Integrated crop management (ICM) demonstrations were done in 20 farmers' fields in the Krishi Vigyan Kendra operated mandals of Ananthapur and Satya Sai districts in Andhra Pradesh state during the Kharif seasons of 2022-23 and 2023-24. The objective was to demonstrate the influence of ICM to increase tomato yield at field level. According to the data, ICM practices produced a mean yield of 59.7 t/ha, which is 6.23% higher than farmers practice (56.2 t/ha). The increment in yield of tomato crop under ICM practices was due to use of improved hybrid of Arka Samrat coupled with ICM module developed by Dr YSR Horticultural University. ICM practices resulted in a higher economic benefit and adoption of ICM practices resulted in higher benefit-cost ratio (3.80) than the farmers practice with private hybrids (3.48). Tomato productivity per unit area increased by applying scientifically sound, long-term

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management practices. The study demonstrated that, ICM enhanced tomato yields. This can be used to influence farmers to adopt enhanced tomato production management technologies in the future.

Keywords: Tomato; ICM; farmer practice; yield; economics.

1. INTRODUCTION

Tomato (*Solanum lycopersicum*) is the most important solanaceous vegetable crop farmed worldwide next to potato due to its high production potential, high nutritional value and wide ecological amplitude [1]. Tomato also known as 'Protective Food' are widely planted as an annual plant. It contains minerals, vitamins and organic acids, which are beneficial for health. Tomatoes are also rich in lycopene, minerals, vitamins A, B and C [2,3]. The global tomato production in 2020 is approximately 186.82 million tons, with an area of 5.05 million ha with a productivity of 36.98 tons/ha [4]. More than half of the world's tomato production (56.71%) is concentrated in four countries. China is the world's largest producer of tomatoes (31.81%), accounting for about one-third of global production, followed by India (10.39%), the United States (7.36%) and Turkey (7.12%) [4]. India is the world second leader of tomato production with an area of 0.81 million ha producing 20.57 million tons with productivity of 25.34 tons/ha [5]. The major Tomato producing states in the country are Andhra Pradesh, Madhya Pradesh, Karnataka, Gujarat, Odisha, West Bengal, Chhattisgarh, Bihar, Telangana, Tamil Nadu, Uttar Pradesh, Maharashtra, Haryana and Himachal Pradesh. These states account for about 90% of the total production of the country [6]. However these production statistics can vary from year to year due to factors like weather conditions, crop pest and diseases and market demand. Andhra Pradesh is producing about 12% of tomatoes in the country and is the second leading producer of tomato involving a production of 2450.67 thousand tonsfrom an area of 58400 ha with a productivity of 42 t/ha [7]. In Andhra Pradesh, Ananthapur district occupies the second place in production next to Chittoor district, with an area of 2659hawith a production of 26.59 thousand metric tons with productivity of 10 t/ha, which is far below the average productivity of the state [8]. The factors for low productivity in tomato may be due to lack of knowledge on improved genotypes, production practices, outbreak of pest and diseases, climate change, labor shortage, cultivation under rainfed conditions and high cost of production. Integrated crop management (ICM) seeks to achieve economic, environmental and social balance in crop production. The ICM employs various crop management strategies and technology to boost crop yields, prevent environmental harm and ensure crop production sustainability [9]. The ICM is a knowledge-based, whole-systems approach that emphasizes the need of knowing local ecosystems and adjusting management strategies to better suit these ecosystems [10]. ICM is particularly ideal for small farmers because it strives to decrease dependence on purchased inputs and make the most of indigenous technical knowledge and land use methods. In light of the aforementioned information, frontline demonstrations of ICM practices in tomato were conducted in farmers' fields to document (i) the varieties and ICM technologies, and (ii) tomato fruit yields as influenced by the ICM technologies in Andhra Pradesh State India. This would be beneficial for farmers to implement improved practices into their farming systems.

2. MATERIALS AND METHODS

The study was conducted at Krishi Vigyan Kendra (KVK) Kalyandurg in Anantapur district of Andhra Pradesh state in farmers' fields during *Kharif* 2022-23 and 2023-24 with an objective to demonstrate the ICM practices. Ten Front Line Demonstrations (FLDs) each were conducted in 2022-23 and 2023-24 in farmer's field of KVK operated mandals. Regular trainings were held on and off campus to disseminate tomato productivity-enhancing technologies in KVK operational area. Package of practices was followed as per the information provided by Dr YSR Horticultural University. All the improved practices (ICM) were demonstrated as shown in Table 1 (Dr YSRHU 2021). Arka Samrat was the improved hybrid used in ICM practice. Private hybrids were used as a farmers practice, need based management practices were followed by the farmers after incidence of pest and disease. Data on yield attributes like number of fruits per plant, fruit length, fruit diameter, fruit weight and yield per plant were recorded at the time of first harvest. Yield data for the improved practice and farmers practice were recorded at the time of

Table 1. Details of variety and technology demonstrated (ICM)

Tomato - Arka Samrat: High yielding F_1 hybrid developed by crossing IIHR-2835 X IIHR-2832. First F_1 Hybrid with triple disease resistance to ToLCV, BW and early blight. Fruits oblate to high round, large (90-110g), deep red and firm. Suitable for fresh market.
ICM Package Includes:
1. Deep summer Ploughing 2. Application of Neem cake @200kg per acre. 3. Soil application of Azospirillum, Phoshobacteria, and Potash mobilizing bacteria @ 5 Kg/ha. 4. Seed treatment with Imidachloprid 8g/kg. 5. Two rows of maize/jowar as boarder crop. 6. Marigold as trap crop (1:16). 7. Installation of Yellow & blue sticky traps- for sucking pest management (20 per acre). 8. Removal and destruction of virus affected plants 9. Neem oil 10,000 ppm @ 2ml/L alternating with the chemical sprays 10. Imidacloprid 40% + Fipronil 40%WG (Police)– 40 to 50 g/acre.Cyantraniliprole - 240 ml/ acre & Acetamiprid – 40 to50 g/acre (Dr YSRHU-2021)

multiple harvests and the % yield gain in demonstrations over farmers practice were computed using the method proposed by Yadav et al*.* [11].

