Evaluation of some bio-rational insecticides against the looper complex, *Hyposidra spp.* in tea plantations of Dooars, West Bengal

A. Basu Majumder*, S. K. Pathak and T. K. Hath

ABSTRACT

The efficacy of some bio-rational insecticides against tea looper complex, *Hyposidra spp*. was evaluated at two different locations of Dooars tea plantations, West Bengal. The results indicated that all the insecticides were effective in reducing the looper population to a significant level. However, in comparison to other insecticides, neem based insecticides could not give the desired level of control. Among the different treatments, diflubenzuron 25 WP @ 700g/ha caused maximum reduction of loopers over control in both the sprayings at both the locations [Location I: 66.91% and 65.54% reduction of loopers at 7 days after 1st and 2nd spraying respectively) and Location II: 68% and 50.85% reduction of loopers at 7 days after 1st and 2nd spraying respectively)] and appeared to be the best treatment against loopers. *Bt-k* @ 1000 mL/ha was the next best treatment for suppressing looper population at 7 days after 1st spraying (64.44% and 67.81% reduction of loopers at Location I and II respectively) which was at par with recommended insecticide deltamethrin 2.8 EC @ 200 mL/ha (65.14% and 62.16% reduction of loopers at Location I and II respectively). However, in 2nd spraying, its efficacy was declined. Both the doses of Neem based insecticides recorded 31-49% reduction of loopers after 1st spraying but this was reduced only to 9-17% after 2nd spraying, Thus, in consideration of the performance of the insecticides, diflubenzuron @700 g/ha and *Bt-k* @ 1000 mL/ha could be included in the IPM package of looper.

Key words: Bio-rational insecticides, looper complex, tea, tea plantations

INTRODUCTION

Tea is an important plantation crop of Dooars located at the foot hills of Sub-Himalayan West Bengal and provides subsistence for thousands of people. This region accounts for 12.61% area under tea in India contributing 14.48% production of made tea (Anonymous, 2008a). However, insect pests are considered as one of the limiting factors hindering the production of tea in this region. In North-East India, tea plant is colonized by a complex of insect species including the tea mosquito bug, red spider mites, thrips, termites, red slug caterpillar, looper caterpillar, green leafhopper etc. (Gurusubramanian and Borthakur, 2005). Among these insect pests, loopers of *Hyposidra spp.* have gained much importance during the last couple of years owing to their severity of damage and magnitude of crop loss (Anonymous, 2008b).

Pest control in tea is largely dependent on broad spectrum chemical pesticides. The average pesticide use pattern in Dooars was estimated to be of 14.16 L/kg per ha per year of which synthetic pesticides constitute 85% (Sannigrahi and Talukdar, 2003). However, often the planters of this region experience that, in spite of adopting control measures with synthetic insecticides, considerable amount of crop loss is incurred every year due to looper attack. Moreover, large scale and injudicious application of these synthetic pesticides over the years has not only upset the natural ecosystem by enhancing secondary pest outbreak, pest resurgence, and variation in susceptibility but also created problems of pesticide residue in made tea (Das, 1959; Gurusubramanian *et al*., 2005). So, there is an urgent need of some alternate eco-friendly insecticides against loopers for successful cultivation of tea in Dooars. Hence, under the present study, some bio-rational insecticides were evaluated against *Hyposidra spp.* at two different locations in Dooars tea plantations,

India in order to check their suitability in IPM of looper.

