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EVALUATION OF BIO INTENSIVE PEST MANAGEMENT MODULE (BIPM) AGAINST SHOOT AND FRUIT BORER, *EARIAS VITTELLA* FAB. ON BHENDI

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Abstract

A present investigation was carried out farmer field at C. Mutlur, Chidambaram to study efficiency of different Bio Intensive Pest Management (BIPM) Modules against shoot and fruit borer (*Earias vittella* fab.) on bhendi and their impact on natural enemies like spider and coccinellids and crop yield during kharif 2017 and rabi 2018. The results of present investigations revealed that Module III proved most effective treatment and it was recorded the lowest shoot and fruit infestation (12.90 & 16.66%, 11.08 & 12.54%) followed by module IV (13.76 & 18.67%, 12.69 & 13.46%) during kharif 2017 and rabi 2018, respectively. The Moderate shoot and fruit damage was observed in module II and module I compared to untreated check. Among the different modules the maximum fruit yield and the highest benefit cost ratio was recorded in module III (10.95 & 11.35 t/ha) followed by module IV (10.55 & 11.03 t/ha). Maximum mean number of coccinellids and spiders were encountered in Module-III also which might be an excellent option for sustainable management of major insect pests of bhendi. The Module III was recorded as best module controlling of shoot and fruit borer on bhendi compared to farmer's practices.

Keyword : BIPM, shoot and fruit damage, natural enemies, benefit cost ratio, bhendi

Introduction

Bhendi *Abelmoschus esculentus* (L.) Moench is one of the most important vegetable crops in India. It is commonly known as okra or lady's finger belongs to the family Malvaceae and the origin of bhendi is Africa. In India ranks first in the world with 5,784.0 thousand tones (72% of the total world production) of bhendi (FAO, 2015). It is a short duration crop and widely cultivated different season such as February-March, June-July and October-November. Among the various biotic and abiotic stresses that constrained the successful cultivation of okra crop, one of the important limiting factors in the cultivation of okra is insect pests. More than one hundred insect species have been reported as pests of bhendi (Santoshkumar *et al*., 2013). There are a few insect pests such as leaf hopper, aphid, white fly, shoot & fruit borer and spider mite, which are important in bhendi. Among them, shoot and fruit borer, *Earias vittella* Fab. considered a major pest which cause severe damage to crop (Shitole and Patel, 2009) and notorious noctuid pest causing more than 50% loss in cotton and bhendi crops (Mahapatro and Gupta 1998) and 69% on bhendi alone (Rawat and Sahu, 1973) in various parts of India. *E. vittella* alone is reported to cause 13.8 to 41.6 per cent net yield loss in bhendi (Rai *et al*., 2010).

Besides, the use of chemical insecticides is not advisable in bhendi crops which might lead to serious problems of residue deposition in fruits. Therefore it has now become necessary to develop the BIPM modules for the management of *E. vittella*.

Materials and Methods

A field trial was carried out at C. Mutlur, Chidambaram during season kharif (Aug-Sep. 2017) and rabi (Jan.-April, 2018) by raising the variety of Arka anamika at spacing 45×30 cm and an area for 0.5 acre to evaluate the efficacy of certain IPM modules against *E. vittella*. Five IPM modules were formulated mentioned below and tested along with the control.

Module I
Summer ploughing
Application of farm yard manure @ 12.5 tones/ ha
Hand picking of mature larva and pupa
Sparaying of pungam oil @ 3% @ 45 DAS

Module II
Soil incorporation of vermicompost @ 1.5 tones/ha
Spray of NSKE @ 5% at 25 DAS
Spray of neem oil @ 3% in 35 DAS
Spraying of pungam oil 3% + panchagavya 3% in 45 DAS
Spraying of *B. thuringiensis* (dipel) @ 0.2% in 60 DAS

Module III
Soil incorporation of neem cake @ 250kg/ha
Grow maize as a border crop
Spraying of NSKE 5% + panchagavya 3% in 35 DAS
Spraying of *B. thuringiensis* (dipel) @ 0.3% in 45 DAS
Spraying of spinosad 45% SC @ 120 ml/ha in 55 DAS
Trichogramma chilonis egg card @ 2.5 lakhs/ha releasing of 60 DAS and 75 DAS
Pheromone funnel traps @15/ha

Module IV
Seed treatment with imidacloprid 70 WP @ 5 g/kg of seed
Spraying of imidacloprid 17.8 SL @ 0.5 ml/lit of water at 35 DAS
Flubendiamide 39.35% SC @ 200 g/ha at 50 DAS
Emamectin benzoate 5% SG @ 250 g/ha at 65 DAS

Module IV
Untreated check

Distance between the module upto 500 m to following all the modules. Three replications were followed for each module to evaluate under Randamized Block Design (RBD) (Pazhanisamy, 2015).

