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Integrated Pest Management Strategies for Fruitfly (*Bactrocera cucurbitae*) in Bittergourd (*Bactrocera cucurbitae*)

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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

The present study was conducted to evaluate the effects of Integrated Pest Management practices against bitter gourd fruit fly in Tiruvallur District, Tamil Nadu, India. The demonstration was conducted at farmer's fields in two village viz., Kilambakkam and Periya kilambakkam of the district Tiruvallur during Kharif season 2018 and 2019. The front line demonstration was consisted of IPM (Field sanitation, fruit fly baits, Installation of fruit fly traps and spraying of neem oil 3%) and Non –

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IPM practices (Spraying of chemical insecticides). When compared to non-IPM fields, IPM techniques with fruit fly traps (with cue lure) attracted a large number of fruit flies, resulting in a 64 percent reduction in fruitfly infestation and a 3-4 times higher yield. The use of pheromone traps instead of insecticides to control fruit flies results in significant cost savings and pesticide-free bitter gourd output.Results indicated average fruit yield of 12.80 t/ha, an increase of 55.29% increase in yield over farmers practice as well as a net income of Rs.1,62,700/-. Reduction in cost of cultivation due to less investment for plant protection aspects has been recorded

Keywords: Integrated Pest Management (IPM); bitter gourd; marketable yield; net profit.

1. INTRODUCTION

"Bitter gourd is a popular and demanded vegetable among cucurbits grown in India. Bitter gourd (*Momordica charantia* L). Fruits are considered as a rich source of vitamins and minerals and are rich in vitamin C (88 mg/100 g)" [1]. "In terms of nutritive value, bitter gourd ranks first among cucurbits, being rich in iron, phosphorus and ascorbic acid" [2]. "A substance with clinical properties of insulin has been isolated from bitter gourd fruits and hence is recommended for consumption to diabetic patients" [3].

"Insect pests are a big stumbling block to enhancing this crop's output and productivity. Bitter gourds are attacked by a variety of insect pests, with melon fruit fly damage being the most significant limiting factor in attaining large yields and good quality fruits". Panday et al*.,* [4]. "It prefers young, green, and tender fruits for egg laying. The females lay the eggs 2 to 4 mm deep in the fruit pulp, and the maggots feed inside the developing fruits. At times, the eggs are also laid in the corolla of the flower, and the maggots feed on the flowers. A few maggots have also been observed to feed on the stems" [5]. "Fruits that are attacked early in their development fail to develop properly and fall to the ground or rot on the plant. Because the maggots cause interior harm to the fruits, pesticides are ineffective in controlling this pest. As a result, new ways of control must be investigated, and an integrated control strategy must be developed for effective pest management". Dhillon et al*.,* [6]. "The crop loss due to melon fly varied from 30 - 100% depending upon the season". Panday et al*.,* [4]. "Its abundance increases when the temperatures fall below 32° C, and the relative humidity ranges between 60 to 70%. Keeping in view the importance of the pest and crop, melon fruit fly management could be done using integrated pest management strategies". Sandeep Kumar et al*.,* [7]. "The melon fruit fly can successfully be managed by bagging fruits, field sanitation, fruit fly baits, cue-lure traps, growing fruit fly-resistant genotypes, augmentation of biocontrol agents, and soft insecticides". [6]. Therefore, attempts were made in the current study to develop IPM modules that did not use chemical pesticides and instead used pesticide alternatives such as bio-agents, fruit fly traps and plant products. He et al., [8] & Chakraborti, [9].

Gourds are cultivated in 350 ha in Tiruvallur district with bitter gourd alone occupying 40 hectares. Farmers cultivate hybrid bitter gourds in Kadambathur, Thiruvalangadu, Thiruthani, periyapalayam and Ekkadu blocks. The yield loss due to fruitfly damge was recorded more than 50%. Hence it was proposed to popularize Integrated Pest management module through frontline demonstrations for effective management of pests in Bitter gourd in Tiruvallur district.

2. MATERIALS AND METHODS

The demonstration on Integrated Pest Management was conducted at farmers' fields in two village viz. kilambakkam and periyakilambakkam of the district Tiruvallur, Tamil Nadu during 2018 -19. Before conducting the demonstrative experiment, Farmers were not practicing integrated pest management practices. They have no awaremess on methyl eugenol pheromone traps. The farmers depend only on pesticides for the control of fruit fly incidence. "Observation on No. of branches/vine and days to first female flower appearance was recorded in situ from ten randomly sampled and tagged plants per plot. Matured fruits were harvested at 3 days interval for assessment of number of fruits per plant, average fruit weight, and fruit yield. Fruit yield per hectare was obtained through conversion of the net plot yield. The data on larvae (maggot) per plant was recorded at 10 days interval and percent fruit damage was calculated on the basis of total number of healthy fruit and infested ones. The data collected were subjected to analysis of

variance" (Steel and Torrie, 1987). "Economic parameters such as cost of cultivation, net return and benefit cost ratio (BCR) were calculated by considering all inputs and outputs" [10].