MATERIALS AND METHODS

Field evaluation of some bio-rational insecticides (*Btk* , Azadirachtin based neem formulation and an insect Growth Regulator) was conducted against tea looper, *Hyposidra spp.* at two different locations; location I- T.R.A's experimental plot at Nagrakata and location II- Gandrapara Tea Estate, Binnaguri, West Bengal over two spring seasons (March-April) of 2008 and 2009. Besides these insecticides, one synthetic insecticide (synthetic pyrethroid) recommended by Tea Research Association for looper control was also included for comparison. In both the locations, pruned/skiffed tea bushes were selected for experiments and no pesticide was applied to the bushes since pruning/skiffing. The experiments were laid out following Randomized Block Design with three replications each having a plot size of 5m x 4m. For each of the insecticides except synthetic pyrethroid, two different doses were included in field experiments depending on initial lab trial results. The treatments included were diflubenzuron (25 WP) @ 350g/ha and 700 g /ha, *Bacillus thuringiensis* var. *kurstaki* (*Btk*) formulation (17,600 IU/mg: 3.5%) @ 750 mL/ha and 1000 mL/ha, azadirachtin (5%) based neem formulation @ 250 mL/ha and 500 mL/ha, synthetic pyrethroid (deltamethrin 2.8 EC) @ 200 mL/ha and untreated check. The total quantity of insecticidal solution for spraying of each treatment was calculated on the basis of plot size. Water volume for spraying was applied as per T.R.A's recommendation i.e. 400 L/ha. Insecticides were sprayed when loopers were in $2^{nd}/3^{rd}$ instar stages. Spraying was done at the afternoon hours with hand operated Aspee High-Tec sprayer using NMD 60450 nozzles where uniform coverage of pesticides on each plot and bush was taken care of. Two sprayings were given at an interval of seven days. For recording the percent reduction/increase of looper population in each treatment, five tea bushes from each plot/replication was randomLy selected and tagged. The looper population on these bushes was recorded one day before spraying and subsequently 3 and 7 days after spraying. The same procedure was followed for second spraying. The percent reduction/increase in looper population due to different treatments was worked out following the formula of Henderson and Tilton (1955). Data thus obtained were analyzed with statistical software SPSS 10.0.

RESULTS AND DISCUSSION

The pooled results of two years experiment presented in table 1 and table 2 revealed that in both the locations, all the treatments were significantly superior to the treatment of neem based insecticides in controlling looper population. In location I, prior to treatments, looper population per bush was ranged from 9.03 to 11.00 in different plots. Deltamethrin 2.8 EC @ 200 mL/ha gave effective control at 3 days after 1st spraying (62.99%) which persisted up to 7 days after spraying (65.14%). However its effectiveness gradually reduced after second spraying. The treatments diflubenzuron @ 700 g ha^{-1} and *Bt-k* @ 1000 mL ha^{-1} were recorded as second best treatments in reducing looper population at 3 days after first spraying giving 51.23 % and 50.62% reduction of loopers over control respectively. However, both the doses of neem formulation (Aza 5%) were at par with each other and caused only 47-49% reduction over control. In 2nd spray, the efficacy of diflubenzuron increased at 7 days after spraying whereas the efficacy of deltamethrin reduced at 7 days after spraying. Neem formulation was the least performing treatment against loopers. The chronological order of effectiveness of various treatments based on percent reduction of looper population over control at 7 days after 2nd spraying in descending manner was diflubenzuron @ 700 g ha^{-1} (65.54%) > diflubenzuron @ 350 g ha^{-1} (46.62%) > *Bt-k* @ 1000 mL ha^{-1} (34.98%) and deltamethrin @ 200 mL ha^{-1} (32.32%) > *Bt-k* @ 750 mL ha^{-1} (17.01%) and neem formulation @ 500 mL ha^{-1} (16.29%)> neem formulation @ 250 mL ha^{-1} (10.21%).

In location II, pre-treatment population of loopers per bush in different plots was ranged from 10.62 to 12.90. Percent reduction of loopers over control was maximum in plots treated with deltamethrin 2.8 EC @ 200 mL/ha at 3 days (62.82%) and 7 days (62.16%) after first spraying. At higher dose, the)

Table 1. Field evaluation of some bio-rational insecticides against *Hyposidra spp*. at T.R.A, experimental plot Nagrakata (location I) during spring (Pooled data of 2008 and 2009)

