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Evaluation of IPM modules for the management of sucking pests of capsicum under protected condition

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Abstract
Among the different modules evaluated against sucking pests of capsicum, M1-Bio intensive module comprising of i) Both neemcake and vermicompost application at 50 g per plant each at 30 days interval from transplanting to flowering and root dip with imidacloprid 17.8 SL at 0.5 ml per litre, ii) three sprays of azadirachtin 10000 ppm at 1.0 ml per litre + *Lecanicillium lecani* at 5.0 g per litre, iii) spraying of *Pseudomonas fluorescens* at 5.0 g per litre, iv) chilli – garlic extract at 0.5 percent, vi) cyantraniliprole 10.26 OD at 1.5 ml per litre and vii) two sprays of ecomite at 3.0 ml per litre proved to be quite effective against capsicum sucking pests and obtaining higher yield (54.53 t ha^{-1}), higher net returns (Rs. 2171810 ha^{-1}) and B:C ratio (2.97). Thus, biointensive module included safest IPM components and there is a tremendous scope for exploitation of bio-agents such as *Lecanicillium lecanii* and neem based insecticides which are green labeled, eco-friendly, economically feasible and easily adoptable by the farmers.

Keywords: Capsicum, protected condition, biointensive module, thrips and mites

1. Introduction
One of the important limiting factors in the cultivation of capsicum is damage caused by pests. Butani [6] reported over 20 insect species on chillies (*Capsicum* spp.) from India of which thrips, *Scirtothrips dorsalis* (Hood)s and mite, *Polyphagotarsonemus latus* (Banks) are the most damaging pests [4]. Quantitative yield loss is to an extent of 11-32 percent where as quality loss is 88-92% [17]. It may even cause 100 percent loss under green house condition [19]. Peak activity of chilli mite is noticed in the months of November – February [30] and the mite population is favoured by higher temperature, lower humidity and lesser intensity of rainfall [18]. This chilli mite is really a threat to the capsicum cultivation and causing huge economic loss every year. The conventional insecticides like organophosphates and carbamates were extensively used to control these pests which resulted in development of resistance to the most of the common insecticides used in capsicum ecosystem, besides several hazards like elimination of natural fauna, resurgence and residues. In this contest, integrated pest management (IPM) practices were carried out against the sucking pest complex under protected cultivation. The outcome of the study is to develop bio-intensive, adaptive IPM and Recommended plant protection (farmers practice against sucking pests) under protected cultivation.

2. Materials and Methods
The experiment was laid out at University of Horticultural Sciences, Bagalkot during *Kharif* and *Rabi* 2017-18 in Randomized Block Design (RBD) under polyhouse having size 20mx10m in which four IPM modules including untreated control were designed block wise in which five replications were formulated. The size of each block was 20m x 1.0m and size of each treatment was 4m x 1.0m. A popular capsicum hybrid, *Indus* (Indus Pvt. Ltd.,) was chosen for the study. The procedure for the raising of crop was followed as per recommendation of Indian Institute of Horticultural Research (IIHR) Bengaluru. Different modules were imposed as mentioned below. Sprays were applied based on economic threshold levels (ETL - Two thrips /leaf and One mite /leaf) [16]. Totally nine pickings of capsicum were carried out during 2017-18 kharif and *Rabi* season.

The total fruit yield from each plot was considered and expressed in terms of fruit yield per hectare basis and subjected for statistical analysis with suitable transformation of the values.