Twenty plants were randomly selected for recording data in each replication once in 15 days interval after 30 DAS and continued till the end of the cropping period. Knapsack sprayer was used for spraying botanicals, entomopathogens and insecticides. Periodically tender bhendi yield was recorded. Damage recorded at regular intervals was pooled and overall mean per cent damage was worked out and natural enemy populations counted regular interval upto end of the crop period. The common practices which followed for all the modules.

$$\text{Per cent of shoot infestation} = \frac{\text{Number of inf ected shoot}}{\text{Total number of shoot}} \times 100$$

$$\text{Per cent of fruit damage} = \frac{\text{Number of inf ected fruit}}{\text{Total number of fruit}} \times 100$$

Results and Discussions

Kharif season 2017

The data on the incidence of *E. vittella* under different BIPM modules conducted during kharif 2017 and rabi 2018 have presented in Table 1 & 2. In kharif 2017 the per cent shoot damage by *E. vittella* was differed significantly among differs from the BIPM modules. In 30 DAS only shoot infestation was observed to M-I (7.55%) and M-II (5.14%). Highest per cent shoot damage was observed in M-I (28.97%) but lowest per cent shoot damage was noticed in M-III (12.62%) which was significantly superior over M-IV (13.42%) at 45 DAS. The module M-III (14.48%) superior by registering lowest per cent shoot damage followed by M-IV (15.28%) and M-II (19.63%) at 60 DAS. Similar trends were followed at 75 and 90 DAS also. In overall mean less per cent shoot damage was obtained in M-III (12.90%) indicated superiority over M-IV (13.76 %) and M-II (18.03%).

The lowest per cent fruit damage by *E. vittella* was observed M-III (18.89%) followed by module M-IV (19.63%) and M-II (22.41%). However, highest per cent fruit damage was noticed module M-I (28.97%). Similar trends were followed by 60, 75 and 90 DAS. In overall mean per cent fruit damage of *E. vittella* on module M-III indicated superiority over module M-IV (18.67%) and M-II (22.13%). The module M-I was considered to be the next best (25.16%) when compared to the untreated check (39.64%).

Sardana *et al.* (2005) was confirmed with Module III comprising of releases of egg parasitoid *T. chilonis* @ 1 lakh/ha based on monitoring of pest population using pheromone trap, three spray of NSKE @ 5% intermittently with need based application and periodic removal of borer and disease affected plants were superior over all other modules in managing the pest complex of okra. Installation of 10 pheromone trap per acre, release of *T. chilonis* from 25 day after sowing were effective in managing okra pest reported by Paulraj and Ignacimuthu (2005).

Rabi season 2018

The confirmatory field experiments were conducted to study the effective of BIPM modules against *E. vittella* on bhendi during rabi season 2018 present in Table 25. The moderate per cent of shoot infestation by *E. vittella* was noticed in M-I with 7.96% per plant followed by M-II (3.53%) at 30 DAS. At 45th DAS the higher per cent infestation of shoot by *E. vittella* was observed in M-II with 15.28% per plant. The lowest per cent of shoot damage was recorded in M-III (11.57%) followed by M –IV (14.02%) and M-I at (14.48%). In 60 DAS the lowest per cent of fruit damage was observed on M-III (11.57%) followed by M –IV (13.43%) and M-II at (17.79%). The module M-III, M-IV and M-II were equally superior by registering lowest per cent damage at 60 DAS. Similar trends were followed at 75 and 90 DAS also. In overall mean per cent shoot damage 11.08% was obtained in M-III indicated superiority over M-IV (12.69%) and M-II (15.69%). The module M-I was considered to be the next best (18.83%) when compared to the untreated check.