Treatment	Doses (g/mL ha^{-1})	Pre-treatment count*	Mean percent reduction of loopers over control		Pre-treatment count	Mean percent reduction of loopers over control	
			3 DAIS**	7 DAIS		3 DAIIS	7 DAIIS
Diflubenzuron 25 WP	350	9.04	39.55^{c†}	54.47b	4.27	32.28^{b}	46.62^{b}
Diflubenzuron 25 WP	700	10.52	51.23^{b}	66.91^{a}	3.67	48.67^{a}	65.54^{a}
Bt-k 17600 IU/mg: 3.50%	750	9.03	35.57^{cd}	56.15^{b}	4.15	21.07^{c}	17.01^{d}
Bt-k 17600 IU/mg: 3.50%	1000	10.12	50.62^{b}	64.44^{a}	3.72	37.55^{b}	34.98^{c}
Neem formulation (Aza 5%)	250	10.36	30.77^{d}	47.39^{c}	5.65	13.80^{c}	10.21^{e}
Neem formulation (Aza 5%)	500	9.82	37.40^{c}	49.12^{c}	5.10	17.31^{c}	16.29^{d}
Deltamethrin 2.8 EC	200	10.43	62.99^{a}	65.14^{a}	3.83	36.69^{b}	32.32^{c}
Control	Water spray	11.00	-	-	11.48	-	-

* Looper population per bush * *DAIS- Days after 1st spraying, DAIIS- days after 2nd spraying † means followed by same letter in column does not differ at 5% level of significance by DMRT

effectiveness of diflubenzuron was found to increase from 3 days (48.47%) to 7 days (68.00%) after first spraying. Similar trend was noticed in case of higher dose of *Bt-k.* The chronological order of effectiveness of various pesticides at location II after 7 days after second spraying was diflubenzuron @ 700 g ha^{-1} (50.85%) > deltamethrin @ 200 mL ha^{-1} (43.99%) > diflubenzuron @ 350 g ha^{-1} (36.61%) >*Bt-k* @ 1000 mL ha^{-1} (31.16%) > *Bt-k* @ 750 mL ha^{-1} (23.23%) > neem formulation @ 500 mL ha^{-1} (14.58%)> neem formulation @ 250 mL ha^{-1} (8.66%).

A critical examination of the experimental results with these bio-rational insecticides against tea looper, *Hyposidra spp.* at two different locations of Dooars tea plantation showed that all the treatments were effective in reducing the looper population. However, variations existed in their efficacy. In general, all the treatments were significantly superior to the treatments of neem based insecticides. It has been observed that both the doses of diflubenzuron caused a gradual reduction of loopers from 3 days to 7 days of two the sprayings. In case of *Btk* and neem, there was a drastic reduction in looper population from 3 days to 7 days after first spraying when the loopers were in early instars and the effectives was found to decrease gradually in second spraying with the advancement of loopers. Similar trend was noticed with synthetic pyrethroids where its efficacy gradually decreased with time. The findings of the present study showed that initial mortality with diflubenzuron was low but the per cent mortality increased with time; affected loopers lost the urge for feeding and failed to moult. In some cases, dead loopers were seen hanging with half moulted skin attached to their body. A similar kind of observations were reported in earlier trials of Tocklai Experimental Station, TRA where diflubenzuron at different doses gave effective control of loopers and other caterpillar pests of tea (TRA, 1984, 1987, 2009). Chatterjee (2001) reported that early larval instars of *Helicoverpa armigera*, *Plutella xylostella* and *Pieris brassicae* were more susceptible to *Btk* and with progressive advancement of larval instars; the insects became less susceptible to bio-pesticides. Jayanthi and Padmavathamma (1996) also reported higher percentage of mortality of early instar caterpillars of *Pieris brassicae* due to different doses of *Bt* as compared to older instars which is in supportive of the results of the present work. The percent reduction in looper population under present study is further substantiated by the result of another Tocklai trial (TRA, 1989) where *Btk* at different doses caused about 40

Table 2. Field evaluation of some bio-rational insecticides against *Hyposidra spp*. at Gandrapara T.E, Binnaguri (location II) during spring (Pooled data of 2008 and 2009)