Details of the modules for the management of sucking pest of capsicum protected cultivation

Modules	Treatment Details
M_1: Biointensive module	1. Both neemcake and vermicompost application @ 50 g/plant each at 30 days interval from transplanting to flowering and root dip of seedlings with Imidacloprid 17.8SL @ 0.5 ml/l for 30 min at the time of transplanting. 2. Azadirachtin 10000 ppm @ 1.0 ml/l + *Lecanicillium lecani* @ 5.0 g/l 3. Spraying of *Pseudomonas fluorescens* @ 5.0 g/l 4. Chilli –Garlic extract @ 0.5% 5. Azadirachtin 10000 ppm @ 1.0 ml/l + *Lecanicillium lecanii* @ 5.0 g/l 6. Cyantraniliprole 10.26 OD @ 1.5 ml/l 7. Ecomite @ 3.0 ml/l 8. Azadirachtin 10000 ppm @ 1.0 ml/l + *Lecanicillium lecanii* @ 5.0 g/l 9. Ecomite @ 3.0 ml/l
M_2: Adaptable module	1. Both neemcake and vermicompost application @ 50 g/plant each at 30 days interval from transplanting to till flowering and root dip of seedlings with Imidacloprid 17.8SL @ 0.5 ml/l for 30 min at the time of transplanting. 2. Azadirachtin 10000 ppm @ 1.0 ml/l + *Lecanicillium lecanii* @ 5.0 g/l 3. Cyantraniliprole 10.26 OD @ 1.5 ml/l 4. Thiamethoxam 25 WG @ 0.2 g/l 5. Azadirachtin 10000 ppm @ 1 ml/l + *Lecanicillium lecanii* @ 5.0 g/l 6. Fipronil 5 SC @ 1.0 ml/l 7. Diafenthiuron 50 WP @ 1.0 g/l 8. Abamectin1.9EC @ 0.2 ml/l 9. Ecomite @ 3.0 ml/l
M_3:Recommended Plant Protection	1. Root dip with Imidacloprid 17.8SL @ 0.5 ml/l for 30 min 2. Acetamiprid 20 SP @ 0.2mg/l 3. Diafenthiuron 50WP @ 1.0 g/l 4. Fipronil 5 SC @ 1.0 g/l 5. Thiacloprid 21.7 SC @ 0.2 ml/l 6. Thiamethoxam 5 WG @ 0.2 g/l 7. Milbemectin 1 EC @ 0.5 ml/l 8. Spiromesifen 240 SC @ 1.0 ml/l 9. Abamectin @ 0.2 ml/l
M_4: Untreated check	-------

2.1 Observations on thrips and mites
Both nymphs and adult population were counted on top three young leaves from ten randomly selected plants. The thrips were directly counted using 10 x magnification lens in the polyhouse. The observations were taken at 5, 7, 9, 11, 13, 15, 17, 19 and 21 WAT (Weeks After Transplanting). Similarly, the top three leaves along with mite population were collected and kept in the perforated polythene bag of size 16 x 14 cm and the samples were brought to laboratory for examination under 20x magnification using binocular microscope. Similarly, mite count as well as LCI was recorded at 9, 11, 13, 15, 17, 19 and 21 Weeks After Transplanting The mean data entered into computer for computing average number of thrips and mite population per plant, square root transformations- and subjected to ANOVA using M-STATC ® software package. The treatment effect was compared by following Duncan's Multiple Range Test (DMRT).

2.2 Leaf Curl Index (LCI): Upward curling due to thrips and downward curling due to mites were taken by visual observations on leaves using 0-4 scale rating as per the standard procedure (Niles, 1980) [23].

3. Results
Consequent to sole reliance and continuous usage of synthetic insecticides, not only control measures have lost their efficacy but also becoming economically non-viable. In this background, the results for different modules involving ecofriendly tools with minimal toxicant usage were carefully designed and verified are presented here.

3.1 Effect of modules against capsicum thrips
Overall, the mean thrips population from 5 Weeks After Transplanting to 21 Weeks After Transplanting was the lowest in M1-Bio intensive module (0.49/leaf) which was followed by M2-Adaptable module (0.98/leaf) and M3-Recommended Plant Protection (1.01/leaf) module indicating that bio intensive module was significantly effective in reducing the thrips population. Correspondingly, the mean LCI from 5 WAT to 21WAT was minimum in M1-Biointensive module (0.37/plant) which was followed by M2-Adaptable module (0.63/plant) and M3-Recommended Plant Protection (0.79/leaf) confirming M1-Biointensive module was significantly superior in suppressing the thrips population(Table 1 and 2).