Among them different module lowest per cent fruit damage by *E. vittella* was noticed on M-III (11.57%) with on par on M-IV (12.17%) followed by M-II (17.72%) at 45 DAS. The highest per cent fruit damage was shown in M-I (21.29%). The per cent of fruit damage with similar trends followed at 60, 75 and 90 DAS also. In the overall mean per cent fruit damage M-III (12.54%) to be considered as a best module compared to other module.

Population of natural enemies in different BIPM modules

The table 3 showed that highest mean number of coccinellids observed in module-V (untreated check) (0.53 grubs/plant) followed modules-III (0.46 grubs/plants) and M-II (0.41 grubs/plant). Whereas the lowest coccinellids population was recorded in M-IV (0.14 grub/plant) (farmer's practices) on bhendi field during rabi season 2018 (Plate 17). Similar trend in present of coocinellids was noticed at bhendi field during the kharif season 2017.

The highest spider population was observed in module-V (untreated check) (0.45 spider per plant) followed modules-III (0.35 spider/plants) and M-II (0.27 spider/plant), however the lowest coccinelids population was recorded in M-IV (0.09 grub/plant) (farmer's practices) on bhendi field during rabi season 2018. Similar trend in present of spider was recorded at bhendi field during the kharif season 2017 (Table 3).

The present finding are in accordance with Mishra and Mishra (2002) reported that maximum activity of predatory coccinellids were seen in bio-pesticides *(B.t.,* NSKE, neem oil) treated plants and in untreated plants. Similarly, Rosaiah (2001) reported that NSKE and other botanicals were found safer to predator, *viz*., chrysopids, coccinellids, spider and *Apantelese* in bhendi ecosystem.

Economics of IPM module

From the result it is evident that damage indicated inversely proportional relationship to the yield. The highest fresh tender bhendi yield recorded under module- III (10.95 & 11.35 t/ha) was significantly higher over module I, II, IV and V (Table 4). However all the modules were recorded higher yield than the untreated check. The application of IPM module generated higher return values present in M- III (Rs. 1,31,400 per ha) compared to less for M- IV farmer practice (Rs. 1,26,600 per ha). The total IPM input cost was Rs. 7,110/ha only. The net profit was obtained also higher in M-III followed by M- II, M- IV (farmer's practices).

The maximum cost benefit ratio was recorded with M-III (1:3.54) followed by M- II (1:3.28), M- IV (1:3.12), M- I (1:2.62) (Fig. 20). The results of present finding are in line with Rajashekhar *et al.* (2016) who envisaged the higher benefit cost ratio was observed in NCIPM recommended Module (M5) with 3.91 followed by Bio intensive Module (M2) with 2.15, Insecticide Module (M7) and Bio intensive Module + Insecticide Module (M6). Similarly, Singh *et al.* (2012) observed IPM modules net return was also higher in module (M1) which was Rs. 1,82,340 and Rs. 1,65,060/ha. Further, Preetha and Nadarajan (2006) reported Biointensive module (M_2) which has the potential to reduce the fruit borer attack registered the maximum yield, BC ratio and was followed by existing recommendation module (M_4). The results conclude that adoption of BIPM practices proved the potential to provide higher yields and substitute synthetic vulnerable insecticides without any enhancement in cost of cultivation.

Conclusion

The result concluded that components of module III effectively suppression of *E. vittella* infestation and economically feasible to the farmer.

Table 1 : Effectiveness of BIPM modules against *E. vittella* in bhendi during kharif season 2017 location:C. Mutlur (Preliminary)