Treatments	Doses (g/mL ha^{-1})	Pre-treatment count*	Mean percent reduction of loopers over control		Pre-treatment count	Mean percent reduction of loopers over control	
			3 DAIS**	7 DAIS		3 DAIIS	7 DAIIS
Diflubenzuron 25 WP	350	11.23	40.05^{c}†	54.59^{b}	5.80	32.00^{c}	36.61^{c}
Diflubenzuron 25 WP	700	10.62	48.47^{b}	68.00^{a}	3.88	44.15^{a}	50.85^{a}
Bt-k 17600 IU/mg: 3.50%	750	12.37	37.92^{c}	50.61^{b}	7.00	24.99^{d}	23.23^{e}
Bt-k 17600 IU/mg: 3.50%	1000	11.98	48.46^{b}	67.81^{a}	4.40	36.33^{b}	31.16^{d}
Neem formulation (Aza 5%)	250	12.45	35.71^{c}	37.31^{c}	8.88	10.80^{f}	8.66^{g}
Neem formulation (Aza 5%)	500	12.45	40.16^{c}	41.27^{c}	8.28	16.69^{e}	14.58^{f}
Deltamethrin 2.8 EC	200	13.40	62.82^{a}	62.16^{a}	5.70	46.09^{a}	43.99^{b}
Control	Water spray	12.90	-	-	14.58	-	-

* Looper population per bush * *DAIS- Days after 1st spraying, DAIIS- days after 2nd spraying † means followed by same letter in column does not differ at 5% level of significance by DMRT

per cent reduction of loopers at one week after spraying. However, Widiastuti *et al*. (1996) found that different local strains of *Bt* along with a commercial *Bt* product were nontoxic to *H. talaca* larvae in Cocoa ecosystem of Indonasia. The deviation in the results of present findings from Widiastuti *et al*. (1996) might be due to the differences in the virulence of the microbes as well as the genetic diversity of pest population in two different locations because a recent study showed that a commercial formulation of *Btk* is moderately to highly toxic for 2 days and 7days old larvae of *H. talaca* under laboratory condition (TRA, 2008).

In case of Azadiractin based neem based insecticide, around 30-49% reduction of loopers was observed with different doses after a week of 1st spraying whereas in 2nd spraying, the percentage suppression of loopers was only 8-17% which was not up to the desired level. This indicated that Azadiractin based neem based insecticide was effective against early instar loopers but as loopers grew, it became ineffective.

Similarly, Ahmed *et al.* (2002) found that neem based pesticide could not show effective reduction in the infestation of *Chilo partellus* on maize in Pakistan and around 50% reduction in infestation of the pest at 24 and 48 hours of first spray was observed after that time period, there was no significant difference in infestation level with untreated crop. Rahman *et al.* (2006) also reported that different neem formulations caused 20.32-57.86% control of loopers, *Biston supressaria* on tea after one week of application. However, Sannigrahi, *et al*. (1995) reported that different formulations of neem could give moderate (50-60%) control of loopers, *Biston supressaria* and bunch caterpillar, *Andraca bipunctata* after two sprays which slightly deviated from the present findings owing to the differences of formulations, agro-climatic situations and insect species.

Thus, in consideration of the performance of different bio-rational insecticides used under present study, diflubenzuron @700 g/ha and *Bt-k* @ 1000 mL/ha may be included in the IPM package of loopers, *Hyposidra spp.*

ACKNOWLEDGEMENTS

The Authors are thankful to P. Ghosh, Ex- Chief Advisory Officer, Nagrakata Sub-Station TRA and Assitt. Manager, Gandrapara Tea Estate for their support and cooperation in carrying out the experiment.

REFERENCES

Ahmed, S., Saleem, M. A. and Rauf, I. 2002. Field Efficacy of Some Bio-insecticides against Maize and Jowar Stem Borer, *Chilo Partellus* (Pyralidae: Lepidoptera). *International Journal Agriculture and Biology,* **4**(3): 332-334.

