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Evaluation of Different Pest Management Modules for the Management of Thrips (*Scietothripsdorsalis* Hood; *Thripsparvispinus* Karny), Whitefly (*Bemisiatabaci* Gennadius) and Mites (*Polyphagotarsonemuslatus* Banks) in Chilli

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Abstract

An experiment entitled "Evaluation of different pest management modules for the management of thrips (*Scietothripsdorsalis* Hood, *Thripsparvispinus* Karny), whitefly (*Bemisiatabaci* Genn.) and mites (Polyphagotarsonemuslatus Bank) in chilli" was conducted at the AICRP on Vegetable Crops, Department of Horticulture, Mahatma PhuleKrishiVidyapeeth, Rahuri, Dist.: Ahmednagar (Maharashtra) during kharif2023. During the course of study, three pest management modules viz., Bio-intensive, Integrated and Chemical module consisting spraying of different pesticides as well as biopesticides were evaluated with untreated control in Randomized Block Design (RBD) with five replications. The studies on evaluation of pest management modules against thrips revealed that Integrated module was found to be most effective and recorded least (4.11 mean surviving thrips/3 leaves/plant) thrips population and it was at par with chemical module which recorded 4.53 mean surviving thrips/3 leaves/plant. In case of black thrips, Integrated module found significantly superior over all other modules with (2.88 mean surviving black thrips/3 flowers/plant) and found at par with chemical module which recorded 3.32 mean surviving black thrips/3 flowers/plant. In case of whitefly, the Integrated module was observed superior to rest of the treatments and recorded 3.02 mean surviving whitefly population per three leaves per plant and found at par with Chemical module which recorded 3.09 mean surviving whitefly population/3 leaves/plant. The Integrated module found most effective for controlling of mites, with (4.21 mean surviving mites/3 leaves/plant) and found at par with chemical module. Impact of different pest management modules on predatory coccinellids in chilli showed that the treatment with Bio-intensive module recorded maximum survived grub population, i.e. 4.22 grubs plant^{-1} followed by Integrated module (3.85 grubs plant^{-1}) indicating their relative safety to the grubs of coccinellids after sprays. The highest yield of green chilli was registered from the Integrated module plot 165.02 q ha^{-1} with ICBR (1:13.95). followed by chemical module with 158.54 q ha^{-1} with ICBR (1:8.52); while in the Bio-intensive module the yield recorded was 149.66 q ha^{-1} with ICBR (1:9.93).

Key words : IPM, Bio-intensive module, *Thripsparvispinus*, *Bemisiatabaci*, *Scirtotripsdorsalis*.

Chilli, a significant spice, is widely utilized worldwide. India holds a prominent position in the global chilli market, being both the largest consumer and exporter. Approximately 42% of the country's spice exports consist of chilli, with major destinations including China, Vietnam, Thailand, Sri Lanka, Indonesia and Malaysia. Indian chillies are renowned for their colour and pungency levels. In India, chilli is cultivated across 7.43 lakh hectares, yielding 19.14 lakh tonnes with a productivity of 2.57 tonnes per hectare. Andhra Pradesh, Telangana, Karnataka, Tamil Nadu and Maharashtra are the primary green chilli producing states, with Maharashtra's key production regions including Nagpur, Chandrapur, Dhule, Nanded, Pune, Kolhapur and Amaravati districts, covering 6753 hectares and producing 25,517 tonnes with a productivity of 3.78 tonnes per hectare (Anonymous, 2022).

The primary constraint in chilli yield is the presence of both insect and non-insect pests, starting from the nursery phase and persisting after transplantation. Over 55 pest species have been identified as threats to chilli crops. Among these, thrips (*Scietothripsdorsalis* Hood) and mites (*Polyphagotarsonemuslatus* Banks) are particularly detrimental, causing up to a 50% reduction in yield (Ahmed *et al.* 1987). Thrips, in both nymph and adult stages, damage leaves by scraping the epidermis and extracting cell sap, resulting in tissue necrosis and colour changes from silver to brown or black. Chilli mites, similarly in both nymph and adult forms, feed on tender shoots, leading to symptoms such as downward curling, leaf crinkling, elongation of petioles and blister patches. Infestation during flowering can cause flowers to transform into leafy shoots, leading to withering and drying (Karuppachamy *et al.* 1993). Whitefly exacerbate damage by tapping into plant phloem, injecting toxic saliva, and reducing turgor pressure. Their congregations can quickly overwhelm susceptible plants, with further harm caused by mold growth stimulated by the honeydew they secrete.