3.2 Effect of modules on capsicum mites
By and large, the mean mite population from 9 WAT to 21 WAT (Weeks After Transplanting) was the lowest in M1-Biointensive module (0.47/leaf) which was followed by M2-Adaptable module (0.91/leaf) and M3-Recommended Plant Protection (1.00/leaf) M1-Biointensive module was superior in suppressing mite population (Table 3). Similar trend was observed in mean data on LCI per plant where M1-Biointensive module (0.35/plant) exhibited lower LCI followed by M2-Adaptable module (0.78/plant) and M3-

Recommended Plant Protection confirming the superiority of M1-Biointensive module against mite population (Table 3 and 4).

3.3 Effect of IPM modules on yield (t/ha) and cost economics of capsicum

All the modules proved to be superior over untreated control in terms of fruit yield The fruit yield among the modules ranged from 32.31 to 54.53 tons per hectare. The results indicated that M1-Biointensive module registered significantly highest yield of 54.53 tons per hectare with net returns of (Rs. 2171810) and 40.74 percent increase over untreated control (32.31 t ha^{-1}). Next best module was M2-Adaptable module (44.10 t ha^{-1}) which is on par with M3-Recommended Plant Protection (43.09 t ha^{-1}) in recording the yield of 26.73 percent and 25.01 percent increase over control, respectively (Table 5).

Table 1: Effect of IPM modules on capsicum thrips

IPM module	Mean number of thrips per leaf									
	5 WAT	**7 WAT**	**9 WAT**	**11 WAT**	**13 WAT**	**15 WAT**	**17 WAT**	**19 WAT**	**21 WAT**	**Mean**
M1-Biointensive Module	0.97^{c} (1.21)	0.92^{b} (1.19)	0.84^{c} (1.16)	0.72^{c} (1.10)	0.48^{c} (0.99)	0.25^{d} (0.87)	0.13^{c} (0.79)	0.07^{c} (0.75)	0.05^{c} (0.74)	0.49^{c} (0.98)
M2-Adaptable Module	1.70^{b} (1.48)	2.34^{a} (1.68)	1.52^{b} (1.42)	1.63^{b} (1.46)	0.81^{b} (1.14)	0.42^{c} (0.96)	0.22^{b} (0.85)	0.11^{bc} (0.78)	0.07^{b} (0.75)	0.98^{b} (1.17)
M3-Recommended Plant Protection	1.54^{b} (1.43)	2.36^{a} (1.69)	1.56^{b} (1.43)	1.70^{b} (1.48)	0.88^{b} (1.17)	0.56^{b} (1.03)	0.24^{b} (0.86)	0.12^{b} (0.79)	0.09^{b} (0.77)	1.01^{b} (1.18)
M4-Untreated Check	2.32^{a} (1.68)	2.54^{a} (1.74)	2.98^{a} (1.86)	2.92^{a} (1.85)	2.58^{a} (1.75)	2.46^{a} (1.72)	1.84^{a} (1.53)	1.23^{a} (1.31)	0.89^{a} (1.18)	2.20^{a} (1.63)
S.Em ±	0.02	0.03	0.03	0.03	0.02	0.02	0.01	0.01	0.01	0.02
C.D. at 5%	0.07	0.08	0.08	0.08	0.06	0.05	0.04	0.03	0.02	0.06

WAT: Weeks After Transplanting, Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values
In a column, means followed by same alphabet do not differ significantly ($p = 0.05$) by DMRT

Table 2: Effect of IPM modules on capsicum thrips due to Leaf Curl Index (LCI)

