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Evaluation of IPM Modules against Fall Armyworm in Maize through Frontline Demonstration and Its Economic Impact

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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

Aim: The present study was undertaken to assess IPM modules against Fall Armyworm in Maize through Frontline Demonstration and its economic impact.
Place and Duration of Study: The present study was carried out in Ananthapuramu district of Andhra Pradesh during the period 2020-2023.
Methodology: The main objective of frontline demos is to demonstrate recently available crop production and protection technology, as well as their management practices, in a farmer's field in a micro farming setting. The KVK, Reddipalle conducted front line demonstrations on maize throughout rabi seasons of 2020-21, 2021-22 and 2022–2023, as part of annual technical

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programme of Krishi Vigyan Kendra, Reddipalle, Ananthapuramu district organised 30 FLD locations in KVK operational area of adopted villages. Following a group discussion, a list of farmers was created, and those who were chosen received specialised training in various parts of suggested protection technologies.

Results: According to the current results and subsequent analysis of the results, maize reported a higher total (91120 Rs ha^{-1}) when compared to farmers practice (74309 Rs ha^{-1}). The benefit cost ratio was significantly higher in the recommended approach (2.51) when compared to farmers practice (2.12). The higher grain output and better market pricing of the produce may be the causes of the maize demonstration's higher net returns and B: C ratio.

Conclusion: The FLD intervention is highly effective among maize farmers with increased net returns of 13618 rupees per hectare. Hence, FLD plays a vital role in dissemination of technology on a community basis when compared to other approaches.

Keywords: Frontline demonstration; maize; fall armyworm; cyantraniliprole.

1. INTRODUCTION

Maize, Zea mays L. is regarded as the queen of cereals owing to its high potentiality and ability to produce higher biological yields in a shorter period of time. Indian cultivation of maize cover over 9.86 million hectares of area with production of 26.26 million tonnes with productivity of 2664 kg/ha [1]. It is attacked by nearly 130 species of insect pests in India causing considerable yield losses [2]. Adding to the list of new invasive pests, fall armyworm (FAW), Spodoptera frugiperda (Lepidoptera: Noctuidae) is native to the tropical region of the western hemisphere from the United States to Argentina. In India, it was first reported in Hassan district of Karnataka on maize [3] which later spread to Tamil Nadu, Andhra Pradesh, Telangana and West Bengal. Farmers' resort to spray various insecticides with short intervals resulted in resistance, secondary pest outbreak and pest resurgence along with destruction of natural enemies and environmental pollution. However, the productivity of maize in the is very low per unit area due to lack of proper management schedules and advanced technological interventions. Increasing awareness of the potential impact of such toxic chemicals has led to the development of eco-friendly new molecules to ensure minimum risk to man and environment [4]. Due to maize cultivation utilising a traditional farming method, repetitive usage of various insecticides and lack of awareness regarding cutting-edge technologies, and major abiotic and biotic stresses, the potential yield of maize is decreasing. Taking into account the above consideration, frontline demonstrations were carried out in a systematic manner on farmers' field to show the worth of a new variety and convincing farmers about potentialities of improved production management practices of maize for further adoption. Currently, Frontline Demonstrations (FLDs) which are essential for increasing the farmers income through Krishi Vigyan Kendra's. Therefore, it can be said that front-line demonstration is an effective extension intervention to show farmers the possibilities of increasing maize crop production. In order to maximise the productivity potential of the maize crop, close the technology gap, speed up technology adoption, and lower disease and insect infestation, it is advised that extension agencies engaged in the transfer and application of agricultural technologies on farmer's fields prioritise organizing frontline demonstrations.

2. MATERIALS AND METHODS

Front line demonstrations (FLDs) are among the most effective extension strategies because, in general, farmers are motivated by the idea that "Seeing is believing." The main objective of frontline demos is to demonstrate recently available crop production and protection technology, as well as their management practices, in a farmer's field in a micro farming setting. The KVK, Reddipalle conducted front line demonstrations on maize throughout rabi seasons of 2020-21, 2021-22 and 2022–2023, as part of annual technical programme of Krishi Vigyan Kendra, Reddipalle, Ananthapuramu district organised 30 FLD locations in KVK operational area of adopted villages. Following a group discussion, a list of farmers was created, and those who were chosen received specialised training in various parts of suggested protection technologies. The technological interventions on maize fall armyworm were composed of seed treatment with Fortezaduo (Cyantraniliprole + Thiamethoxam) @ 4 ml/Kg, Installation of S. frugiperda pheromone traps, *Metarhizium anisopliae* (1x107) @ 2ml/lt at 30-35 DAS and cyantraniliprole 10.26% OD. n this demonstration control plot was also kept where farmer practices

(indiscriminate use of Spraying of different insecticide mixture (Profenophos, flubendiamide and various insecticide mixtures). The gaps were categorized into three groups and given scores like full adoption (No Gap)-1, partial adoption (partial gap) -2 and no adoption (Full gap)-3 scores respectively. The yield data were collected from both the demonstration and farmers practice by random crop cutting method and analyzed by using simple statistical tools. Adoption gap index was calculated using the formula given by Rajashekhar et al. [5]. Adoption gap index is the per cent deviation in farmers' practices as compared to the improved practices.

