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IPM modules of chilli (*Capsicum annuum* L.) in Gangetic alluvial plains of West Bengal

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ABSTRACT

Chilli thrips (Scirtothrips dorsalis Hood), aphids (Aphis gossypii Glover), broad mite (Polyphagotarsonemus latus Banks) and fruit borer (Heliothes armigera Hubner) are major sucking and chewing pests of chilli in Indian sub-continent inflicting yield loss up to 75 % or more. Now-a-days, IPM has been attaining immense importance in the agricultural scenario of India and abroad. Hence formulation of a sustainable IPM module was felt necessary under West Bengal, like other crops in India, where vegetable cultivation is done mostly by the small and marginal farmers. Different IPM modules were attempted of which , module: I (M-I) comprised of organics and safer insecticide and was found to be the most effective module against sucking pest complex (aphids, thrips, mites) vis-a-vis chilli fruit borer, and the prevailing natural enemies (Amblyseius ovalis., Spiders, Chielomenes sexmacculata, Coccinella septempunctata and Stethorus gilvifrons) in chilli eco-system were moderately safe (average 8.45% mortality) . Yield of green chilli was higher (5.13 q^{-1}ha) in M-I (marigold trap crop, vermicompost 2.5 tha^{-1} + neem cake 250 kg^{-1}ha (devoid of recommended dose of fertilizers, i.e RDF) superimposed with sequential application of insecticides like neemazal TS @ 2 ml l^{-1} (5 WAT), diafenthiuron @ 1g/l (8 WAT), flubendiamide @ 0.2 ml l^{-1} (11 WAT) and neemazal T.S.@ 2.5 ml l^{-1} at 14 WAT) followed by M II (5.04 ha^{-1}) (marigold trap crop+ neemcake 500 kg^{-1}ha + vermicompost 1.25 t ha^{-1} + without RDF) superimposed with sprays of NSKE @ 5%(5 WAT), abamectin @ 0.75 ml l^{-1} (8 WAT), spinosyn @ 0.3 ml l^{-1} (11 WAT) and NPV @250 LE per hectare (14 WAT) and M III (neemcake 125 kg^{-1}ha + vermicompost 625 kg^{-1}ha at transplanting (TP) and at 50 DAT (50% N and 100% PK) superimposed with sprays of nimbecidine @ 5 ml l^{-1} (2 WAT), NSKE @ 5% (5 WAT), nimbicidine @ 5 ml l^{-1} (7 WAT), NSKE @ 5% (11WAT) . In M III, the natural enemies were totally undisturbed even their population was found to be increased in time hours. Further, highest B:C (benefit:cost) ratio was recorded in M-III followed by M-IV: (cent per cent RDF+ recommended plant protection (RPP) followed by application two rounds of emamectin benzoate (@ 0.3 ml/l) (2WAT) and propargite (2.5 ml/l) (5 WAT) + carbaryl (4 g l^{-1}) (7, 11 WAT) + M-I. Hence, M-III in comparison with M-I and M-II seemed to be a quite promising strategy (yield of green chilli:4.91ha^{-1}) as it did not require any insecticidal interference keeping natural enemy eco-system undisturbed.

***Keywords*: Integrated pest management, module, neemcake, vermicompost**

The most important chilli growing states in India are Andhra Pradesh (49%), Maharashstra(26%), Karnataka(15%) ,West Bengal (12%) and Tamil Nadu(3%), which together constitute nearly 75 per cent of the total area. The pest profile of chilli is complex with more than 293 insects and mite species debilitating the crop in the field as well as in storage (Anon, 1987). Amongst these, thrips, Scirtothrips dorsalis Hood., yellow mite, Polyphagotarsonemus latus Banks and fruit borer, Helicoverpa armigera Hubner are the most vital production constraints Reddy and Puttaswamy (1983). They cause a havoc economic loss every year especially in the southern districts of West Bengal, India, and has become a threat to chilli growers (Sarkar *et.al.*2008). In recent past, development of resistance to pesticides, resurgence and contamination of food and ceo-system are problems related with insecticide management. Pesticide residues in chilli are also of great concern from the point of domestic consumption as well. Keeping this in back drop, an attempt was made to formulate a sound management programme with minimum or no pesticide usage.

