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Effect of Non-Pesticidal Management (NPM) modules against Chilli pests

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Abstract

Investigations on the effect of NPM modules on the activity of pests of chilli viz., aphids, thrips, mites and fruit borer and yield, economics of NPM and conventional practices, carried out during 2012-213 and 2013-2014 kharif seasons at the Karchal village of Medak District, Telangana state. The experiment was laid out in RBD Randomized Block Design. Among the four NPM modules evaluated. The NPM module –I was found to be the most effective against aphids, thrips, mites and fruit borer H. armigera. In this, Maize as a barrier crop, marigold as a trap crop, Vermicompost 5 t/ha + Neem cake 10 q/ha, with sprays of Neemazal (3ml/l) at 5 and 11WAT (Weeks After Transplanting), Nimaasthram (250 l/ha) at 8 WAT, Agniasthram (6 lit/ha) at 13 WAT were applied , with the result a dry chilli yield 4.13 q/ha was obtained with a net return of Rs. 18,241/-. Whereas, in chemical Intervention, Recommended Dose of Fertilizer (M-IV) recorded a dry chilli yield 3.79 q/ha with a net return of Rs. 11330/-.

Keywords: Aphids, Thrips, Mites, Fruit bore *H.armigera*, NPM (Non-pesticidal management) modules, Organic manures, NPM practices.

Introduction

Chilli (*Capsicum annuum L.*) it is present in Solanaceae family which represents a diverse plant group. The name is derived from Latin word Capsa that means hallow pod Heiser[1]. Chilli crop grown all over India. It is an essential ingredient of Indian curry, which is characterized by tempting colour and titillating pungency. India is the largest producer of chillies in the world.

Asian Vegetable Research and Development Centre (AVRDC) in Asia were conducted survey, their results shows the major insect pests that attack chilli are aphids, mites and thrips. Chilli thrips multiply appreciably at a faster rate during dry weather periods and causes yield loss of 30 to 50 per cent in South India Vasundarajan[2] and sometime more than 90 per cent yield reduction Krishnakumar[3]. India is the largest producer of chilli (*Capsicum annuum L)* in the world. It is being damaged by more than 20 pests of which most important ones are thrips, aphids, fruit borer and mites. Farmers use chemical pesticides for the control of these pests. Though the recommended schedules of pesticides sprays are 3 - 4, the farmers are spraying different pesticides more than ten times for the crop protection against these pests. This ultimately lead to high cost of production, low net returns, heavy debts and finally into a crisis situation and pesticide residues being left in the environment polluting air, water and soil. Hence it is necessary to overcome this problem; Non Pesticidal Management (NPM) is one of the best alternatives, presently attracting a lot of attention. In this approach, no chemical pesticides are used in cultivating crop. It is an *"NPM include combination of eco-friendly practices such as cultural and agronomic practices (intercrop, trap crop) physical method (pheromone, lighttrap), biological methods, parasitoids, predators and entomopathogens and traditional farmers practices manage the crop pests. It also attempt to promote favorable ecological, economical and sociologically"*. It involves making best use of natural resources locally available and takes best advantage of the natural processes. The concept of Non Pesticdal Management of pests and disease management which seek minimum use of chemical pesticides can reduce human and environmental hazardous and lower the cost of cultivation.

NPM farming has assumed importance as an offshoot of environmental concerns in the Western World. The almost total dependence on chemical fertilizers, pesticides, herbicides and growth regulators for enhancing crop productivity gradually culminated in a situation where in need to reconsider the alternative for chemical agriculture gradually developed in the Western World. It is a well-documented fact that increased dependence on agro-chemicals including fertilizers has led to several ill effects on the environment.

Due to monoculture of chilli, now-a-days pest build up is so much that farmers have to resort to minimum of 5 to 6 chemical sprays. Numbers of sprays have increased over the years, but in vein and on the contrary, cost of cultivation has increased enormously making cultivation of chilli highly risky and non-profitable. In addition to this, these pesticidal sprays became a threat to chilli ecosystem causing resurgence of pests and menace to natural enemy fauna. Pesticide residues in chilli are also of great concern from the point of domestic consumption and exports as well. It is necessary to overcome this problem

non-pesticidal management is one of the best alternative methods presently attracting lot of attention which includes plant extracts and cow dung and urine and organic manures which are eco-friendly and safe to the live stock and human being.

Materials and Methods

Field experiments were conducted at Karchal Village of Medak (District), Telangana state, four different Non-Pesticidal Management modules were formulated by selecting best treatments evaluated during first year 2012- 2013 kharif season., To evaluate the efficacy of these Non pesticidal Management modules, against chilli pests, an field was laid out in Randomized Block Design (RBD) during kharif 2013-2014. Each Non Pesticidal Management module was laid out in an area of 20 x 20 m with 3m buffer zone in between each module. Each module was further demarcated in to five regions to serve as replications for observations and statistical analysis.