Nowadays, a new invasion pest of thrips, *Thrips parvispinus* (Karny), causing serious damage to flowers and fruits of chilli was observed. This pest causes severe damage to the plant by sucking on flowers and leaves leading to scabbing. In India it was first reported on papaya in 2015 (Tyagi *et al.* 2015). It was found that this chilli ecosystem first affected India; 2021 (Nalini and Gaikwad, 2022). An outbreak of *T. parvispinus* was reported from southern states (Andhra Pradesh, Karnataka and Telangana), causing 70-100 per cent damage, particularly in chilli crop (Shridhar *et al.* 2021).

Hence, it is imperative to take ecological factors into account when implementing pest control measures. Currently, there are significant challenges in managing crop insect pests effectively. Therefore, it is crucial to adopt advanced pest control techniques that prioritize both human safety and environmental protection. One approach involves minimizing the use of chemical pesticides by integrating them with botanical and microbial pesticides to produce healthy, high-quality crops. Additionally, new pesticide molecules have been introduced to the market, which are considered safer for the natural enemies of pests.

Materials and methods

The field experiment entitled, "Evaluation of different pest management modules for the management of thrips (*Scirtothripsdorsalis* Hood; *Thripsparvispinus* Karny), whitefly (*Bemisiatabaci* Gennadius) and mites (*Polyphagotarsonemuslatus* Banks) in chilli" was conducted at AICRP on Vegetable crops, Mahatma Phule Krishi Vidyapeeth, Rahuri during *kharif* season, 2023-2024. The experimental conducted with three modules for management of major pests of chilli with untreated control. The modules are

T1: Bio-Intensive module (M1) including

1. Seedling dip with imidacloprid 17.8% SL @ 1 ml l^{-1} of water at transplanting,
2. Spraying of emamectin benzoate 5 SG @ 0.4 g l^{-1} at 25 DAT,
3. Spraying of *Lecanicilliumlecanii* ($1x10^8$ cfu g^{-1}) @ 2.5 g l^{-1} + Neem oil (0.5%) at 35 DAT,
4. Spraying of pongamia oil @ 1% at 45 DAT,
5. Spraying of spinosad 45 SC @ 0.32 ml 1^{-1} at 55 DAT ,
6. Spraying of buprofezin 25% SC @ 1 ml l^{-1} at 65 DAT,
7. Spraying of *Metarhiziumanisopliae* ($1x10^8$ cfu g^{-1}) @ 2.5 g l^{-1} + Neem oil (0.5%) at 75 DAT.

T2: Integrated module (M2) including

1. Seedling dip with imidacloprid 17.8% SL @ 1 ml l^{-1} of water at transplanting,
2. Spraying of spinosad 45 SC @ 0.32 ml l^{-1} at 25 DAT,

3. Spraying of fipronil 5% SC @ 2 ml l^{-1} at 35 DAT,
4. Spraying of fenproparthrin 30% EC @ 0.33 ml l^{-1} at 45 DAT,
5. Spraying of emamectin benzoate 1.50 % + fipronil 3.50% SC @ 1.2 ml/l at 55 DAT,
6. Spraying of *Lecanicilliumlecanii* (1x10^8 cfu g^{-1}) @ 2.5 g l^{-1} + Neem oil (0.5%) at 65 DAT,
7. Spraying of *Metarhiziumanisopliae* (1x10^8 cfu g^{-1}) @ 2.5 g l^{-1} + Neem oil (0.5%) at 75 DAT.