IPM module	Leaf curl index due to thrips									
	5 WAT	**7 WAT**	**9 WAT**	**11 WAT**	**13 WAT**	**15 WAT**	**17 WAT**	**19 WAT**	**21 WAT**	**Mean**
M1-Biointensive Module	0.61^{b} (1.05)	0.90^{b} (1.18)	0.52^{c} (1.01)	0.38^{c} (0.94)	0.27^{c} (0.88)	0.23^{c} (0.85)	0.17^{c} (0.82)	0.12^{c} (0.79)	0.09^{c} (0.77)	0.37^{d} (0.92)
M2-Adaptable Module	0.82^{bc} (1.14)	1.12^{bc} (1.27)	0.96^{bc} (1.20)	0.74^{bc} (1.11)	0.62^{bc} (1.05)	0.53^{bc} (1.01)	0.38^{bc} (0.94)	0.28^{bc} (0.88)	0.20^{bc} (0.84)	0.63^{c} (1.05)
M3-Recommended Plant Protection	0.92^{a} (1.19)	1.14^{b} (1.27)	1.16^{b} (1.28)	1.04^{b} (1.23)	0.84^{b} (1.15)	0.75^{b} (1.11)	0.58^{b} (1.04)	0.42^{b} (0.96)	0.30^{b} (0.89)	0.79^{b} (1.12)
M4-Untreated Check	1.28^{a} (1.33)	1.72^{a} (1.48)	1.94^{a} (1.55)	2.33^{a} (1.67)	2.55^{a} (1.74)	1.96^{a} (1.56)	1.85^{a} (1.52)	1.36^{a} (1.36)	0.93^{a} (1.19)	1.77^{a} (1.49)
S.Em ±	0.06	0.07	0.06	0.07	0.06	0.05	0.05	0.04	0.03	0.02
C.D. at 5%	0.17	0.20	0.19	0.19	0.18	0.16	0.15	0.12	0.09	0.05

WAT: Weeks After Transplanting, Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values
In a column, means followed by same alphabet do not differ significantly ($p = 0.05$) by DMRT

Table 3: Effect of IPM modules on capsicum mites

IPM module	Mean number of mites per leaf							
	9 WAT	**11 WAT**	**13 WAT**	**15 WAT**	**17 WAT**	**19 WAT**	**21 WAT**	**Mean**
M1-Biointensive Module	0.36^{c} (0.93)	0.56^{c} (1.03)	1.18^{b} (1.29)	1.04^{b} (1.10)	0.58^{c} (0.97)	0.27^{c} (0.88)	0.21^{c} (0.78)	0.47^{c} (0.77)
M2-Adaptable Module	0.72^{b} (1.10)	0.98^{bc} (1.08)	1.14^{a} (1.61)	2.22^{a} (1.64)	1.21^{b} (1.30)	1.15^{b} (1.28)	0.73^{bc} (0.93)	0.91^{b} (0.99)
M3-Recommended Plant Protection	0.86^{b} (1.16)	1.12^{b} (1.27)	1.16^{a} (1.62)	2.36^{a} (1.68)	1.37^{b} (1.36)	1.30^{b} (1.33)	0.82^{b} (0.96)	1.00^{b} (1.04)
M4-Untreated Check	1.48^{a} (1.40)	1.98^{a} (1.56)	2.90^{a} (1.83)	2.94^{a} (1.79)	3.13^{a} (1.61)	2.27^{a} (1.65)	2.09^{a} (1.60)	1.87^{a} (1.27)
S.Em ±	0.05	0.06	0.09	0.09	0.07	0.07	0.05	0.06
C.D. at 5%	0.16	0.19	0.27	0.27	0.21	0.20	0.15	0.18

WAT: Weeks After Transplanting, Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values
In a column, means followed by same alphabet do not differ significantly ($p = 0.05$) by DMRT