MATERIALS AND METHOD

The experiment was conducted during January 2009-2010 and 2010-2011 in a farmer's field (8.75m above msl) at Ranaghat area of West Bengal, India, following RBD. Each IPM module was laid out in an area of 20 x 20 m with 4 m buffer zone between each module. Each module was further ear marked into five segments to serve as replications for recording observations and subsequent statistical analysis. Marigold var. African tall was raised before one week of planting of chilli in main field. Chilli seedlings of 30 days old were considered for transplanting. After 15 days of chilli planting, 20-25 days old marigold seedlings (two seedlings per hill *i.e.*, 2:1 ratio) were planted in chilli plots with a spacing of 60 cm between each plant to synchronize the flowering of marigold and chilli with peak flowering and fruiting stage and approximately coinciding with the time of appearance

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of *H. armigera,* followed by little modification of Srinivasa *et.al.* (1994) The population count of thrips (*Scirtothrips dorsalis*) and mite (*Polyphagotarsonemus latus*) were taken at 70 and 100 DAT and the mean population was worked out. For this purpose, five plants were selected at random from each plot and tagged. Four leaves on the top shoot leaf of each selected plant were recorded for observation. Ten plants were selected randomly in each plot and scored for leaf curling index (LCL) at 70 and 100 DAT visually by following the 0-4 scale (Niles, 1980). Four different IPM modules were attempted.

Module I (M I): Marigold trap crop, vermicompost 2.5 t^{-1}ha + Neem cake 250 kg ha^{-1} (devoid of application of recommended dose of fertilizers, *i.e* RDF) superimposed with sprays of Neemazal TS @ 2 ml l^{-1} at 5 *week after transplanting* (WAT), diafenthiuron @ 1gl^{-1} (8 WAT), flubendiamide @ 0.2 ml l^{-1} (11 WAT) and Neemazal@2ml l^{-1} (14 WAT).

Module II (M II): Marigold trap crop, neemcake 500 kg h^{-1}a + vermicompost 1.25 t^{-1}ha + without application of RDF superimposed with sprays of NSKE @ 5%(5 WAT), abamectin @ 0.75 ml l^{-1} (8 WAT), spinosyn @ 0.3 ml l^{-1} (11 WAT).

Module III (M III): Neemcake 125 kg ha^{-1} + vermicompost 625 kg ha^{-1} at transplanting (TP) and at 50 DAT (1/2 of N and full amount of PK fertilisers) superimposed with sprays of nimbecidine @ 5 ml l^{-1} (7 WAT), NSKE @ 5% (11 WAT), Nimbecidine @ 5 ml l^{-1} (7 WAT), NSKE @ 5% (11WAT).

Module IV (M IV): Full dose of RDF, recommended plant protection (RPP) followed by two round sprays of emamectin benzoate (0.3 ml l^{-1}) (2 WAT) and propargite 2.5 ml l^{-1} (5 WAT) + carbaryl (4 g l^{-1}) (7, 11 WAT).

Cost benefit ratio

The fruit yield per plot was recorded and computed to hectare t^{1}ha. The data thus tabulated, pooled and ranked on the basis of their yield performance. The benefit-cost ratio (CBR) of different modules was calculated by estimating different cost of cultivation and return from fruit yield after converting them to one hectare of land. The average market price of green chilli was rupees 7 kg^{-1} during the experimental period.

RESULTS AND DISCUSSION

Data presented in table 1 indicated that, the mean population of thrips varied from 0.16 to 0.38 and among the different modules, M-I was found to be superior by recording significantly less number of thrips (0.16) and was *on par* with M-II (0.21) and M-III (0.29). Significantly higher number of thrips per leaf was observed in M-IV.. Further, the population of mite was least (0.16) in M-I and was *on par* with M-II (0.27) and M-III (0.34). Significantly more number of mites per leaf was recorded in M-IV (0.41) (Table 1).