Marigold was raised in the nursery before one week of planting of chilli in main field. After 15 days of chilli planting, 20-25 days old marigold seedlings (3 seedlings per hill) were planted in chilli plots with a spacing of 60cm between each plant to synchronize the flowering of marigold and chilli with peak flowering. One line of maize was also maintained around each plot as a barrier crop, (Nimaastram, Agniastram is a locally prepared NPM practices). The organics were incorporated in the field thoroughly a week before as well as 50 Days after Transplanting (DAT) of chilli variety Byadgi dabbi seedlings. To compare the treatment efficacy, 100 per cent Recommended Dose of Fertilizer (RDF) with four sprays of Recommended Pesticides Practices (RPP) at 2^{nd}, 5^{th}, 7^{th} and 11^{th} week after Transplanting (WAT) as chemical check was also maintained. The treatments were detailed below.

Aphids, thrips, mites population count was taken at 70 and 100 days after Transplanting. For counting these, five plants selected randomly in each plot and observed six leaves of each plant by using destructive sampling procedure. The fruit borer, *H. armigera* larval count was taken at 70, 85, 100 and 115 DAT. For counting these, five plants selected randomly in each plot and observed. Later number of *H.armigera* larvae was worked out. The sucking pests and fruit borer population mean data were studied and tabulated and subjected to one way ANOVA. Duncan's Multiple Range Test (DMRT) compared the efficacy of treatment and read at 0.05 probability.

Results and Discussion

The results of the experiment carried out to evaluate the effects of NPM modules against on chilli pests aphids, thrips, mites and *H.armigera* revealed.

Aphids: At 70 DAT, significantly less number of aphids (0.08) were seen in M-I and was on par with M-II (0.10) and M-III (0.18). Significantly higher number of aphids per leaf was registered in M-IV.

At 100 DAT, the aphids population ranged from 0.10 to 0.30. While, M-IV recorded higher number of aphids (0.30). However, M-I recorded least number of aphids (0.10) and was on par with NPM-Module-I (0.13) and NPM-Module-III (0.20). Experimental results declare a similar trend of treatment effect noticed (Table-1).

Thrips: At 70 DAT, the population of thrips varied from 0.14 to 0.35 and among the different modules, M-I were found to be superior by recording significantly less number of thrips (0.14) and was on par with M-II (0.20) and M-III (0.28). Significantly higher number of thrips per leaf were registered in M-IV. Similar trend was also observed at 100 DAT and mean data (Table-1).

Mites: At 70 DAT, the population of mites was least (0.14) in M-I and was on par with M-II (0.17) and M-III (0.27). Significantly more number of mites per leaf were recorded in M-IV (0.37). Similarly, At 100 DAT, M-I registered significantly less number of mites (0.16) compared to Module-II 0.34, Module-III 0.40 and Module-IV 0.42. The mean data also revealed a similar trend (Table-2).

H. armigera: The population density of fruit borer, *H. armigera* at different intervals i.e. 70, 85, 100 and 115 DAT was significantly less in M-I (0.10, 0.12, 0.14 and 0.15 respectively) and was on par with M-II (0.14, 0.17, 0.15 and 0.24 larva/plant). Significantly more larval density (0.34, 0.46, 0.39 and 0.50) was registered in M-IV (Table-3). Mean data on larval density influenced due to NPM strategies was of the order Module-I < Module-II < Module-III < Module-IV. Yield: Data presented in Table-4 indicate yields obtained in different NPM modules. Significantly Module-I recorded higher yield (4.13 q/ha) and followed module-II 4.01q/ha and module-III 3.91q/ha. However, module-IV recorded least yield 3.79 q/ha. Among the different modules, highest net return (Rs. 18241/-) was registered in M-I, followed by M-III (Rs.17639/-) and M-II (Rs. 16979/-). M-IV recorded lowest net return of Rs. 12467/- (Table-4).

Discussion: Significantly less mean population of sucking pests *viz.,* aphids (0.09), thrips (0.12) and mites (0.15) were observed in M-I and followed Module-II, Module-III. Significantly higher number of aphids (0.28), thrips (0.37) and mites (0.40) were recorded in M-IV (Table-1 and 2).

The reduced activity of sucking pests in M-I and M-II might be due to the components of NPM *viz.,* newer effective plant extracts such as Nimaasthram and Agniasthram. They were quite effective against chilli pests versus conventional pesticides used in RPP.