Anonymous, 2008a. Tea Statistics. Available from: http://www.teaboard.gov.in/pdf

Anonymous, 2008b. *Quarterly Advisory bulletin: March-June*. Nagrakata sub-station, Tea Research association. 1-3 **PP.**

Chatterjee, H. 2001. Investigation on potentialities of microbials on some important lepidopteran pests in terai region of West Bengal. *Ph D thesis*.U. B. K. V. Pundibari, Cooch Behar. 131 **PP**.

Das, G. M. 1959. Problems of Pest control in tea, *Science and Culture*, **24** (2): 493-498.

Gurusubramanian, G., Borthakur, M., Sarmah, M. and Rahman, A. 2005. Pesticide selection, precautions, regulatory measures and usage. In: *Plant protection in tea* (Dutta, A. K. *et al.* eds.). Assam Printing Works Private Limited, Tocklai Experimental Station, TRA, Jorhat, Assam, India. 81-91 **PP**.

Gurusubramanian, G. and Borthakur, M. 2005. Integrated management of tea pests. In: *Field management in tea* (Eds.: A.K. Dutta, S.K. Baruah, N. Ahmed, A.K. Sarma and D. Burugohain). Tocklai Experimental Station, TRA, Jorhat, Assam Printing Works Private Limited, Jorhat, Assam, India. 159-172 **PP**.

Henderson, C. F. and Tilton, E. 1955. Test with acaricides against the brown mite. *Journal of Economic Entomology*, **48**: 157-161.

Jayanthi, P. D. K and Padmavathamma, K. 1997. Response of tobacco caterpillar, *Spodoptera litura* (Fab.) to various concentrations of *Bacillus thuringiensis* var *kurstski*. *Pesticides Research Journal*. **9**(1):20-24.

Mukherjee, S. and Singh, S. 1993. Development in tea pest management. *Two and a Bud.* **40** (1): 2-6.

Rahman, A. Sarmah, M., Borthakur, M., Singh, K., Gurusubramanian, G. and Hazarika, M. 2006. Prospects in use of neem formulations and biocides in tea pest management in north-east India. *Crop Research*, **31**(1): 160- 170.

Sannigrahi, S., Singh, K. and Barbora, B. C. 1995. Neem Based Pesticides and Their Use against Tea Pests. *Two Bud*. **42**(l): 7-11.

Sannigrahi, S. and T. Talukdar. 2003. Pesticide use patterns in Dooars tea industry. *Two Bud*, **50**:35-38.

TRA. 1983. Annual Scientific Report 1982-83. *Entomology*. Tocklai Experimental Station, Tea Research Association, 47-52 **PP**.

TRA. 1984. Annual Scientific Report 1983-84. *Entomology*. Tocklai

Experimental Station, Tea Research Association, 71-83 **PP**.

TRA. 1987. Annual Scientific Report 1986-87. *Entomology*. Tocklai Experimental Station, Tea Research Association, 63-73 **PP**.

TRA. 1989. Annual Scientific Report 1988-89. *Entomology*. Tocklai Experimental Station, Tea Research Association, 66-72 **PP**.Widiastuti, H., Darmono, T. W. and Hadioetomo, R. S. 1996. Characteristics of selected *Bacillus thuringiensis* isolates from Indonesia and their toxicity to *Hyposidra talaca*. *Menara Perkebunan*. **64**(2): 65-78.

Tocklai Experimental Station, Tea Research Association, 78-81 **PP**.

TRA. 2009. Annual Scientific Report 2008-09. Nagrakata Sub-station. Tocklai Experimental Station, Tea Research Association, 95 **PP**.

TRA. 2008. Annual Scientific Report 2007-08. *Nagrakata Sub-station.*

A. Basu Majumder*, S. K. Pathak and T. K. Hath[1]

*Directorate of Research,Tea Board of India,14, B. T. M Sarani, Kolkata- 700 001, West Bengal, India.

Phone: +91-33-2235-1411 (320),

E-mail: anirbanbm@yahoo.co.in

1Department of Agricultural Entomology, Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, India.

Manuscript history

Received : 26.05.2011

Revised : 21.05.2012

Accepted : 23.05.2012