T3: Chemical module (M3) including

1. Seedling dip with imidacloprid 17.8% SL @ 1 ml l^{-1} of water at transplanting,
2. Spraying of chlorfenapyr 10% SC @ 1.5 ml 1^{-1} at 25 DAT,
3. Spraying of tolfenpyrad 10% EC @ 2 ml l^{-1} at 35 DAT,
4. Spraying of spirotetramat 15.31% OD @ 0.8 ml l^{-1} at 45 DAT,
5. Spraying of emamectin benzoate 1.50 % + fipronil 3.50% SC @ 1.2 ml l^{-1} at 55 DAT,
6. Spraying of fenpropathrin 30% EC @ 0.33 ml l^{-1} at 65 DAT,
7. Spraying of cyantraniliprole 10.26% OD @ 1.2 ml 1^{-1} at 75 DAT.

T4 : Untreated control.

The three modules with untreated control replicated five times were evaluated in R.B.D. during kharif season of 2023 at AICRP on Vegetable Crops, MPKV, Rahuri. Chilli variety Jyoti was selected, transplanted on 31th July, 2023 in a plot size 3.60 x 3 m. with 60 x 45 cm. 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 pests population and natural enemies population were recorded after each spraying.

Results and Discussion

The cumulative data of pertaining to effect of different modules on the average of population of thrips, whitefly, mites, and adult Coccinellid beetles were counted and presented at 35, 45, 55, 65, 75 and 85 DAT presented in Table 1-5.

1. Effect of different modules on thrips (*Scietothripsdorsalis* Hood) population : The overall results indicates that Integrated module (4.11 thrips/3 leaves/plant) was found effective in suppressing the population of thrips. However, the chemical module was found at par with Integrated module

Table 1. Effect of different modules on thrips (*Scietothripsdorsalis* Hood) population

Module	Number of thrips / 3 leaves plant^{-1}						
	35 DAT	45 DAT	55 DAT	65 DAT	75 DAT	85 DAT	Mean
M1 : Biointensive module	6.55 (2.62)	6.54 (2.62)	5.93 (2.52)	5.83 (2.55)	5.45 (2.48)	5.51 (2.41)	5.97 (2.53)
M2 : Integrated module	4.61 (2.30)	3.64 (2.08)	4.51 (2.20)	3.82 (2.03)	4.08 (2.09)	4.00 (2.08)	4.11 (2.13)
M3 : Chemical module	5.06 (2.38)	4.57 (2.21)	4.89 (2.32)	4.00 (2.12)	4.47 (2.19)	4.19 (2.21)	4.53 (2.24)
M4 : Untreated module	10.43 (3.29)	10.56 (3.34)	10.62 (3.36)	11.17 (3.39)	10.52 (3.29)	10.47 (3.33)	10.63 (3.33)
S.E. ±	0.04	0.05	0.03	0.04	0.03	0.04	0.04
CD at 5%	0.13	0.14	0.12	0.13	0.11	0.13	0.12
CV%	7.55	7.44	7.77	7.71	7.73	7.80	7.70

Figures in the parentheses indicates $\sqrt{x} + 0.5$ values and recorded the thrips population 4.53 thrips/3 leaves/plant as against 10.63 thrips/3 leaves/plant in untreated control.

The present investigation is in agreement with the results of Annamalai *et al.* (2014) who reported that *B. bassiana* and *L. lecanii* significantly decrease theT. tabaci infestations in onion crop under the greenhouse as well as field conditions.

2. Effect of different modules on black thrips (*T. parvispinus* Karny) population : The overall results indicates that Integrated module (2.88 black thrips/3 flowers/plant) was effective in suppressing the black thrips infestation on chilli and found at par with Chemical module (3.32 black thrips/3 flowers/plant) as against the chemical module which recorded population 9.69 black thrips/3 flowers/plant.