Table-1
Effect of NPM modules on population of sucking pests in chilli

NPM Modules	Aphids (No./leaf)		Mean	Thrips (No./leaf)		Mean
	70 DAT	100 DAT		70 DAT	100 DAT	
M-I	0.08 b	0.10 b	0.09 b	0.14 b	0.11 b	0.12 b
M-II	0.10 ab	0.13 b	0.15 ab	0.20 ab	0.17 ab	0.18 ab
M-III	0.18 ab	0.20 ab	0.19 ab	0.28 ab	0.30 ab	0.29 ab
M-IV	0.25 a	0.30 a	0.28 a	0.35 a	0.39 a	0.37 a
CV	5.07	5.14	5.15	5.28	5.27	5.13
S.Em±	0.02	0.02	0.02	0.02	0.03	0.02
CD at 5%	0.08	0.08	0.08	0.08	0.09	0.08

In a column, means indicated by the same alphabet/alphabets shows that there is no significant difference by DMRT (0.05). DAT: Days After Transplanting.

Table-2
Effect of NPM modules on mites population in chilli

NPM Modules	Mites (No.leaf)		Mean
	70 DAT	100 DAT	
M-I	0.14 b	0.16 b	0.15 b
M-II	0.17 ab	0.34 ab	0.26 ab
M-III	0.27 ab	0.40 a	0.34 ab
M-IV	0.37 a	0.42 a	0.40 a
CV	5.65	5.19	5.21
S.Em±	0.03	0.03	0.03
CD at 5%	0.09	0.09	0.09

In a column, means indicated by the same alphabet/alphabets shows that there is no significant difference by DMRT (0.05). DAT: Days After Transplanting.

Table-3
Effect of NPM modules on fruit borer, (*Helicoverpa armigera)* population in chilli

NPM Modules		*H. armigera* (larvae / plant)			
	70 DAT	85 DAT	100 DAT	115 DAT	Mean
M-I	0.10 b	0.12 c	0.14 c	0.15 c	0.13 c
M-II	0.14 b	0.17 bc	0.15 bc	0.24 bc	0.18 bc
M-III	0.24 ab	0.33 ab	0.30 ab	0.36 ab	0.31 ab
M-IV	0.34 a	0.46 a	0.39 a	0.50 a	0.42 a
CV	5.24	5.04	5.18	5.32	5.22
S.Em±	0.02	0.02	0.02	0.02	0.02
CD at 5%	0.08	0.08	0.08	0.09	0.08

In a column, means indicated by the same alphabet/alphabets shows that there is no significant difference by DMRT (0.05). DAT: Days After Transplanting.

Table-4
Dry chilli yields as influenced by NPM modules in chilli

NPM Modules	Dry chilli produce q/ha	Gross Returns	Total production cost (Rupees)	Net Returns (Rupees)	B:C ratio
M-I	4.13 a	29736/-	11495/-	18241/-	2.59
M-II	4.01 ab	28872/-	11893/-	16979/-	2.43
M-III	3.91 ab	28152/-	10513/-	17639/-	2.67
M-IV	3.79 b	22740/-	10273/-	12467/-	2.21
CV	10.71	-	-	-	
S.Em±	0.23	-	-	-	
CD at 5%	0.72	-	-	-	

In a column, means indicated by the same alphabet/alphabets shows that there is no significant difference by DMRT (0.05). DAT: Days After Transplanting.

Influence of organic soil manure such as vermicompost, Neem cake and neem products against chilli pests has been recorded by - Varghese and Giraddi[4], Giraddi and Smitha[5], Ramesh[6], Surekha and Arjun Rao[7], Mallikarjun Rao and Ahmed[8], and Mallikarjun Rao *et al* [9,10], in chilli which lend support to the present findings. These results are similar with the findings recorded by Srinivas and Lawvande[11] in onion crop, who obseved that lower number of thrips per plant obtained in onion crop bordered by two rows of maize with one insecticidal spray, whereas the population of thrips was more in control plot and insecticidial sprayed plots.

Literature pertaining to this kind of studies is not available. However, the research carried out in similar line by Hussain and

Samad[12], reported that in chilli successful control of virus carried by homopotaran pests was possible because of perimeter crop of maize acting as a barrier crop.

The published information on chilli crop against the target pest is nil. However, the work carried out in other crops indicated similar findings by Cerruti *et al.*[13], who reported that border crop of maize – have achieved that border crop could be effective plant for protect against virus transmission. They also observed that viruli forms of aphids find out for host plant on the border crop. After discovering a border crop the aphid loses its effect. Now virus free aphid enters the area of main crop, where it is no longer ability of transmit ion a virus disease and hence indicated maize is a good border crop of management strategy in vegetables. Results get by Nderiu *et al*[14], observed that among the different barrier cropping method *such as* zeamays, peral millet and redgram for the management of bhendi pests, observed that the bhendi plots border by zeamays had recorded least aphids population and obtained higher yield compared to peral millet and redgram barrier field plots.

