Efficacy of biopesticides in the management of pod borer, *Etiella zinckenella* (Treitschke) (Pyralidae: Lepidoptera) infesting senna, *Cassia angustifolia* Vahl.

Suganthy, M.

ABSTRACT

Cassia angustifolia Vahl. is an important medicinal plant belonging to the family Leguminaceae. Like other plants, medicinal plants too have to bear the attack of injurious insect pests. Extensive monitoring and development of eco-friendly pest management practices are essential in the production of high quality, pesticide residue free produces. Results of field experiments revealed that among the treatments, foliar application of chlorpyriphos 20 EC (standard check) @ 1.0 L/ha was significantly superior over all other treatments, recording the lowest number of pod borer and the untreated control was significantly inferior, recording maximum number of pod borers per plant. Among the biopesticides tested, neem seed kernel extract 5 per cent showed maximum efficacy with the least number of pod borer per plant, followed by neem oil 3 per cent, *Bacillus thuringiensis* @ 750g/ha and *Beauveria bassiana* @ 2 kg/ha, which were statistically on par in their efficacy. Results on the efficacy of biopesticides on pod damage revealed that *Bacillus thuringiensis* @ 750 g/ha showed promising efficacy with the minimum pod damage at 14 DAT, followed by neem seed kernel extract 5 per cent. Regarding yield, neem seed kernel extract 5 per cent treated plots recorded maximum leaf and pod (dry) yield followed by neem oil 3 per cent and *Bacillus thuringiensis* @ 750 g/ha. Hence, neem seed kernel extract 5 per cent can be recommended as suitable biopesticide for the management of pod borer, *Etiella zinckenella* infesting senna, *C. angustifolia.*

Keywords: *Cassia angustifolia,* Pod borer, *Etiella zinckenella*, Bio-pesticides, Yield

MS History: 17.05.2019 (Received) - 23.09.2019 (Revised) - 20.12.2019 (Accepted).

Citation: Suganthy, M. 2019. Efficacy of biopesticides in the management of pod borer, *Etiella zinckenella* (Treitschke) (Pyralidae: Lepidoptera) infesting senna, *Cassia angustifolia* Vahl. *Journal of Biopesticides,* **12** (2): 197-202.

INTRODUCTION

Senna (*Cassia angustifolia* Vahl.) is a small perennial herb cultivated mostly in dry tracts. In Tamil Nadu, it is cultivated as a cash crop in Southern districts *viz.*, Madurai, Virudhunagar, Tuticorin and Tirunelveli. Its leaves and pods contain laxative principles *viz.,* sennosides A, B, C and D which are widely used in industry as a laxative stimulant and vermifuge. It finds an important place in pharmacopoeia of India, Europe and Britain. India exports senna leaves and pods and there is a continuous rise in the export from 24 crore INR in the year 2005-06 to 47 crores in 2009-10. India exported more than 11,000 metric tonnes of senna leaves and pods worth of more than 70 crores during 2017-18 (Exim Bank, 2018). Green leaf caterpillar, *Catopsila pyranthe*, *Eurema hecabe*, aphids, *Toxoptera odinae* and *Aphis gossypii*, spiny pod borer, *Etiella zinckniella* and cigarette beetle, *Lasioderma sericorne* were reported to attack leaves and fruits of senna (Jhansi Rani and Sridhar, 2005; Usha Rani and Kalyanasundaram, 2005). Murali Baskaran *et al.* (2007) assessed the damage potential of various insect pests of senna and reported that aphids caused 3.1 to 5.8 per cent damage, 3.3 to 7.4 per cent by *C. pyranthe*, 2.5 to 3.8 per cent by *E. hecabe* and the infestation of pod borer, *E. zinckeniella* resulted in maximum damage of 12.5 per cent. Pest management in medicinal plants is only in primitive stage and no systematic approach has been made which are meager and infancy. Due to increasing demand of medicinal plants in Western