Significantly less leaf curl index (LCI) was observed in M-I (0.11) and which was *on par* with M-II (0.14). But highest LCI was recorded in M-IV (0.25), and *on par* with M-III (0.21) (Table 1). The less incidence of sucking pests in M-I and M-II might be due to the intervention of components of IPM *viz.,* newer insecticide chemistries such as diafenthiuron and vertimec. They are quite effective against chilli mites and other sucking pests against conventional chemistries used in RPP (recommended package of practices). Organic amendments *viz.,* neem cake, vermicompost besides neem derivatives and their effectiveness against sucking pests has been well documented by various researchers (Varghese and Giraddi, 2005, Giraddi and Smitha, 2004), which are in conformity to the present findings. The population density of fruit borer, *H. armigera* at different intervals 70, 85, 100 and 115 DAT was significantly less in M-I (0.08, 0.10, 0.12 and 0.12 respectively) and was on par with M-II (0.12, 0.20, 0.20 and 0.24 larvae $plant^{-1}$). More larval density (0.32, 0.44, 0.40 and 0.48) was recorded in M-IV (Table 2). Fluctuation of larval density might be influenced due to IPM strategies and was in the decreasing order of intensity as, M-I < M-II < M-III < M-IV. Similarly, M-I registered significantly less fruit damage (2.77%), which was *on par* with M-II (2.93). Significantly higher per cent fruit damage was noticed in M-IV (4.27). Mean data indicating extent of fruit damage was in the order M-I < M-II < M-III < M-IV (Table 2). Different soil amendments like neem cake and vermicompost (either in combination or alone) attempted against chilli fruit borer had given promising results (Mallikarjun Rao *et al.* 1998., Giraddi *et al.* 2003 and Ravikumar, 2004). Further, the present findings are in conformity with the findings of Shivaramu (1999) who observed that module comprising of 18 : 1 of chilli : marigold proportion and sequential application of achook, dipel and carbaryl recorded less larval load of *H. armigera* and fruit damage in chilli. IPM module consisting of 18 rows of chilli plus one row of marigold and three sprays with nimbecidine, dipel and carbaryl in sequence were found to be promising against *H. armigera* (Nadaf, 2002). Plant height as influenced by different IPM modules (Table 3) varied from 70.15 to 83.86 cm at 90 DAT. Significantly the highest plant height (83.86 cm) was recorded in M I and was *on par*

Table 1 : Effect of IPM modules on the prevalence of sucking pests of chilli at Kalyani.

IPM module	Chilli thrips (No. leaf^{-1})	Chilli broad mite (No. leaf^{1}))	LCI*
M I	0.26 b (1.13)	0.27 b (1.13)	0.12 b
M II	0.31 ab (1.15)	0.37 ab (1.18)	0.15 b
M III	0.39 ab (1.18)	0.44 ab (1.20)	0.22 a
M IV	0.48 a (1.22)	0.51 a (1.23)	0.26 a
SEm(±)	**0.02**	**0.04**	**0.01**
LSD(0.05)	**0.09**	**0.10**	**0.04**

Note: LCI= Leaf curl index*

Table 2: Effect of IPM modules against fruit borer (*Heliothes armigera*) population in chilli at Kalyani.

IPM Module	Fruit borer larvae plant^{1}			Mean larval	Fruit population	damage (%)*
	70 DAT	85 DAT	100 DAT	115 DAT		
M-I	0.10 b(1.04)	0.20 c (1.09)	0.14 c (1.06)	0.14 c (1.06)	0.14 (1.06)	3.25
M-II	0.15 b (1.07)	0.32 bc (1.14)	0.26bc (1.12)	0.23bc (1.10)	0.24 (1.11)	3.75
M-III	0.30 ab (1.14)	0.42 ab (1.19)	0.35 ab (1.16)	0.38 ab (1.18)	0.36 (1.17)	4.25
M-IV	0.42 a (1.19)	0.55 a (1.25)	0.55 a (1.25)	0.51 a (1.23)	0.50 (1.23d)	5.56
SEm(±)	**0.09**	**0.09**	**0.10**	**0.10**	**0.09**	**2.03**
LSD(0.05)	**0.21**	**0.14**	**0.23**	**0.25**	**0.14**	**4.77**

**Percent bored fruits*

Table 3: Effect of IPM on yield attribute of chilli in a farmer's field at Kalyani.

IPM module	Plant height (cm)	No. of branches plant^{-1}	No. of green fruits plant^{-1}	Yield(t ha^{-1})
M-I	92.50	30.25	125.50	8.13
M-II	88.75	28.75	110.75	6.04
M-III	75.25	26.50	100.50	4.91
M-IV	70.50	20.50	96.75	4.29
LSD(0.05)	7.01	6.50	13.25	3.21