3. RESULTS AND DISCUSSION

Integrated Pest Management with recommended dose of fertilizers significantly increased the vine length, number of branches/vine and average fruit weight as compared to farmers practice (methyl eugenol + malathion 50 EC at 1:1 ratio) (Table 1). Plant growth of control plot was reduced due to imbalance use fertilizers and high use of toxic chemicals and improper usage of pesticides. The marketable yield was recorded significantly higher in IPM plot (12.80 tonnes ha^{-1} and 13.20 tonne ha^{-1}) as compared to farmer practice (8.60 tonnes ha^{-1} and 8.50 tonne ha^{-1}) during kharif 2018 and 2019 respectively (Table 2). The loss of yield was due to small and fruit fly damage were higher in control plot and the loss observed was 39.48% and 38.80% in both years. Days to first female flower production was also earlier in IPM plot compared to chemical treated one. Number of branches (9.89) in demo plot. As well the vine length was recorded more in IPM treated plot. (273.56 cm).

The data on fruit damage at the time of harvesting and yield showed that the IPM plot was superior with less fruit damage 11.20% and 12.47% as compared to control 37.48% and 41.05% in both years respectively. Earlier workers (Ranganath et al., [10] ;Kumar et al. [11] have reported that minimum fruit fly incidence was observed in integrated pest management module.

The highest gross return and benefit cost ratio was obtained by application of recommended practices. Benefit cost ratio of 3.80 and 4.35 was calculated in IPM bitter gourd in Kharif 2018 and 2019 season respectively in comparison to control plot which rendered 2.33 and 2.27 benefit cost ratio in respective season and year (Table 3). When compared to the control plot, the IPM plot had a better net return due to lower yield loss caused by fruit fly. Because of the evident benefits and effective management of fruit fly, the trial may make it more convenient for most bitter gourd growers to employ IPM technology. Reduction in cost of cultivation due to less investment for plant protection aspects has been recorded. The Yield parameters, pest incidence and economics assessed in varieties from ten trials is detailed[12].

Fig. 1. Field experiment

Table 1. Effect of IPM practice on growth and yield attributes of bittergourd (*Bactrocera cucurbitae)*

Year/Season	Treatments	Vine length at 90 DAS (cm)	No.of branches /vine	Days to first female flower appearance	No. of days for 50% flowering	No. of fruits per plant	Fruit weight/g
2018, Kharif	Farmers Practice	213.58	7.56	55.24	102.60	19.20	37.05
	IPM module (TNAU 2018)	279.21	10.60	48.12	97.80	25.81	63.03
	CD P=0.05	7.26	1.38	3.25	4.22	2.37	3.33
	CV	2.87	14.99	6.10	6.31	10.33	6.42
2019, Kharif	Farmers Practice	224.58	7.24	57.58	104.22	15.55	41.43
	IPM module (TNAU 2018)	273.56	9.84	49.24	90.27	20.78	65.36
	CD P=0.05	10.82	1.19	3.65	7.08	2.12	4.05
	CV	4.24	13.60	6.54	7.09	11.38	7.39

Table 2. Effect of IPM practice on Yield (t/ha), Yield loss (%) and percent fruit damage of bittergourd (*Bactrocera cucurbitae)*

Year/Season	Treatments	Yield (t/ha)	percent fruit damage	Yield loss (%)	No. of insects per trap per week
2018, Kharif	Farmers Practice	8.60	37.48	39.48	
	IPM module (TNAU 2018)	12.80	11.20	5.62	250
	CD (0.05)	1.047	4.97		
	CV	9.539	16.47		
2019, Kharif	Farmers Practice	8.50	41.05	38.80	
	IPM module (TNAU 2018)	13.20	12.47	6.68	270
	CD (0.05)	1.795	2.56		
	CV	9.164	8.27		

Table 3. Effect of IPM practice on cost of cultivation, net return and cost benefit ratio of bittergourd

Year/Season	Treatments	Cost of cultivation (Rs./ha)	Net Return (Rs./ha)	Benefit Cost Ratio (BCR)
2018, Kharif	Farmers Practice	55250	73750	2.33
	IPM module (TNAU 2018)	50500	141500	3.80
2019, Kharif	Farmers Practice	56000	71500	2.27
	IPM module (TNAU 2018)	48500	162700	4.35

4. CONCLUSION

In farmers' practices, severe fruit fly and sucking pest incidence was noted even after several insecticides sprays . It has been found that integrated pest management techniques are the greatest substitute for producing high-quality food with a favorable benefit-to-cost ratio. Farmers were prepared to set up yellow sticky traps for sucking pest monitoring and control as well as methyl eugenol traps for controlling fruit flies.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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