The present investigation is in agreement with findings of Lalithapriya *et al.* (2022) who revealed that Module-IV found most effective which comprises, Mulch + blue sticky traps along with need-based application of insecticides *viz*. fipronil 80WG @ 0.2 g L^{-1}, spinetoram 11.7 SC @ 1 ml L^{-1}, spirotetramat 240 SC @ 0.8ml L-1, acetamiprid 20% SP @ 0.2 g L^{-1}, thiamethoxam 25% WG @ 0.2g L^{-1}, dimethoate 30%EC @ 2ml L^{-1} sprayed sequentially at 10 days interval. The findings of Bankar *et al.* (2022) for effective management of the *T. parvispinus* in chilli crop, the integrated approach must be considered during pest control. The integration of control measures will be more effective and ecologically sound than any single method of controlling thrips.

3. Effect of different modules on number of whitefly (*Bemisiatabaci* Genn.) population : The overall results indicates that Integrated module (3.02 whitefly/3 leaves/plant) was effective in controlling the whitefly on chilli and found at par with chemical module (3.09 whitefly/3 leaves/plant), as against the untreated control which recorded 10.18 whitefly/3 leaves/plant.

The present results are in confirmatory with the findings of Pawar *et al.* (2022) who reported that IPM module was found most effective treatment against whitefly in bitter gourd after four sprays which support the present investigation.

4. Effect of different modules on number of mites (*Polyphagotarsonemuslatus* Banks) population : The overall cumulative results indicates that Integrated module (4.21 mites/3 leaves/plant) was effective in controlling the mite on chilli and found at par with Chemical module (4.50

Table 2. Effect of different modules on black thrips (*T. parvispinus* Karny) population

Module	Number of black thrips/3 flowers/plant						
	35 DAT	45 DAT	55 DAT	65 DAT	75 DAT	85 DAT	Mean
M1 : Biointensive module	-	-	4.50 (2.21)	4.61 (2.24)	4.32 (2.20)	4.18 (2.10)	4.40 (2.21)
M2 : Integrated module	-	-	2.85 (1.84)	2.86 (1.84)	2.92 (1.82)	2.89 (1.82)	2.88 (1.84)
M3 : Chemical module	-	-	3.12 (1.89)	3.49 (1.97)	3.38 (1.94)	3.30 (1.90)	3.32 (1.95)
M4 : Untreated module	-	-	10.08 (3.26)	9.74 (3.21)	9.61 (3.19)	9.35 (3.12)	9.69 (3.19)
S.E. ±	-	-	0.03	0.04	0.03	0.04	0.04
CD at 5%	-	-	0.10	0.12	0.10	0.13	0.11
CV%	-	-	6.14	6.17	6.48	7.49	6.57

Figures in the parentheses indicates $\sqrt{x + 0.5}$ values

Table 3. Effect of different modules on number of whitefly (*Bemisiatabaci* Genn.) population

Module	**Number of whitefly/3 leaves/plant**						
	35 DAT	**45 DAT**	**55 DAT**	**65 DAT**	**75 DAT**	**85 DAT**	**Mean**
M1 : Biointensive module	4.33 (2.23)	4.70 (2.28)	4.53 (2.18)	4.64 (2.27)	4.38 (2.17)	4.26 (2.14)	4.45 (2.19)
M2 : Integrated module	3.13 (1.90)	3.53 (2.00)	3.10 (1.90)	2.68 (1.72)	2.85 (1.76)	2.80 (1.82)	3.02 (1.86)
M3 : Chemical module	3.47 (1.98)	2.91 (1.83)	2.79 (1.76)	3.00 (1.87)	3.10 (1.90)	3.30 (1.94)	3.09 (1.89)
M4 : Untreated module	11.02 (3.39)	11.08 (3.36)	10.21 (3.24)	9.65 (3.16)	9.70 (3.22)	9.46 (3.19)	10.18 (3.26)
S.E. ±	0.08	0.06	0.05	0.05	0.05	0.05	0.06
CD at 5%	0.24	0.17	0.16	0.15	0.14	0.16	0.17
CV%	12.40	11.12	11.30	9.78	8.80	10.33	10.62

Figures in the parentheses indicates $\sqrt{x} + 0.5$ values

Table 4. Effect of different modules on number of mites (Polyphagotarsonemuslatus Banks) population

