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RESEARCH ARTICLE

REDUCTION OF MAIZE FALL ARMYWORM (*SPODOPTERA FRUGIPERDA*, J.E. SMITH) POPULATION WITH THE USE OF TNAU TECHNOLOGY CAPSULE

[1*]Thilagam, P., [2]Dinakaran, D., [1]Nanthakumar, S. and [1]Gopikrishnan, A.

[1]TamilNadu Agricultural University, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu
[2]Department of Plant protection, Agricultural College and Research Institute, Vazhavachanur, Tiruvanamalai

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ABSTRACT

Evaluation of integrated pest management (IPM) technology capsule against fall armyworm, *Spodoptera frugiperda* (J.E.Smith) developed by Tamil Nadu Agricultural University, Coimbatore was tested along with farmers' and zero practice during the rabi season 2019 at Agricultural Research Station, Virinjipuram and in farmers' field. The results revealed that there was a reduction in the larval population of *S. frugiperda* among the various modules tested. At vegetative stage at 15 days after sowing (DAS), the leaf damage was found to be lowest in technology capsule (16.6 %) followed by farmers' practice (30.0%) and the highest was recorded in zero practice (43.3 %). At 60 DAS, the lowest tassel damage was reported in technology capsule (6.6%) and zero practice reported with highest damage (56.6). Even at the time of harvest, the cob damage varied from 3.3 - 23.3 per cent with the lowest in technology capsule and the highest in zero practice. The results on the leaf grade revealed that the lowest scale was observed in technology capsule at 30 DAS (3) followed by farmers practice (6) as compared to zero practice which reported with 9. The natural enemy population *viz*., coccinellids and spiders in different management options, ranged from 0.3 - 2.3 numbers per plant. The reduction in the larval population reflected in the highest grain yield in technology capsule (4200 kg /ha) followed by farmers' practice (2990 kg/ha) and zero practice (1700 kg/ha).

Key words: Fall army worm, Spodoptera frugiperda, Evaluation studies, Technology capsule, Farmers' and Zero practice

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INTRODUCTION

The fall armyworm (FAW), *Spodoptera frugiperda* (J.E.Smith) is a lepidopteran pest that feeds in large numbers on the leaves and stems of more than 80 plant species, causing more damage to economically important cultivated grasses such as maize, rice, sorghum and sugarcane but also other vegetable crops and cotton. During April 2017, there was a continuous spread of FAW in Africa and invaded India during 2018. In Tamil Nadu, the pest was recorded in Karur and Coimbatore districts of Tamil Nadu during July 2018 and reported to the tune of 40-45 % (Srinivasan *et al*., 2020). The maize crop is cultivated in an area of about 1500 ha in Vellore district during all the three seasons viz., kharif, rabi and summer. In Vellore district, infestation level at vegetative and leaf whorl stage reported as 5-50 per cent damage in different blocks (Thilagam and Dinakaran, 2020). The larvae feed on the growing points by remaining inside the leaf whorl. The symptoms also include scrapping of leaves, pinholes, small to medium elongated holes, parallel shot holes and irregular shaped holes on leaves, loss of top portion of leaves, presence of chewed up frass material and faecal pellets in the leaf whorl, drooping of leaf portion above the feeding area and feeding on economic parts *viz*., tassel and cob. Due to the hidden behaviour of the pest, the effective management strategies should be developed and reliance on single method of management option would fail. Hence, various integrated approaches against this pest were designed by the Department of Agricultural Entomology, Centre for Plant Protection Studies, Tamil Nadu Agricultural University (TNAU), Coimbatore for testing IPM module efficacy with farmers' and Zero practice.

MATERIALS AND METHODS

A field experiment was laid out at Agricultural Research Station, Virinjipuram and also in farmers' field simultaneously during rabi 2019 using maize hybrid Shivani. The experiment was laid out with the following TNAU Technology capsule to evaluate FAW (Figure 1) and by adopting farmers' practice in farmers' field in Gollamangalam Village, Madhanur block of Vellore district along with recommended practices as provided in Table 1. Observations on the larval population of *S. frugiperda* was taken at different stages of crop with the recommended practices at 15, 30, 45, 60 and 75 days after

Corresponding author: **Thilagam, P.,**
Tamil Nadu Agricultural University, Agricultural Research Station, Virinjipuram, Vellore, Tamil Nadu.