Table 4: Effect of IPM modules on capsicum mites due to leaf curl index

IPM module	Leaf curl index due to mites							
	9 WAT	11 WAT	13 WAT	15 WAT	17 WAT	19 WAT	21 WAT	Mean
M1-Biointensive Module	0.30c (0.89)	0.32c (0.90)	0.72c (1.10)	0.92b (1.19)	0.45c (0.97)	0.25c (0.86)	0.16c (0.81)	0.35c (0.75)
M2-Adaptable Module	0.56b (1.03)	0.90b (1.18)	0.78bc (1.13)	2.22a (1.64)	1.00b (1.22)	0.89b (1.17)	0.64b (1.06)	0.78b (0.94)
M3-Recommended Plant Protection	0.70b (1.09)	0.96b (1.20)	0.98b (1.21)	2.36a (1.68)	1.12b (1.27)	1.00b (1.22)	0.72b (1.10)	0.87b (0.97)
M4-Untreated Check	1.04a (1.24)	1.38a (1.36)	1.52a (1.41)	2.74a (1.79)	1.68a (1.47)	1.97a (1.56)	1.42a (1.38)	1.31a (1.13)
S.Em ±	0.04	0.05	0.06	0.09	0.06	0.06	0.05	0.05
C.D. at 5%	0.13	0.16	0.17	0.27	0.18	0.18	0.15	0.16

WAT: Weeks After Transplanting, Figures in the parenthesis are $\sqrt{x + 0.5}$ transformed values
In a column, means followed by same alphabet do not differ significantly (p= 0.05) by DMRT

Table 5: Effect of IPM modules on yield and cost economics against sucking pests of capsicum under protected cultivation

IPM module	Yield (t/ha)	Cost of plant protection (Rs/ha)	Other production Cost (Rs/ha)	Total cost of production (Rs/ha)	Gross returns (Rs/ha)	Net returns (Rs/ha)	B:C Ratio
M1-Biointensive Module	54.53a	99900	1000000	1099900	3271800	2171810	2.97
M2-Adaptable Module	44.10b	104922	1000000	1104922	2646000	1541078	2.39
M3-Recommended Plant Protection	43.09b	55290	1000000	1055290	2585400	1530110	2.45
M4-Untreated Check	32.31c	0.00	*991000	991000	1938600	947600	1.95
S.Em ±	0.45	-		-	-	-	-
C.D. at 5%	1.39	-		-	-	-	-

Gross return = Yield x Market price of capsicum (Rs. 60/kg) Net Returns = Gross return - Total cost
B:C ratio = Gross returns / Total cost *Spraying cost of Rs. 9000/- excluded

4. Discussion

4.1 Thrips on capsicum

Overall, the mean thrips population and its corresponding LCI from 5 WAT to 21 WAT was lowest in M1-Bio intensive module which was significantly superior in suppressing the thrips population (Table 1 and 2) (Fig.1). The effectiveness of bio intensive module may be attributed that organics after translocation in to the plant system trigger bio-chemical processes of the plants, leading to variations in the levels of its metabolites which in turn induces tolerance or resistance in plants. Unlike succulency observed in the crop receiving NPK fertilizers, the crop amended with organics does not exhibit such features. In addition, such crop environment might help for buildup of natural enemies, resulting in reduced activity of pests on crops amended with vermicompost and neem cake at recommended rates.

The above findings are corroborated with (Varma and Supare (1997) [33]; Devi *et al.* (2017) [9]; Veena *et al.* (2017) [34] who reported that soil application of vermicompost (5.0 t ha^{-1}) recorded a minimum of thrips (9.96/leaf) and mite (4.98/leaf) population. Further, in support of the present investigation, Giraddi *et al.* (2003) [11] observed that basal application of neem cake at 250 kg per ha with 45 kg N per ha was effective in reducing the sucking pests *viz.*, thrips (1.22 /plant). Similar opinion was expressed by Sarkar *et al.* (2015) [26] and Akshata *et al*, (2018) [2].