Module	**Number of mites/3 leaves/plant**						
	35 DAT	**45 DAT**	**55 DAT**	**65 DAT**	**75 DAT**	**85 DAT**	**Mean**
M1 : Biointensive module	5.62 (2.51)	6.20 (2.60)	6.33 (2.59)	5.60 (2.48)	6.12 (2.54)	6.19 (2.57)	6.01 (2.54)
M2 : Integrated module	4.45 (2.23)	3.71 (2.01)	4.40 (2.24)	4.26 (2.17)	4.25 (2.20)	4.21 (2.16)	4.21 (2.16)
M3 : Chemical module	4.44 (2.20)	4.61 (2.22)	4.54 (2.27)	4.43 (2.20)	4.44 (2.22)	4.57 (2.27)	4.50 (2.22)
M4 : Untreated module	10.31 (3.27)	10.16 (3.25)	10.49 (3.29)	11.24 (3.40)	10.98 (3.41)	10.87 (3.35)	10.67 (3.33)
S.E. ±	0.04	0.03	0.04	0.05	0.04	0.05	0.04
CD at 5%	0.14	0.11	0.12	0.15	0.13	0.17	0.14
CV%	7.17	5.90	6.65	6.17	7.38	6.65	6.65

Figures in the parentheses indicates $\sqrt{x} + 0.5$ values

mites/3 leaves/plant), As against the untreated control which recorded 10.67 mites/3 leaves/plant.

The present investigation is in agreement with the findings of Kurbett *et al.* (2018) who reported that root dip with imidacloprid 17.8 SL at the time of transplanting and spray of fenpropathrin, spinosad, spiromesifen, diafenthiuron significantly decrease the mites infestations in chilli crop under the field conditions.

5. Effect of different modules on coccinellids per plant : The cumulative results indicates that Bio-intensive module (4.22 grubs/plant) was most favourable and safest module for coccinellids on chilli and followed by Integrated module (3.85 grubs $plant^{-1}$). The Chemical module that was found most toxic to natural enemies and recorded least coccinellids population (1.41 grubs $plant^{-1}$). Whereas, maximum population (5.14 grubs $plant^{-1}$) observed in untreated control.

The present investigation is in agreement with the findings of Tiwariet al. (2011) who observed that, the commercial neem insecticide found safe to adult coccinellid predators. The findings of Bade *et al*. (2017) who reported that the use of *L. lecanii* @ 2.5 kg ha^{-1} recorded highest population of 4.49 lady beetles $plant^{-1}$ and it was superior over all the treatments for lady beetle except, untreated control, which support the present investigation.

Table 5. Effect of different modules on coccinellids plant^{-1}

Module	Number of coccinellids (grubs plant^{-1})						
	35 DAT	**45 DAT**	**55 DAT**	**65 DAT**	**75 DAT**	**85 DAT**	**Mean**
M1 : Biointensive module	3.13 (1.90)	4.54 (2.21)	4.88 (2.31)	3.44 (1.96)	5.04 (2.31)	4.32 (2.19)	4.22 (2.16)
M2 : Integrated module	3.02 (1.88)	4.00 (2.12)	4.40 (2.21)	3.12 (1.89)	4.60 (2.26)	4.00 (2.11)	3.85 (2.08)
M3 : Chemical module	0.88 (1.21)	1.76 (1.51)	1.27 (1.33)	1.51 (1.42)	0.85 (1.14)	2.20 (1.68)	1.41 (1.53)
M4 : Untreated module	4.93 (2.34)	4.81 (2.31)	5.54 (2.46)	5.12 (2.37)	5.26 (2.40)	5.20 (2.39)	5.14 (2.37)
S.E. ±	0.03	0.03	0.04	0.04	0.03	0.07	0.04
CD at 5%	0.13	0.09	0.12	0.12	0.10	0.21	0.14
CV%	7.74	8.15	8.81	11.93	7.94	14.08	9.77

Figures in the parentheses indicates $\sqrt{x} + 0.5$ values

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