Table 4: Economics of IPM modules against chilli pests

Modules	Total return (Rs.)	Common operational cost (Rs.)	Treatment cost (Rs.)	Total cost (Rs.)	CBR
M-I	32750	4519	2004	6523	1:5.02
M-II	30250	6246	2004	8250	1:3.67
M-III	28750	3116	2004	5120	1:5.61
M-IV	24200	2391	2004	4395	1:5.50

with M II (80.28 cm) and M III (77.62 cm). Module IV receiving RDF and RPP recorded least plant height of 70.15 cm. Further, significantly higher number of branches (28.32) were recorded in module I and was *on par* with M-II(26.8). Least number of branches (21.40) were observed in M-IV. M-I recorded highest number of green fruits (110.86) and was *on par* with MII (105.82) and M-III (99.46). Lowest number of green fruits (94.57) were recorded by M-IV (Table3). Data presented in table 3 indicate yield obtained in different IPM modules. Significantly higher yield (8.13 t ha^{-1}) was recorded in module I and was *on par* with module-II (6.04 t ha^{-1}) and module-III (4.91 t ha^{-1}). However, least yield (4.29 t ha^{-1}) was registered in module IV. Influence of neemcake and vermicompost on different yield attributing characters and yield is well documented by Smitha (2002), which lend support to the present findings. Chilli fruits were graded based on colour and wrinkles, which indicated quality of fruits. Module I, II and III registered grade 4.40, 4.48 and 4.52 for fruit quality and were *on par* with each other. Significantly inferior (3.84) quality fruits were recorded in module – IV. Among the different modules, highest B:C ratio (5.72) was registered in M-III, followed by MIV (5.6) and M-I (5.11). M-II recorded lowest CBR ratio of 3.9 (Table 4).

REFERENCES

Anonymous, 1987, *Progress Report 1987.* Asian Vegetable Research and Development Centre, Taiwan, pp.77-79.

Giraddi, R.S. and Smitha, M.S. 2004 , Organic way of controlling yellow mite in chillies. *Spice India,* **17**:19-21.

Mallikarjuna Rao, N., Muralidhara Rao, G. And Tirumalarao, K., 1998, Efficacy of neem products and their combinations against chilli pod borers. *Andhra Agric.J.,* **45**: 179-81.

Mondal. B and Mondal, P. 2012. Ecofriendly pest management practices for leaf curl complex of chilli (*Capsicum annuum* L.) *J Bio. Pest.* **5** (Suppl.) : 115-18.

Nadaf, A. M., 2002, Testing of IPM modules for the management of Helicoverpa armigera Hubner in chilli. *M Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, India.

Niles, G. A., 1980, Breeding cotton for resistance to insect pests. In: *Breeding Plant Resistance to Insects,* (Eds. Macwell. F. G. and Jennings) , P.R John Wiley and Sons, New York, pp. 337- 69.

Ravikumar, 2004, Evaluation of organics and indigenous products for the management of *Helicoverpa armigera (*Hubner) in chilli.Approved *M Sc.(Agri.) Thesis*, Univ. Agric. Sci., Dharwad, India.pp.68

Sarkar,P.K.,Timsina .G.P., Vanlaldiki,H. and Chakraborty,S. 2013. Arylpyrrole acaro insecticide chlorfenapyr- a tool for managing yellow thrips, *Scirtothrips dorsalis* Hood and broad mite *Polyphagotarsonemus latus* Banks of Chilli. **9:***J. Crop Weed*. 188-92

Sarker, P.K., Sarkar, H., Sarkar, M.A. and Somchoudhary,A.K. 2005. Yellow mite, *Potyphagotarsonemus lotus* (Banks): A menace in chilli cultivation and its management options using biorational acaricides. *Indian J. Pl. Prot.* **33**: 294-96.

Shivaramu, K, 1999, Investigations on fruit borer *Helicoverpa armigera* (Hubner) in chilli. *Ph. D Thesis*, Univ. Agric. Sci., Dharwad, India.pp.163

Shrinivasan, K., Krishna Moorthy, P. N. and Ravi prasad, T. N., 1994, African marigold as a trap crop for the management of the fruit borer, *Helicoverpa armigera* in tomato. *Int. J. Pest Mngt.,* **40**:56-63.

Smitha. M.S., 2002, Management of yellow mite, *Polyphagotarsonemus latus* (*Banks) (Acari; Tarsonemidae)*on chilli. *M.Sc. (Agri.) Thesis,* Univ. Agric. Sci., Dharwad, India.

Varghese, T.S. and Giraddi, R.S., 2005, Integration of neem cake in the plant protection schedule for thrips and mite management in chilli (cv. Byadagi). *Karnataka J. Agril.Sci.,* **18**:154-56.

Visalakhsmi,V. Mohana Rao,P.R. and Satyanaryana,N.H. 2013.Evaluation of Integrated pest management modules in rice eco-system, *J. Crop Weed.* **9:**165-67.