3. RESULTS AND DISCUSSION

3.1 Fruit and Yield Characters

The highest fruit numbers per plant were observed in the fields where ICM was practiced in both years (Table 2). As per the pooled data, ICM practices recorded (77 fruits) 11.6% more fruits than farmers practice (69 fruits). Similarly, ICM practices had higher effects of increasing the average fruit length (5.5cm), average fruit diameter (4.82 cm) and average fruit yield (161.3g) over the framers practice (Table 2). The average fruit weight is one of the important yield contributing parameters of tomato which ultimately determines the total yield of the crop. The increase in fruit length and fruit diameter had resulted in the increase in fruit weight of tomato. The ICM practices in tomato recorded 7.9% and 6.8% higher average yield per plant over farmers practice in the year 2022-23 and 2023-24, respectively (Table 2).The average tomato yield recorded was 57.3 t/ha in 2022-23, 62.1 t/ha in 2023-24 and 59.7 t/ha when pooled over the years. On an average, the yield of tomato under study was comparatively higher in ICM practice. This was about 5.72% higher in 2022-23 and 6.70% higher in 2023-24 over farmers practice. The increase in yield in ICM practice can be attributable to more fruits per plant and increased fruit weight. This observation was in agreement with other studies that found similar results that attributed the increases to ICM practices in tomato [12], watermelon [13], sesame [14] and blackgram [15].

3.2 Economics

Economic indicators that is*,* cost of cultivation, gross returns, net returns and Benefit: Cost (B:C) ratio of demonstrated ICM practices are presented in Table 3. The cost of cultivation was slightly higher in farmers practice when compared with the demo practice in both years. From the Table (3), farmers adopting ICM practices could save a production cost of Rs. 3,250/- and Rs. 3,900/- during the year 2022-23 and 2023-24, respectively. Year-to-year variability in cultivation costs can be explained by differences in the local social and economic conditions. The higher cost of production in farmers practice might be due to indiscriminate use of chemical fertilizers and pesticides. Similar observation of cost saving through ICM practices was also observed by Singh 2017 [12]. The gross return calculated was presented in the Table 3. The study demonstrated that ICM practices registered higher gross returns during the second year as compared to first year. This might be attributed to high yield during second year of study. The average gross returns from the pooled data recorded was Rs. 4,77,600/ha as compared to Rs. 4,49,600 in farmers practice. Thus, the ICM practices registered an increase of 6.22 % gross returns over farmers practice. The pooled data on net returns also showed that ICM practices were more economically viable than farmers practice. The study also demonstrated that net returns recorded under ICM practices (Rs.3,52,125/-) were 9.85% higher than farmers practice. Economic analysis of the yield performance revealed that the observed benefit

Table 2. Fruit and yield characters of tomato as influenced by ICM practices

Plant characters	2022-23		2023-24		Pooled data	
	ICM	FP	ICM	FP	ICM	FP
No of fruits per plant	72	63	82	75	77	69
Fruit length (cm)	5.48	4.97	5.32	5.23	5.4	5.1
Fruit diameter (cm)	4.79	4.38	4.85	4.78	4.82	4.58
Fruit weight (g)	162.2	140.8	160.4	144.8	161.3	142.8
Yield per plant (kg)	4.77	4.42	4.85	4.54	4.81	4.48
Yield (t/ha)	57.3	54.2	62.1	58.2	59.7	56.2
% increase in yield	**5.72**		**6.70**		**6.23**	

Table 3. Economics of tomato production as influenced by ICM practices

Economic Parameters	2022-23		2023-24		Pooled data	
	ICM	FP	ICM	FP	ICM	FP
Cost of cultivation (Rs/ha)	1,22,350	1,25,600	1,28,600	1,32,500	1,25,475	1,29,050
Gross Returns (Rs/ha)	4,58,400	4,33,600	4,96,800	4,65,600	4,77,600	4,49,600
Net Returns (Rs/ha)	3,36,050	3,08,000	3,68,200	3,33,100	3,52,125	3,20,550
B:C Ratio	3.75	3.45	3.86	3.51	3.80	3.48

cost ratio of demonstration plots were higher than the control plot i.e., farmer practice. The cumulative effect of technological interventions over two years, revealed an average benefit cost ratio of 3.80 in demonstration plots compared to 3.48 in control plots. Thus, this study demonstrated the economic benefit of adopting ICM practices. This corroborated studies by Rathod et al*.* [16] and Choudhary et al*.* [17] who found similar results.

4. CONCLUSION

From the study it can be concluded that tomatoes under ICM practices have higher yields than farmers practice. The ICM module from tillage to harvesting increased yield, input use efficiency and economic benefits.. It can be concluded that, under present circumstances adopting ICM practices in tomato cultivation could achieve higher economic benefit than farmer's practice. This should influence more farmers to adopt ICM practices in tomato and other major vegetable and fruit crops in Ananthapur and Satya Sai districts of Andhra Pradesh.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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