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Evaluation of different pest management modules for sucking pests of bitter gourd (*Momordica charantia* L.)

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Abstract

An experiment was conducted during *kharif* 2019 for evaluation of different pest management modules for sucking pests of bitter gourd (*Momordica charantia* L.) during the course of study, three pest management modules *viz.,* Bio-intensive, Chemical and IPM module consisting spraying of different biopesticides as well as pesticides were evaluated with untreated control in Randomized Block Design (RBD) with five replications. The studies on evaluation of different pest management modules for sucking pests of bitter gourd revealed that for control of thrips, whitefly, aphids and jassids IPM module observed 4.15 thrips, 4.02 whitefly, 4.03 aphids and 4.08 jassids/3 leaves/plant, respectively.

Effect of different strategies on predatory coccinellids showed that the Bio-intensive module recorded the highest grub population per plant (4.22 grubs/plant) followed by IPM module which record 3.44 grubs/plant indicating their less toxic effects on to the coccinellids after the sprays taken in these respective modules. The highest yield of bitter gourd fruits 230q/ha was registered from the IPM module with highest ICBR 1:7.25 as against 170 q/ha in untreated control.

Keywords: *Momordica charantia,* IPM Module, *Thrips palmi, Bemisia tabaci, Aphis gossypii, Amrasca biguttula biguttula.*

Introduction

Bitter gourd (*Momordica Charantia* L.), an indigenous vegetable to tropical regions of Asia. Taxonomically bitter gourd is belonging to the Cucurbitaceae. In India, bitter gourd is grown over an area of 97 thousandth and annual production of 1137 thousand MT. In Maharashtra, bitter gourd is grown over an area of 2.08 thousand ha with the annual production of 21.27 thousand MT and productivity of 11.72 MT per ha (Anonymous. 2017-18) [2]. Bitter gourd like other cucurbits, is attacked by a wide array of insect and non – insect pests, the major being fruit fly, red pumpkin beetle, whitefly, aphids, and thrips. Infestation of these pests is important limiting factor in the commercial cultivation of the crop. Attack of these pests begin at very early stage of crop growth and continues till harvest and degree of infestation depend upon the prevailing agronomic condition (Sunil *et al*., 2017) [17]. Whereas, in India Singh *et al.*, (2000) [16] reported fruit infestation 31.27% on bitter gourd and 28.55% on watermelon. Several chemical insecticides have been recommended and are being extensively used by the farmers to control these sap sucking pests. However, considering economics and bio-efficacy of pesticidal treatments, satisfactory control could not be obtained in many instances due to miss use of insecticides. Resistance developed by pests and faulty application techniques. Furthermore, heavy doses of insecticides has posed problems of residue in the fruits which cause human hazards upon consumption and also cause pest resurgence, insecticide resistance and destruction of natural enemy. However, the chemical pesticides can be minimized by integrating it with botanical and microbial pesticides for producing healthy and good quality crop. Recently, new molecules of pesticides are introduced in the market which are comparatively safe to natural enemies of the pest. Some promising chemical are integrated in the present study to test the pest management modules against pest of bitter gourd.

Materials and Methods

The three modules with untreated control replicated five times were evaluated in R.B.D. during *kharif* season of 2019 at AICRP on Vegetable Crops, MPKV, Rahuri. Bitter gourd variety Phule Green Gold dibbled on 17thAugust, 2019 in a plot size 4 x 3 m. with 1.5 x 0.5 m. plant spacing.

Spraying was under taken in the morning hours using manually hand operated knap sack sprayer by using 500 litre of water per hector. Six sprays in each module were applied at ten days interval starting from infestation of pests. The three module consists of

Bio-intensive pest management module (BIPM):

1. Spraying of *Azadirachtin* 1500 ppm @ 5 ml/L of water at 20 DAS.
2. Installation of yellow sticky traps @ 30/ha at 25 DAS.
3. Spraying of *Lecanicillium lecanii*@ 5g/L at 30 DAS.
4. Spraying of *Beauveria bassiana*@ 5 g/L at 40 DAS.
5. Spraying of Neem oil (0.5 %) at 50 DAS.
6. Spraying of *Lecanicillium lecanii* @ 5 g/L + *Beauveria bassiana* @ 5 g/L at 60 DAS.
7. Spraying of NSE 5 % at 70 DAS.

Chemical Pest Management module (CPM):

1. Seed treatment with imidacloprid 48 FS @ 5 g/kg of seed.
2. Spraying of thiamethoxam 25 WG @ 0.3 g/L at 20 DAS.
3. Spraying of cyantraniliprole 10.26 OD @ 1.8 ml/L at 30 DAS.
4. Spraying of imidacloprid 70 WG @ 0.1 g/L of water at 40 DAS.
5. Spraying of dimethoate 30 EC @ 1.5 ml/L of water at 50 DAS. Followed by spraying of thiamethoxam 25 WG @0.3 g/L at 60 DAS and cyantraniliprole 10.26 OD 1.8 ml/L at 70 DAS, respectively.