Modules	Mean per cent shoot infestation						Mean per cent fruit damage					
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean
M1	7.55 (15.82)^{b}	18.65 (25.43)^{a}	23.59 (29.01)^{b}	27.78 (31.75)^{b}	31.74 (34.28)^{ab}	21.86	0 (0.29)	28.97 (32.52)^{b}	31.74 (34.28)^{b}	31.94 (34.34)^{b}	33.13 (35.11)^{b}	25.16
M2	5.14 (10.83)^{b}	15.59 (23.15)^{a}	19.63 (26.01)^{ab}	24.52 (29.63)^{ab}	25.26 (30.15)^{ab}	18.03	0 (0.29)	22.41 (28.23)^{a}	30.133 (33.28)^{b}	30.63 (33.59)^{b}	27.50 (31.61)^{ab}	22.13
M3	0 (0.29)^{a}	12.62 (20.79)^{a}	14.48 (22.34)^{a}	17.78 (24.92)^{a}	19.63 (26.26)^{a}	12.90	0 (0.29)	18.89 (25.74)^{a}	20.74 (27.08)^{a}	22.4 (28.21)^{a}	21.29 (27.41)^{a}	16.66
M4	0 (0.29)^{a}	13.42 (21.42)^{a}	15.28 (22.97)^{a}	19.63 (24.26)^{a}	20.50 (26.78)^{a}	13.76	0 (0.29)	19.63 (26.26)^{a}	24.07 (29.38)^{a}	27.5 (31.61)^{ab}	22.13 (27.95)^{a}	18.67
M5	16.67 (24.09)^{c}	28.97 (32.57)^{b}	37.89 (37.97)^{c}	47.61 (43.63)^{c}	46.67 (43.08)^{c}	35.56	0 (0.29)	40.03 (39.24)^{c}	50.52 (45.30)^{c}	52.59 (46.49)^{c}	55.09 (47.93)^{c}	39.64
SE(d)	3.445	2.51	1.72	3.13	2.09			1.25	1.67	2.16	2.49	
CD (0.05%)	7.944	5.79	3.97	7.23	4.81			2.89	3.85	4.99	5.74	

DAS= DAYS After Sowing

*Mean of three replications, Figures in parentheses are arcsine (x + 0.5) transformed values, means in column followed by a common letter are not significantly different at the 5 per cent level (DMRT)

Table 2 : Effectiveness of BIPM modules against *E. vittella in* bhendi during rabi season 2018 location: C. Mutlur (Confirmatory)

Modules	Mean per cent shoot infestation						Mean per cent fruit damage					
	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean	30 DAS	45 DAS	60 DAS	75 DAS	90 DAS	Mean
M1	7.96 (16.29)^{b}	14.48 (22.34)^{a}	21.29 (27.41)^{c}	28.01 (31.88)^{b}	22.41 (28.23)^{a}	18.83	0 (0.29)	21.29 (27.4)^{b}	28.94 (32.51)^{b}	28.95 (32.52)^{c}	28.97 (32.53)^{b}	21.63
M2	3.53 (6.52)^{a}	15.28 (22.97)^{a}	17.79 (24.92)^{bc}	20.56 (26.89)^{ab}	21.29 (27.41)^{a}	15.69	0 (0.29)	17.72 (24.81)^{b}	23.57 (28.99)^{b}	25.24 (30.41)^{bc}	25.24 (30.13)^{b}	18.35
M3	0 (0.29)^{a}	11.57 (19.88)^{a}	11.57 (19.88)^{a}	14.48 (22.34)^{a}	17.78 (24.92)^{a}	11.08	0 (0.29)	11.57 (19.88)^{a}	14.48 (22.34)^{a}	17.78 (24.92)^{a}	18.89 (25.74)^{a}	12.54
M4	0 (0.29)^{a}	14.02 (21.92)^{a}	13.43 (21.43)^{ab}	16.39 (23.79)^{a}	19.63 (26.26)^{a}	12.69	0 (0.29)	12.17 (20.38)^{a}	15.87 (23.47)^{a}	19.63 (26.26)^{ab}	19.63 (26.26)^{a}	13.46
M5	13.10 (21.20)^{b}	26.11 (30.61)^{b}	36.50 (37.14)^{d}	40.95 (39.78)^{c}	53.33 (46.96)^{b}	34.00	0 (0.29)	26.26 (30.14)^{c}	45.23 (42.26)^{c}	47.62 (43.61)^{d}	58.42 (49.85)^{c}	35.50
SE(d)	4.098	2.052	1.930	2.363	2.523			1.168	1.954	1.914	1.560	
CD (0.05%)	9.451	4.733	4.442	5.468	8.485			2.678	4.492	4.403	3.594	