S.No	Technology capsule		Recommendation
1.	Cultural operation	:	Deep ploughing
2.	Application of neem cake (per acre)	:	100 kg
3.	Seed treatment (per kg)	:	Thiamethoxam 30 FS @ 10 g or *Beauveria bassiana* @ 10 g
4.	Rogue spacing	:	For every 10 rows of maize one row without maize
5.	Pheromone Trap (Nos/ acre)	:	5 (should be placed within 7 DAS)
6.	Border crop	:	Cowpea or sunflower
7.	Intercrop	:	Blackgram or greengram
8.	Insecticide application		

Vegetative stage (15-20 DAS) :

S.No	Insecticide	Dose /10 L
1.	Azadirachtin 1%	20 ml
2.	Thiodicarb 75 % WP	20 g
3.	Emamectin benzoate 5 SG	4 g

Leaf whorl stage (40-45 DAS) :

S.No	Insecticide	Dose /10 L
1.	*Metarihizium anisopliae*	80 g
2.	Spinetoram 12 SC	5 ml
3.	Chlorantraniliprole 18.5 SC	4ml
4.	Flubendiamide 480 SC	4 ml
5.	Novaluron 10 EC	15 ml

Tassel / cob stage (60-75 DAS) : As recommended at leaf whorl stage (40-45DAS)

*Developed by Centre for Plant Protection Studies, TamilNadu Agricultural University, Coimbatore
DAS: days after sowing

Table 2. Practices adopted against fall armyworm using different management options in Maize

S.No	Particulars	Technology capsule	Farmers practice	zero practice
1.	Area (acres)	0.5	0.5	0.5
2.	Ploughing	Deep ploughing	Normal ploughing	Normal ploughing
3.	Application of neem cake	50 kg	Not applied	Not applied
4.	Seed treatment with Thiamethoxam @ 30 FS or *Beauveria bassiana* @ 10 g/kg	Treated with thiamethoxam 30 FS10 g/kg of seed	Not treated	Not treated
5.	Rogue spacing	For every 10 rows one row as a blank	Not followed	Not followed
6.	Border crop (Sunflower /Sesamum)	Sesamum	Not followed	Not followed
7.	Intercrop (Blackgram /Greengram)	Black gram	Not followed	Not followed
8.	Pheromone trap	3 Nos	Not installed	Not installed
9.	Plant protection			
i.15 DAS		Spray of azadirachtin 1% 20ml per 10 litres of water	-	-
ii.40 DAS		Spray of Chlorantraniliprole 18.5SC 4ml per 10 litres of water	Spray of chlorpyriphos 30ml / 10 litres of water with Jaggery	-
iii.65 DAS		Spray of flubendiamide 480 SC 4ml per 10 litres of water		

DAS: days after sowing

Figure 1. A field view of demonstration unit on TNAU Technology capsule at ARS, Virinjipuram

Table 3a. Evaluation of Technology capsule against fall armyworm, *Spodoptera litura* at Vegetative stage in maize

Modules	15 DAS				30 DAS					45 DAS				
	Damage (%)		Population (No. per plant)		Leaf grade (1-9)	Damage (%)		Population (No. per plant)		Leaf grade (1-9)	Damage (%)		Population (No. per plant)	
	Leaf	Whorl	FAW	NE		Leaf	Whorl	FAW	NE		Leaf	Whorl	FAW	NE
TNAU Technology Capsule	16.6	3.3	0.66	1.33	3	6.6	9.9	0.2	2.3	1	6.9	4.3	0.3	1.3
Farmers' practice	30.0	26.6	1.66	0.3	6	20.5	36.6	1.2	0.1	6	23.3	36.9	1.8	0.9
Zero practice (control)	43.3	33.3	3.66	1.66	7	40.0	50.0	1.8	0.8	9	36.6	56.6	3.3	0.2

*DAS: days after sowing; NE: natural enemies (Coccinellid + Spider only)

Table 3b. Evaluation of Technology capsule against fall armyworm, *Spodoptera litura* at reproductive stage in maize

Modules	60 DAS			75 DAS			Grain Yield Kg/ha	Cob damage at harvest (%)
	Tasseldamage (%)	FAW (No. per plant)	NE (No. per plant)	Cob damage (%)	FAW (No. per plant)	NE (No. per plant		
TNAU Technology Capsule	6.6	0.1	0.8	6.6	0.1	0.3	4200	3.3
Farmers' practice	23.3	1.16	0.1	26.6	1.3	0.0	2990	23.3
Zero practice (control)	56.6	3.33	0.5	36.6	1.9	0.0	1700	43.6