Sunanda and Dethe (1998) [32] reported that root dip of seedlings with 0.03 percent imidacloprid 200 SL gave excellent control of sucking pests especially, thrips and mites. Our results are in agreement with the findings of chiranjeevi *et al.* (2002) [7] and Jadhav (2010) [15] who reported that chilli seedling root dip with imidacloprid 0.05 percent at the time of transplanting protected the crop from incidence of sucking pests like thrips and mites. The bioagent *Verticilium lecanii* at 5.0 g per litre in combination with botanicals like azadhrachtin10000 ppm at 1.0 ml per litre significantly reduced the thrips population. These botanicals increase the synergistic activity of bioagents (Hazarika *et al* 2009) [13]. Mycoinsecticides may be most effective in pest managements programs integrating beneficial arthropods, or in greenhouse crops where favourable environmental conditions (high humidity and low UV exposure) can be manipulated (Jacobson *et al.*, 2001; Down *et al.*, 2009) [14, 10]. The present findings are supported by various workers (Mallapur and Lingappa, 2005; Patel and Mondal, 2013) [20, 24] who observed that chilli garlic extract at 0.5 percent recorded less thrips population in chilli. Application of cyantraniliprole 10.26 OD at1.2 ml resulted in lowest thrips incidence. Further, the results are in accordance with Balikai and Mallapur 2015 [5] who reported that significantly the lowest thrips population on the gherkins treated with cyantraniliprole 10.26 OD.

4. 2 Mites on capsicum

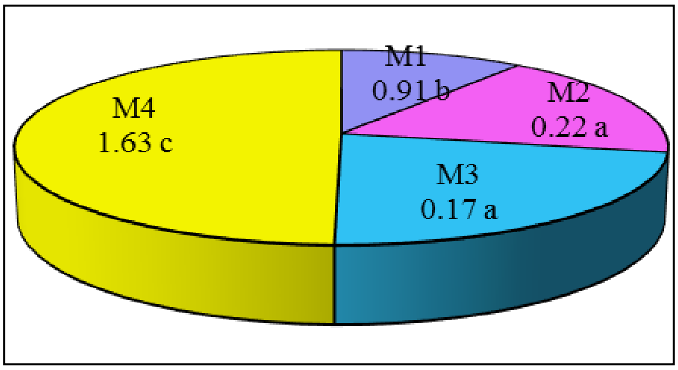
The mean mite population and its LCI from 9 WAT to 21 WAT (Weeks after Transplanting) was lowest in M1-Biointensive module which was superior in suppressing mite population (Table 3 and 4) (Fig.1). The results of the present investigation are in conformity with the findings of Ahmed *et al.* (2001) [1] who reported application of neem cake at 250 to 1000 kg per ha, vermicompost at 750 to 2000 kg per ha was found as effective against thrips and mites by recording the least leaf curl index (LCI) and higher chilli yield.

In support to present findings, Sarkar *et al.* (2015) [26] registered that neemcake and vermicompost where superior in their efficacy in reducing mite population. Neem cake contains 2 percent of bitter terpenoids mainly azadirachtin which is responsible for the antifeedant, antioviposition, growth disrupting, fecundity and fitness reducing properties on insects. Pest suppressing activity of neem cake may be attributed primarily to the certain phenolic compounds released during decomposition (Alam *et al.*, 1979) [3] apart from stimulatory effect on root growth (Mehrotra, 1980) [22].