DAS= Days After Sowing

* Mean of three replications, Figures in parentheses are arcsine (x + 0.5) transformed values, means in column followed by a common letter are not significantly different at the 5 per cent level (DMRT)

Table 4 : Yield of tender marketable fruits and economics employed under different modules of bhendi during kharif 2017 and rabi 2018

Treatment	Rabi 2018					Kharif 2017				
	Average tender fruit yield t/ha	Gross income for tender fruit yield (Rs)	Total cost of cultivation/ ha (Rs)	Net Profit (Rs)	BCR	Average tender fruit yield t/ha	Gross income for tender fruit yield (Rs)	Total cost of cultivation/ ha (Rs)	Net Profit (Rs)	BCR
Module I	7.16	85,920	32,750	53,170	2.62	7.83	93,960	32,650	61,650	2.87
Module II	9.54	1,14,480	34,860	79,620	3.28	9.83	1,17,960	36,500	81,460	3.23
Module III	10.95	1,31,400	37,060	94,340	3.54	11.35	1,38,000	38,830	99,170	3.55
Module IV	10.55	1,26,600	40,600	86,000	3.12	11.03	1,32,360	40,980	91,380	3.22
Module V (Untreated)	4.13	49,560	27,750	21,810	1.78	4.32	51,840	27,890	23,950	1.86

Average cost of marketable fruit – Rs. 12.00, labour charges Rs.250 (men), 150 (women), pheromone funnel trap- Rs. 45, neem cake- Rs.12/kg, vermicompost- Rs. 4/kg, pheromone lure- Rs. 25, *T. chilonis* egg card- Rs. 30/ card, *B. thuringensis* (dipel)- Rs. 1200/ lit, spinosad 45% SC (tracer)- Rs. 1300/100ml, imidacloprid 70 WP- Rs. 680/100g, imidacloprid 17.8% SL- Rs. 145/100ml, Flubendiamide 39.35% SC (Fluid)- Rs. 840/100ml, Emamectin benzoate 5% SG (Missile)- 700/100g.

Table 3 : Impact of different IPM modules on the predatory activity of coccinellids in bhendi during rabi 2018 and kharif 2017

Modules	Mean Population of Coccinellids/plant		Mean Population of Spider/plant	
	Rabi 2018	Kharif 2017	Rabi 2018	Kharif 2017
M- I	0.38	0.43	0.21	0.24
M- II	0.41	0.47	0.27	0.30
M- III	0.46	0.55	0.35	0.41
M- IV	0.14	0.14	0.09	0.07
M- V	0.53	0.68	0.45	0.48

Module I

Module II

Farmer's practice (M-IV)