*DAS: daysafter sowing; NE: natural enemies (Coccinellid + Spider only)

sowing (DAS) in twenty five randomly selected plants. Apart from the larval population, leaf and whorl damage was also recorded at the same time interval as followed for larval count using the given formula. Leaf injury ratings scale based on lesions on leaves (1 to 9 grade) with grade of 1 (no damage or few pin holes) to 9 (most leaves with long lesions) as described by Davis and Williams, 1992. Observations on the natural enemy population viz., spiders and coccinellids were also taken in to account. The data thus obtained are subjected to MS Excel basic function analysis and mean damage at different stages was worked out.

$$\text{Per cent Leaf damage} = \frac{\text{Number of damaged leaves by FAW}}{\text{Total number of leaves}} \times 100$$

$$\text{Per cent Whorl damage} = \frac{\text{Number of Whorls damaged}}{\text{Twenty five plants}} \times 100$$

$$\text{Per cent Tassel damage} = \frac{\text{Number of tassels damaged}}{\text{Twenty five plants}} \times 100$$

$$\text{Per cent cob damage} = \frac{\text{Number of cobs damaged}}{\text{Twenty five plants}} \times 100$$

RESULTS

The results of the data are presented in Tables 2a and 2b showed that there was a reduction in the larval population of *S. frugiperda* among the various modules tested. At vegetative stage at 15 DAS, the leaf damage was found to be lowest in Technology capsule (16.6 %) followed by farmers' practice (30.0%) and the highest was recorded in zero practice (43.3 %). The damage reduction by the larvae were positively reflected in the larval population in technology capsule with 0.66 larva per plant, farmers' practice (1.66 larvae/plant) and in zero practice (3.66 larvae/plant). At different stages of crop growth, the lowest leaf damage was noticed at 45 DAS in technology capsule (6.9 %) and the highest was reported in zero practice (36.6%). At 60 DAS, the lowest tassel damage was reported in technology capsule (6.6%) and zero practice reported with 56.6 per cent. At 70 DAS, the lowest cob damage of 6.6 per cent was reported in technology capsule followed by farmers' practice (26.6 %) and zero practice (36.6 %). Even at the time of harvest, the cob damage varied from 3.3 - 23.3 per cent with the lowest in technology capsule and the highest in zero practice. The results on the leaf grade rating scale revealed that the lowest was observed in technology capsule at 30 (3) and 45 DAS (1) followed by farmers' practice 6 at 30 and 45 DAS as compared to zero practice which reported 7 at 30 and 9 at 45 DAS. With regard to natural enemy population in different management options, the population of coccinellids and spiders ranged from 0.3 - 2.3 numbers per plant throughout the observation period in technology capsule. On the otherhand, inspite of non-use of chemical insecticides in zero practice also reported with minimum occurrence of natural enemies (0.5 - 1.66 Nos /Plant).This might be due to the influence of border and intercrops in technology capsule. The reduction in the larval population, leaf, whorl, tassel and cob damage was well reflected in the highest grain yield in technology capsule (4200 kg /ha) followed by farmers practice (2990 kg/ha) and zero practice (1700 kg/ha).

DISCUSSION

The results on the significant impact of TNAU technology capsule in maize against *S. frugiperd* a was also reported by Usharani *et al*., 2020 and Zadda kavitha *et al*.,2020. The highest yield obtained under improved technologies compared to farmers' practice reflected in the additional return was also reported by Lathwal 2010andRaj *et al*. 2013 in pulses. Likewise, technology capsule doesnt have negative impact on natura enemies even after three rounds of insecticide application, which might be due to the shift in border and inter crops cultivated while spraying. Similar findings in chillies with the use of two rows of maize as a border crop recorded significantly more numberof coccinellids compared to chilli crop bordered by maize (Tatagar *et al*., 2011).

Conclusion

Due to the new insect pest alert in maize cultivation in the recent years, there is a need to combat fall armyworm in major maize growing areas. The findings clearly unravels that the technology capsule developed by TNAU brought out the population of fall armyworm thereby increasing the yield of maize. Hence, large impact demonstrations can be made which might be easily adopted by the farmer as it requires only slight modifications in the existing farmers' practice. This will pave way to increase area expansion under maize cultivation with higher productivity per unit area.

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