Integrated Pest Management module (IPM):

1. Seed treatment with imidacloprid 48 FS @ 5 g/kg of seed, sowing of maize as border crop and installation of yellow sticky trap @ 30/ha at 30 days after sowing.
2. Spraying of *Azadirachtin* 1500 ppm @ 5 ml/L of water at 20 DAS.
3. Spraying of thiamethoxam 25 WG @ 0.3 g/ L of water at 30 DAS.
4. Spraying of *Lecanicillium lecanii*@ 5 g/L of water at 40 DAS.
5. Spraying of cyantraniliprole 10.26 OD @ 1.8 ml/L at 50 DAS.
6. Spraying of Neem oil (0.5%) at 60 DAS.
7. Spraying of *Lecanicillium lecanii* @ 5 g/L + *Beauveria bassiana* @ 5g/L at 70 DAS.

Untreated control.

Observations on sucking pests such as thrips, whitefly, aphids and jassids were recorded on five randomly selected plants from each replication**.** Total number of thrips, whitefly, aphids and jassids were recorded from three leaves of each selected plant. The observation were recorded at 25, 35, 45, 55, 65 and 75 DAS.

*DAS = Days after sowing.

Adult Coccinella beetles were counted per five plants in each replication at 25, 35, 45, 55, 65 and 75 DAS.

The data on average survival population of pests was translated into square root formation$(\sqrt{x + 0.5})$, and then subjected to statistical analysis as suggested by Panse and Sukhatme (1985) [13]. The Standard error (S.E) and critical difference (C.D) at 5% level of probability were calculated to determine efficacy of each insecticide. The yield data was subjected to statistical analysis. Finally, Incremental Cost Benefit Ratio (ICBR) was worked out for each treatment.

Results and Discussions

The cumulative data of pertaining to effect of different modules on the average of population of thrips, whitefly, aphids, jassids and adult Coccinella beetles were counted and presented at 25, 35, 45, 55, 65 and 75 DAS presented in Table 1-5.

Thrips, (*Thrips palmi* Karny)

The overall results states that IPM module (4.15 thrips/3 leaves/plant) was found effective in suppressing the population of thrips on bitter gourd followed by Chemical module (4.94 thrips/3 leaves/plant) as against 10.61 thrips/3 leaves/plant in untreated control.

The present investigation is in agreement with the results of Annamalai *et al*. (2014) [1] who reported that, *B. bassiana* and *L. lecanii* significantly decrease the *T. tabaci* infestations in onion crop under the greenhouse as well as field conditions. The present results are also in support with the findings of Shah (2016) [15] who reported that, Bakain leaf extract, neem oil and neem leaf extract showed comparatively higher mortality of thrips. The findings of Ingale (2018) [8] and Boraste (2019) [4] these workers reported IPM to be effective in controlling thrips in chili and cucumber respectively.

Whitefly, (*Bemisia tabaci* Gennadius)

The overall results indicates that IPM module (4.02 whitefly/3 leaves/plant) was effective in suppressing the whitefly infestation on bitter gourd and was found at par with Chemical module (4.39 whitefly). The least intensity of whitefly was observed in Bio-intensive module (5.61 whitefly/3 leaves/plant).

The present investigation is in agreement with findings of Moreau and Isman (2011) [11] who reported that yellow sticky traps were effective at trapping adult whiteflies and significantly reduced adult populations on the main crops (peppers) compared with the control. The findings of Boraste (2019) [4] who reported that all the pest management modules were significantly superior over untreated control in reducing the whitefly population. Among all the three strategies tested, IPM module was found significantly better for controlling whitefly over other modules. The present investigation is also in support of results of Javed *et al.* (2019) [9] who revealed that the mortality of whitefly caused by *B. bassiana* was significantly higher than that of *L. lecanii*.

Aphids, (*Aphis gossypii* Glover)

The overall results indicates that IPM module (4.03 aphids/3 leaves/plant) was effective in controlling the aphids on bitter gourd and was found at par with Chemical module (4.50 aphids/3 leaves/plant).

The present investigation is in agreement with the findings of Bade *et al*. (2017) [3] who reported that biopesticide treatment with *L. lecanii* @ 2.5 kg/ha was found most effective treatment against aphids after four sprays also support the present investigation. The present investigation is also in support of results of Ingale (2018) [8] and Boraste (2019) [4] these workers reported that among all the management modules IPM module was found significantly superior for reducing aphid population with minimum survived population.