Module III

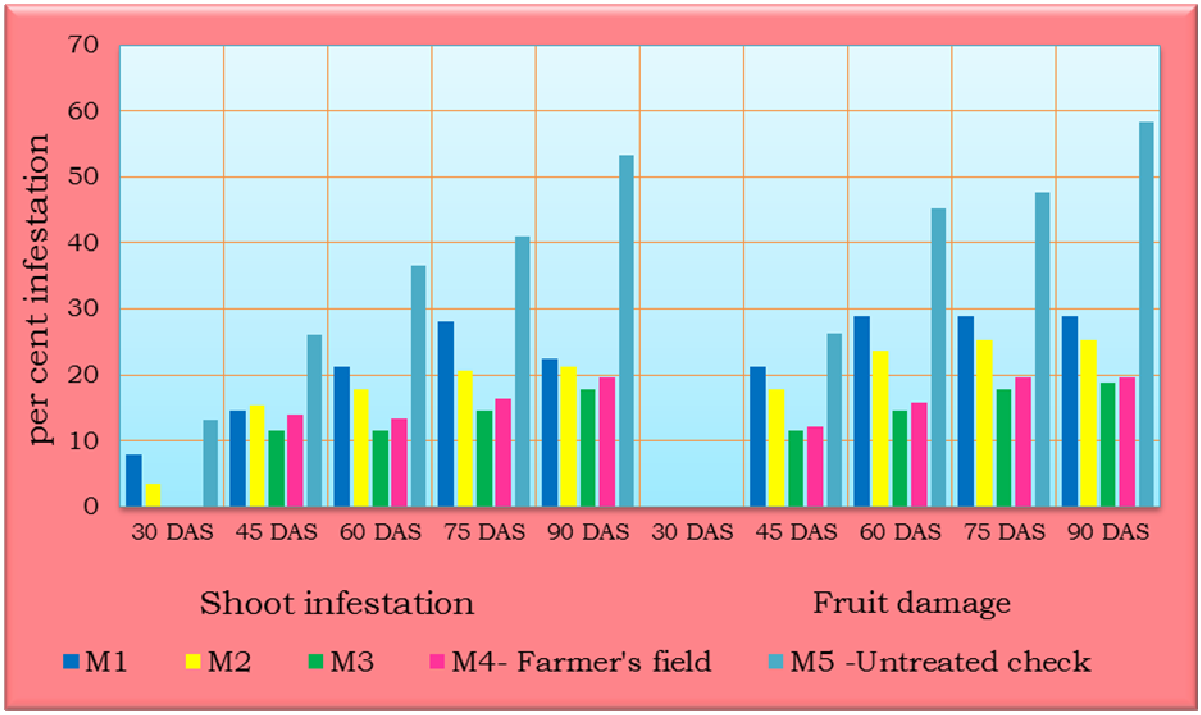

Fig. 1 : Evaluation different modules against incidence of *E. vittella* on bhendi during rabi 2018

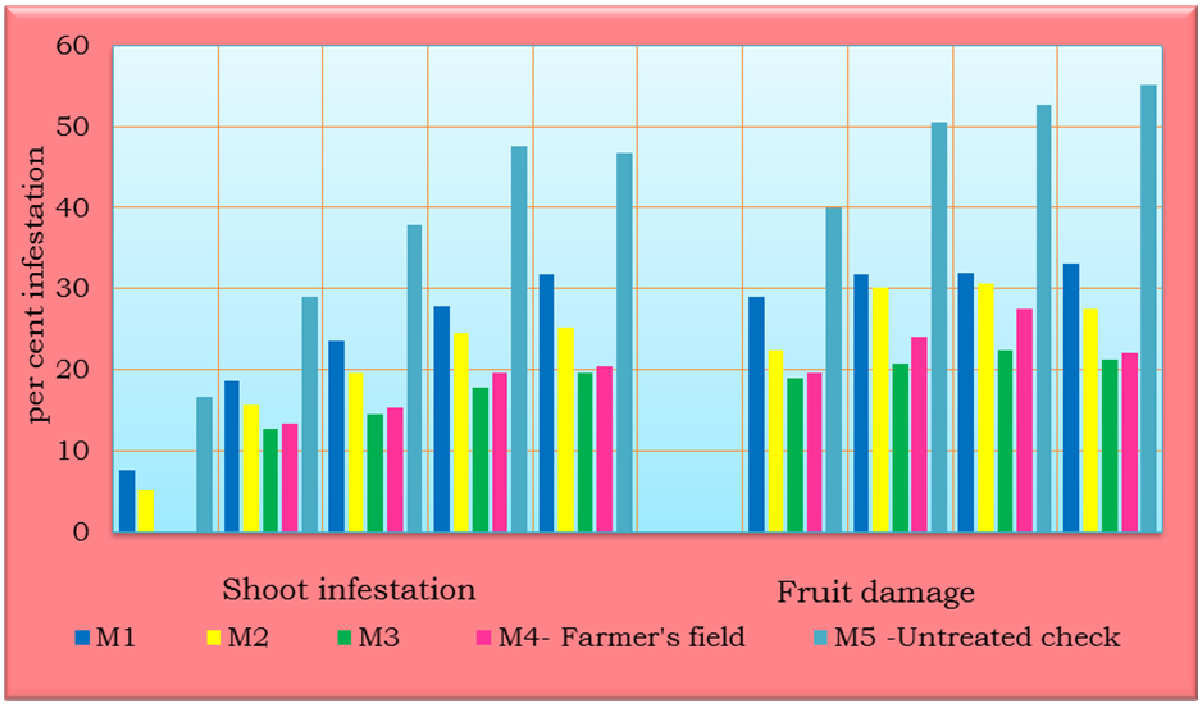

Fig. 2 : Evaluation different modules against incidence of *E. vittella* on bhendi during kharif 2017

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