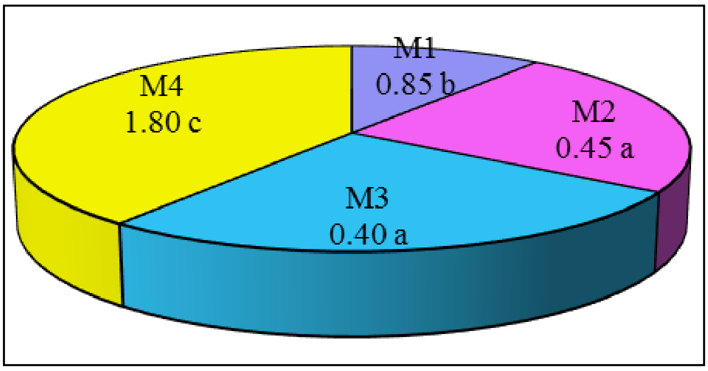
The results of the present investigation are in conformity with the findings of Gundannavar (2006) [12] who reported that, module M1 application of vermicompost @ 2.5 t/ha, neem cake 250 kg/ha (with no application of RDF), superimposed with diafenthiuron at 8 WAT was found to be most effective module against thrips and mites. Vermicompost contains both major and minor plant nutrients in available forms (Giraddi, 2003) [11], besides enzymes, antibiotics, vitamins and plant growth hormones and have definite advantage over the organic manures in respect of quality and shelf life of the produce (Meerabai and Asha, 2001) [21].
Application of *Verticilium lecanii* at 5.0 g per litre + Azadirachtin 10,000 ppm at1.0 ml per litre reported the reduced mite population. In support to present investigation, Hazarika *et al*. (2009) [13] reported that combination of these mycopathogens with botanicals shown synergistic effect in control of red-spider mite (*Oligonychus coffeae*). In the present study, *Pseudomonas florescens* (5.0 g/l) was also effective in reducing the mite population under polyhouse condition. This statement is in line with (Sujay *et al*., 2011 and Sardana *et al*., 2013) [31, 25]. It was recorded that chilli garlic at 0.5 percent recorded less mite population in chilli. The present findings are in conformity with reports of (Mallapur and Lingappa, 2005 [20]. Patil and Mondal 2013 [24]. The results obtained in the present investigation are in conformity with the findings of Choi *et al*., 2004 [8] and Sreenivas *et al*., 2008 [29] who opined that ecomite at 3.0 ml/l was found to be superior in recording the lowest mite incidence in okra. Ecomite is a contact miticide, effective and alternative to other synthetic contact pesticides. This formulation is primarily based plant oils and extracts containing alkaloids, salts of fatty acids and natural oils and used to control mite's effectively on vegetables, rose and other crops and can also be used until harvesting. kills and repels mites and other piercing and sucking insects and destroys their eggs and nymphs**,** phytophagous mites and thrips.

4.3 Cost economics

Among the modules M1- Biointensive module offered highest yield (54.53 t ha^{-1}) net returns (Rs. 2171810) with B:C ratio (2.97). Whereas, next best module was M2-Adaptable module with higher yield (44.10 t ha^{-1}) the net returns of Rs. 1541078 and B:C ratio (2.39) and M3- Recommended Plant Protection bestowed with higher yield (43.09 t ha^{-1}) and net returns of Rs.1530110 with B:C ratio (2.45) (Fig.2, 3). M1 and M2 modules comprising of bio-agents has been considered to be a sound tool of IPM. The results are in close conformity with Sujay *et al*. (2011) [31] who reported the efficacy of Plant growth promoting rhizobacteria (*P. fluorescens*) and their combinations against chilli sucking pests like chilli thrips and chilli mite recorded the highest yield 7,529 kg per ha and CBR was 2.49.