Kibaru[15], also observed maize barrier crops effectiveness against *aphids* infesting irish potato. Wang *et al*[16], also confirmed maize barrier crop effectiveness in soybean plots which recorded least aphids compared with the sole crop of soybean plots. The work done by Mohammed Roff and Ho [17], also confirmed maize border crop effectiveness in chilli crop which reduce aphid population 60 -65 percentage compare sole chilli crop. Which lend support to the present findings?

The present findings proved that, chilli crop surrounded with maize is barrier crop significantly influence the preventing the thrips, aphids mites enter into the chilli main filed. This proved that, the barrier crop of maize could be better control strategy for the management of chilli sucking pests. The work carried out by Shivaprasad[18], reported that sorghum as a barrier crop at 40:6 rows (every 40 rows of chilli 6 rows of sorghum crop) was helpful in control the mites and thrips population and obtained higher yield. However, the work carried out by Jude *Boucher et al* [19] in line with the present findings and reported that in bell pepper, the combination of sprayed and barrier crop provided the best protection against the pepper maggot.

Data presented in Table-3, revealed significantly less mean larval density (0.13 larva / plant) in M-I and was equally effective as M-II (0.19 larva/plant). M-IV recorded significantly higher larval density of 0.41 larva / plant. Different organic manure such as vermicompost, Neem cake (either in mixed together with other organics manure or alone) tried against chilli fruit borer has given good results Varma[20]. Mallikarjun Rao *et al*[21] Giraddi *et al*[22] and Ravikumar[23]. Sudhakar *et al*[24], reported significant reduction in *L. orbonalis* larvae in brinjal due to impact of neem cake. Rosaiah[25], observed pongamia seed extract and neemzal showed least fruit infestation by *H.armigera.*

These reports are in accordance with the present findings. Further, the present findings are in conformity with report of Shivaramu[26], who observed that module comprising of 18:1 chilli: marigold as trap crop proportion. Similarly, Shrinivasan *et al*[27], reported 14 and 16 rows of tomato planted with a row of marigold as a trap crop planted on either side to tomato rows gave better control of *H. armigera* in tomato ecosystem. NPM module consisting of 12 rows of chilli plus one row of marigold as trap crop and three sprays with Nimbecidine, Dipel and carbaryl in sequence were found to be promising against *H. armigera* Nadaf[28].

Published information on this line of work on chilli crop are not available, however the work carried out on other crops supports the present findings. Van den Berg[29], reported that the corn crop bordered by Vertiver grass reduced the incidence of stem borer.

Boucher and Robert[30], reported that in cabbage fields with their bordered crop of collards reduced the incidence of diamond back moth. Hasse [31] also indicated that in scotton crop bordered by castor plant recorded the lowest incidence of *Heliothis* spp. Similarly, the present findings are also in confirmation with the results obtained by Osakabe Maashiro[32] on soybean crop and confirmed that barrier crop of maize had significant effect and reduced the incidence of lepidopteran pod borers during 1999 and 2000 and also indicated that specially during 1999, soybean crop surrounded by barrier crop of maize showed little damage compared to soybean crops sprayed twice with an insecticidal application of Fenvalerate + fenitrothion.

The results obtained in the present study strongly confirmed the usefulness of barrier crop of maize for the control of *Helicoverpa* fruit borer in chilli.

Among different NPM modules, significantly higher dry chilli yield recorded in Module-I 4.13 q/ha and followed by Module-II 4.01 q/ha and Module-III 3.91 q/ha. However, lower yield level was noticed in (RDF) M-IV (3.79 q/ha) (Table-4)

Assessment of cost each NPM module was observed based on net returns. Among the different NPM modules, M-I was found to be highly cost effective by recording highest net return (Rs.18241/-) followed by M-III (Rs.17639/-) and M-II (Rs.16979/-). M-IV recorded lowest net return of Rs. 12467/- (Table-4).

Conclusion

Based on various parameters, it could be summarised that Module –I comprising of maize as a border crop, marigold as a trap crop, Vermicompost 5 t/ha + Neem cake 10 q/ha, with sprays Neemazal 3 ml/lit at (5 WAT), Nimaasthram 250 lit/ha at (8 WAT), Neemazal 3 ml/lit at (11 WAT) Agniasthram (6 lit/ha) at (13 WAT) could be considered as a promising strategy for the management of chilli pests.

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