Jassid, (*Amrascabiguttulabiguttula* Ishida).

The overall cumulative results indicates that IPM module (4.08 jassids/3 leaves/plant) was effective in controlling the jassid on bitter gourd and was found at par with Chemical module (4.53 jassids/3 leaves/plant).

The present investigation is in agreement with the findings of Ghelani *et al*. (2017) [5] who revealed that the NSE (5%) and neem oil were effective treatments after 3 days of application, *L. lecanii* @ 2.5 kg/ha was effective treatment after 7 and 15 days of the application. The findings of Rajput *et al.* (2017) [14] who reported that the different botanical extracts such as datura, neem and eucalyptus against jassid on sunflower crop. The result revealed that the maximum reduction percentage was recorded after application of datura followed by neem and eucalyptus and yield was higher in datura treated plot followed by neem and eucalyptus.

Natural enemy

The cumulative results indicates that Bio-intensive module (4.22 grubs/plant) was most favorable and safest module for coccinellids on bitter gourd and was found at par with IPM module (3.44 grubs /plant). The chemical module that was found most toxic to natural enemies and recorded least coccinellids population (1.38 grubs/plant). Whereas, maximum population (5.16 grubs/plant) observed in untreated control. The present investigation are in agreement with the findings of Hoelmer *et al*. (1990) [7] who observed that, the commercial neem insecticide was not toxic to adult Coccinella predators. The findings of Bade *et al*. (2017) [3] who reported that the use of *L. lecanii* @ 2.5 kg/ha recorded highest population of 4.49 lady bird beetles/plant and it was superior over all the treatments for control of aphid except, untreated control also support the present investigation.

Yield of bitter gourd

Amongst the modules, the IPM module was recorded maximum (230.00 q/ha) yield of marketable fruits of bitter gourd as against in untreated control (170.00 q/ha). Whereas, the Chemical module which was found at par with IPM module and recorded 220.00 q/ha yield of bitter gourd fruits. The Bio intensive module observed less yield (200.00 q/ha) as compared to IPM module and Chemical control module.

The highest incremental cost benefit ratio (ICBR 1:7.25) was recorded in the IPM module. Whereas, the next best module in order of ICBR was Bio-intensive module which recorded 1:5.63 ICBR. The Chemical module recorded comparatively less ICBR 1:4.73 as this module was more costly as compared to others.

Considerable yield advantages due to effective control of pests of bitter gord particularly through the use of IPM was observed in the present investigation is in agreement with Gundannavar (2007) [6] and Pandey and Satpathy (2009) [12], Mondal and Mondal (2012) [10], Tripathy *et al.* (2013) [18], Ingale (2018) [8] and Boraste (2019) [4] These workers reported IPM to be effective in controlling pests in various crops with highest yield. Thus, the observations of earlier workers in respect of these strategies influencing yield of crops could support the findings of present investigation.

Table 1: Effect of different modules on thrips (*Thrips palmi* Karny) population

Module	Number of thrips/3 leaves/plant						
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS	Mean
M1	6.52 (2.65)	6.57 (2.66)	6.06 (2.56)	5.85 (2.52)	5.46 (2.44)	5.40 (2.43)	5.97 (2.54)
M2	5.98 (2.55)	5.63 (2.48)	4.98 (2.34)	4.49 (2.23)	4.41 (2.22)	4.16 (2.16)	4.94 (2.33)
M3	4.68 (2.28)	3.76 (2.06)	4.49 (2.23)	3.89 (2.10)	4.10 (2.15)	4.01 (2.13)	4.15 (2.15)
M4	10.33 (3.29)	10.46 (3.31)	10.68 (3.34)	11.14 (3.41)	10.47 (3.33)	10.61 (3.33)	10.61 (3.33)
SE(±)	0.04	0.03	0.04	0.04	0.03	0.03	0.03
CD	0.13	0.12	0.14	0.13	0.11	0.12	0.12

(Figures in the parathenses indicates $\sqrt{x + 0.5}$values)

M1= Bio-intensive module M3= Integrated Pest Management module

M2= Chemical module M4= Untreated module

Table 2: Effect of different modules on whitefly (*B. tabaci* Gennadius) population