Adoption gap index = (Total no of improved practices- No of improved practices followed by farmer)/ (Total no of improved practices) ×100

Yield parameters of both demonstrations and check involving farmers practices were recorded. Using the yield parameters extension gap, technology gap, yield gap, technology index was calculated as procedure suggested by Rajashekhar et al. [5] and Samui et al. [6].

Extension gap (q/ha) = Demonstrations yield – Yield under existing farmer's practice

Technology gap (q/ha) = Potential Yield – Demo Yield

Additional return = Demonstration return – farmer's practice return

$$\text{Yield gap (\%)} = \frac{Extension\ gap}{Yield\ under\ farmers\ practice} \times 100$$

$$\text{Technology Gap (\%)} = \frac{Technology\ gap}{Potential\ Yield} \times 100$$

3. RESULTS AND DISCUSSION

With technology involvement, the improved plant protection technologies are more crucial for the production and profitability of maize. Detailed materials and procedures with technology assistance for advised practices (Table 1). Additionally, it was noted that farmers largely avoided using fungicides and used insecticides injudiciously and against recommendations reported by Reddy et al. [7].

3.1 Maize Grain Yield and Gap Analysis

Table 2 displays grain yield and gap analysis of maize farmers. Data showed that the average grain production of the maize increased by 7.58 per cent, from 6254 kg ha^{-1} under farmer practice to 6725 kg ha^{-1} under demonstration with technological interventions. Technology index, technology gap and extension gap were also recorded under this study.

3.2 Economic Analysis

According to the current results and subsequent analysis of the results, maize reported a higher total (91120 Rs ha^{-1}) when compared to farmers practice (74309 Rs ha-1). These results are consistent with Dhaka et al. [8], Mistry et al. [9] and Bhati et al. [10] where maize yields were improved along with net returns. Similarly, average additional yield of 9.06q ha^{-1} was reported maize [11]. The improved technologies recorded average yield of 27.62 q/ha which was 32.99 percent higher than the obtained with farmer's practices of 20.73 q/ha as reported by Charak et al. [12]. A similar study was reported in tribal areas of Andhra Pradesh where maize yields were increased by 75.6 percent over control from 62.1 q to 85.3 q/ha [13]. Improved production technologies of maize produced 28.67 per cent higher yields than farmers practice [14]. Economic analysis revealed that in three years

Table 1. Difference between technological intervention through FLD in maize

Technology intervention	Farmers practice	Gap
Seed treatment with Cyantraniliprole + Thiamethoxam	Not Followed	Full Gap
Installation of S. frugiperda pheromone traps	No Pheromone traps used	Full Gap
Azadirachtin 10000 ppm spray 10 to 15 DAS	Followed rarely	Partial gap
Use of bio-formulation Metarhizium anisopliae	Followed rarely	Partial gap
Use of advanced chemical cyantraniliprole 10.26% OD	Indiscriminate use of insecticides with similar mode of action	Partial Gap

Table 2. Grain yield and gap analysis grain yield and gap analysis

Year	No. of demonstrations	Average yield (Kg/ha)		% Increase in demonstration	Extension gap	Technology gap	Technology index
		Demonstration	Farmers practice				
2020-21	10	6435	5967	7.84	468	915	6.36
2021-22	10	6810	6540	4.12	270	540	7.34
2022-23	10	6930	6255	10.79	675	420	5.71
Average	**10**	**6725**	**6254**	**7.58**	**471**	**625**	**6.47**

Table 3. Maize economic analysis

Year	Total returns (Rs ha^{-1})		Input cost (Rs ha^{-1})		Net returns (Rs ha^{-1})		Additional returns (Rs ha^{-1})	B:C Ratio	
	Demonstration	Farmers practice	Demonstration	Farmers practice	Demonstration	Farmers practice		Demonstration	Farmers practice
2020-21	144787	134257	64925	71785	79862	62472	17390	2.23	1.87
2021-22	143010	137340	64170	69730	78840	67610	11230	2.22	1.96
2022-23	169785	153247	55125	60500	114660	92747	12235	3.08	2.53
Average	**152527**	**141614**	**61406**	**67338**	**91120**	**74309**	**13618**	**2.51**	**2.12**

advised approach produced average additional returns of 13618.00 Rupees per hectare. The benefit cost ratio was significantly higher in the recommended approach (2.51) when compared to farmers practice (2.12). The higher grain output and better market pricing of the produce may be the causes of the maize demonstration's higher net returns and B: C ratio. The Technology index shows the feasibility of the technology at the farmers' field. The lower the value of technology index more is the feasibility. In current study, average technology index was 6.47 for the three consecutively.

4. CONCLUSION

On the basis of the result obtained in present study it can be concluded that the yield gap between conventional practices and improved production technologies was perceptibly higher, there is urgent need to make stronger extension services for educating the cultivators in the implementation of improved production technology. However, the yield level under fld was better than the local varieties and performance of these varieties could be further improved by adopting recommended integrated pest management technologies. The fld intervention is highly effective among maize farmers with increased net returns of 13618 rupees per hectare. Hence, fld plays a vital role in dissemination of technology on a community basis when compared to other approaches.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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