LCI due to thrips per plant



LCI due to mites per plant

Fig 1: Effect of IPM modules on Leaf curl index due to thrips and mites

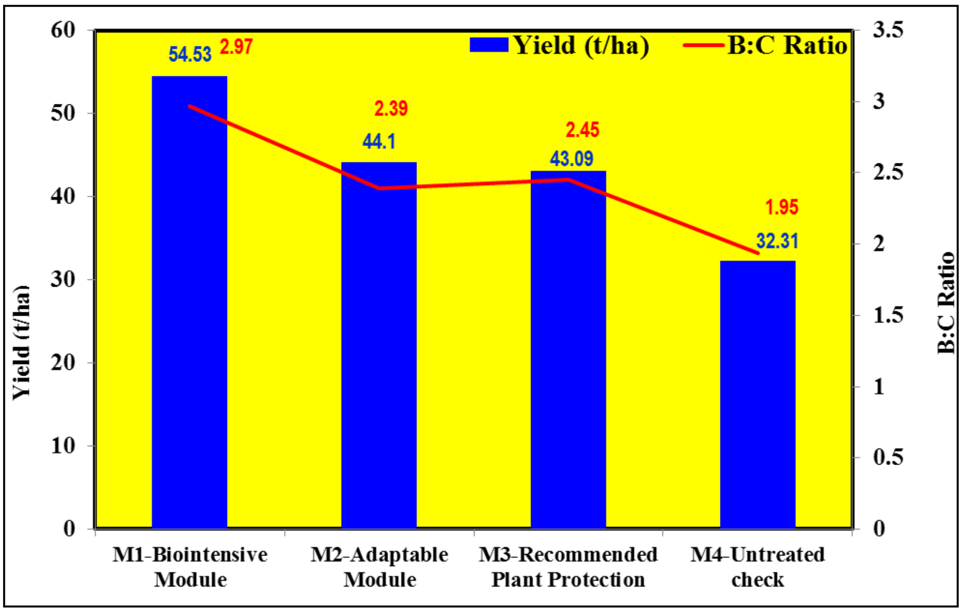


Fig 2: Cost economics of IPM modules against sucking pests of capsicum under protected condition in polyhouse

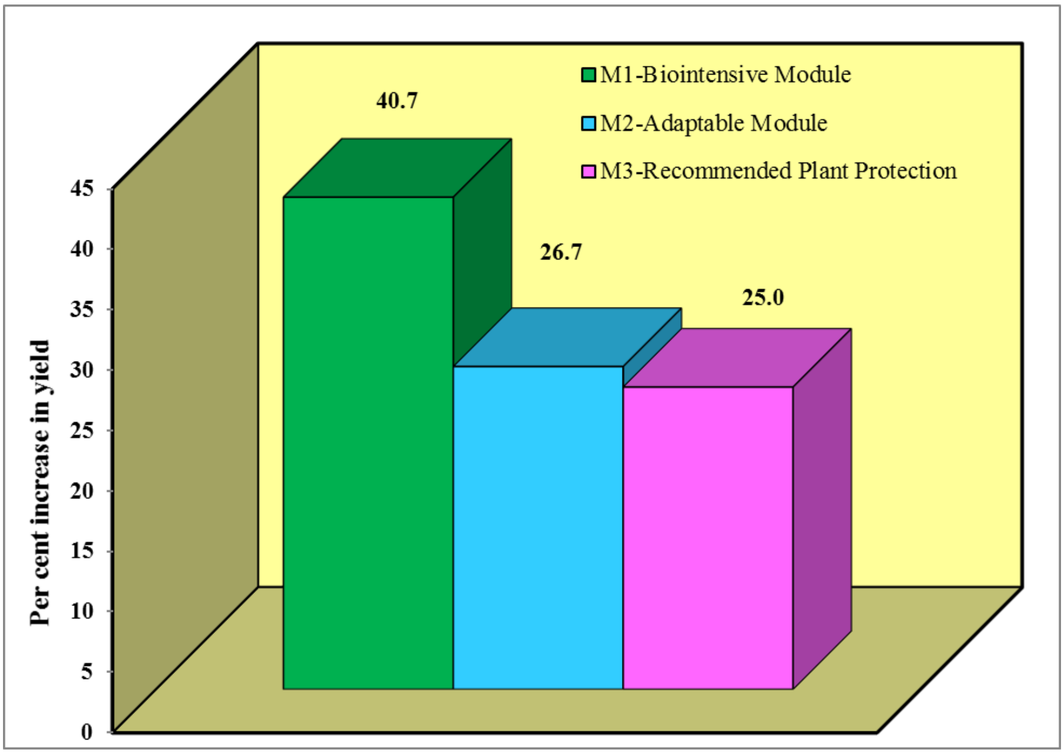


Fig 3: Effect of IPM modules on percent increase in yield of capsicum over control

5. Conclusion

Biointensive module has been considered to be a sound tool of IPM. This module contained safest IPM components and there is a tremendous scope for exploitation of bio-agents such as *Lecanicillium lecanii* and neem based insecticides. It can be concluded that integration of bioagents and green labeled insecticides is an eco-friendly approach, economically feasible and easily adoptable by the farmers. It is remembered that timing of application of either bio-agent or insecticides, based on ETL assumes greatest importance than mere application at improper time. In the light of these studies, it is ideal to adopt either M1-Biointensive module depending upon convenience and availability of bio-agents. This module is socially acceptable, ecologically balanced and easily adaptable.

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