Module	Number of whitefly/3 leaves/plant						
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS	Mean
M1	6.22 (2.59)	5.83 (2.52)	5.50 (2.45)	5.61 (2.47)	5.32 (2.41)	5.18 (2.38)	5.61 (2.47)
M2	4.76 (2.30)	4.57 (2.25)	3.86 (2.09)	4.49 (2.23)	4.36 (2.20)	4.30 (2.19)	4.39 (2.21)
M3	4.63 (2.26)	3.73 (2.06)	4.12 (2.15)	3.86 (2.09)	3.92 (2.10)	3.89 (2.10)	4.02 (2.13)
M4	11.40 (3.44)	11.13 (3.40)	11.08 (3.40)	10.74 (3.35)	10.61 (3.33)	10.35 (3.29)	10.88 (3.37)
SE(±)	0.06	0.07	0.04	0.05	0.04	0.05	0.05
CD	0.20	0.22	0.14	0.16	0.12	0.15	0.16

(Figures in the parathenses indicates $\sqrt{x + 0.5}$values)

Table 3: Effect of different modules on aphids (*Aphis gossypii* Glover) population

Module	Number of aphids/3 leaves/plant						
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS	Mean
M1	5.38 (2.43)	5.62 (2.47)	5.88 (2.53)	5.59 (2.47)	5.66 (2.48)	5.73 (2.50)	5.64 (2.48)
M2	4.34 (2.20)	4.64 (2.26)	4.26 (2.18)	4.77 (2.30)	4.42 (2.22)	4.57 (2.25)	4.50 (2.24)
M3	4.10 (2.14)	3.84 (2.08)	4.24 (2.18)	4.04 (2.13)	4.20 (2.17)	3.78 (2.07)	4.03 (2.13)
M4	12.01 (3.53)	12.03 (3.53)	12.56 (3.61)	12.85 (3.65)	12.78 (3.64)	12.03 (3.53)	12.37 (3.59)
SE(±)	0.05	0.06	0.05	0.05	0.04	0.06	0.05
CD	0.18	0.18	0.17	0.17	0.15	0.18	0.17

(Figures in the parathenses indicates $\sqrt{x + 0.5}$values)

Table 4: Effect of different modules on number of jassids (*Amrascabiguttulabiguttula* Ishida) population

Module	Number of jassids/3 leaves/plant						
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS	Mean
M1	5.66 (2.48)	6.20 (2.59)	6.28 (2.60)	5.67 (2.48)	6.12 (2.57)	6.17 (2.58)	6.01 (2.55)
M2	4.36 (2.21)	4.62 (2.26)	4.55 (2.25)	4.57 (2.25)	4.44 (2.22)	4.67 (2.28)	4.53 (2.24)
M3	4.37 (2.21)	3.70 (2.05)	4.29 (2.19)	3.81 (2.08)	4.18 (2.16)	4.14 (2.15)	4.08 (2.14)
M4	10.24 (3.27)	10.07 (3.25)	10.52 (3.31)	11.19 (3.41)	10.92 (3.37)	10.85 (3.36)	10.63 (3.34)
SE(±)	0.05	0.04	0.06	0.05	0.06	0.05	0.05
CD	0.17	0.15	0.19	0.15	0.20	0.17	0.17

(Figures in the parathenses indicates $\sqrt{x+0.5}$values)

Table 5: Effect of different modules on coccinellids per plant

Module	Number of coccinellids (grubs/plant)						
	25 DAS	35 DAS	45 DAS	55 DAS	65 DAS	75 DAS	Mean
M1	3.16 (1.91)	4.52 (2.24)	4.88 (2.32)	3.44 (1.98)	5.04 (2.35)	4.32 (2.19)	4.22 (2.17)
M2	0.72 (1.09)	1.72 (1.49)	1.28 (1.33)	1.52 (1.42)	0.84 (1.15)	2.20 (1.64)	1.38 (1.37)
M3	3.00 (1.86)	2.76 (1.80)	3.88 (2.09)	3.12 (1.90)	3.88 (2.09)	4.00 (2.11)	3.44 (1.98)
M4	4.96 (2.33)	4.84 (2.31)	5.56 (2.46)	5.12 (2.37)	5.28 (2.40)	5.20 (2.39)	5.16 (2.32)
SE(±)	0.06	0.05	0.05	0.04	0.05	0.04	0.04
CD	0.19	0.16	0.18	0.12	0.16	0.13	0.15

(Figures in the parathenses indicates $\sqrt{x+0.5}$values)

Table 6: Effect of different modules on yield of bitter gourd

Module	Yield of bitter gourd fruits (kg)							
	R I	R II	R III	R IV	R V	Mean	Yield q/ha	ICBR
M1	25.00	23.00	24.00	23.00	25.00	24.00	200.00	1:5.63
M2	24.00	26.00	29.00	28.00	25.00	26.40	220.00	1:4.73
M3	27.00	26.00	28.00	29.00	28.00	27.60	230.00	1:7.25
M4	21.00	18.00	20.00	21.00	22.00	20.40	170.00	--
					SE(±)	0.62	5.24	--
					CD	1.94	16.17	--

*Mean taken of six harvestings

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