Countries during 21st Century, developing countries like India is forced to go for extensive cultivation of economically important medicinal plants which naturally made the pest population in serious proportion (Murali Baskaran *et al*., 2007). Though attempts were made on pest management in senna (Murali Baskaran *et al*., 2008), most of them are with chemical control which is against the concept of using medicinal plants for curing several ailments of human being. Neem is a rich source of insecticide in the tropics and its potential for the management of several insect pests. Changing scenario in pest management concept has brought the natural products and in particular neem based products to the forefront as an effective and reliable pesticidal molecule in the control of pests among crops. The unique properties of the toxic principles from the seeds of Meliaceae are repellent, antifeedant and insect growth regulation combined with low cost, local availability, safety to the environment and compatibility with the agro-ecosystem which emphasize their potential in insect pest management. The efficacy of all neem products was observed by Karmarkar and Bhole (2000) and several field studies on the efficacy of neem based insecticides have been conducted by many workers (Sarode *et al*., 1995; Bhatnagar and Sharma, 1995; Rao *et al*., 1993; Gowri *et al*., 2002; Rathikannu, 2005; Suganthy *et al*., 2010; Suganthy and Sakthivel, 2012, 2013 and 2014; Srinivasnaik *et al*., 2017). Shankar *et al.* (1993) reported that *Bt* formulation was found to be superior over the conventional insecticides and pyrethroids for the management of *H. armigera*. Hence, the present study was undertaken to test the field efficacy of biopesticides on pod borer infesting *C. angustifolia*.

MATERIALS AND METHODS

Field experiments were carried out in the farmer's holding at Pannikundu, Thirumangalam, Madurai district of Tamil Nadu during 2015-2016 and 2016-2017 to the assess the major pest infesting *C. angustifolia* field efficacy of selected biopesticides against podborer, **I**ncidence of pod borer started during second fortnight of February and was observed more during first week of March. The experiments were conducted in Randomized Block Design (RBD) with seven treatments and three replications. The plot size for each replication was 24 m^2. Each treatment was imposed in three randomized plots. When the pest population crossed the economic threshold level (ETL) of 10 per cent pod damage following treatments were imposed. Pre-treatment count of pest population was made before spraying. Post-treatment counts were taken at one, three, five, seven and fourteen days after spraying. Ten plants were selected at random from each plot and the larval count was recorded and expressed as number per plant. Chlorpyriphos 20 EC was used as standard chemical check for comparison, besides having an untreated check. The treatment details are T_1 - Neem oil 3 %; T_2 - Neem Seed Kernel Extract 5%; T_3 - *Metarhizium anisopliae* @ 2 kg/ha, T_4 - *Bacillus thuringiensis* @ 750 g/ha, T_5 - *Beauveria bassiana* @ 2 kg/ha, T_6 - Chlorpyriphos 20 EC 1 litre/ha (Chemical check) and T_7 - Untreated control. The data from field observations were analyzed following the procedure described by Panse and Sukhatme (1969). Wherever necessary, the pest load in number was transformed into square root of x + 0.5 values and percentage into arc sine values before carrying out statistical analysis.

RESULTS AND DISCUSSION

Results of field experiments conducted during 2015-2016 to evaluate the bio-efficacy of certain promising biopesticides in the management of pod borer in senna, *C. angustifolia* revealed that the pre-treatment count of pod borer larva ranged between 3.0 and 3.5 per plant, which were statistically non significant. Among the five bio-pesticides evaluated, the post treatment counts recorded on 1, 3, 5, 7 and 14 days after spraying revealed neem seed kernel extract 5 per cent showing maximum efficacy with the least

Table 1. Efficacy of biopesticides in the management of pod borer, *Etiella zinckenella* infesting senna (*Cassis angustifolia*) during 2015-2016

Treatments	Number of pod borer, *Etiella zinckenella* / plant						Pod damage at 14 DAT (Per cent)#	Dry leaf yield	
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		kg/ 24 m^2	kg/ha
T_1 - Neem oil 3 %	3.1	1.4	0.9	0.6	0.4	0.3	5.40	1.32	550
T_2 - Neem Seed Kernel Extract 5%	3.1	1.1	0.4	0.2	0.2	0.1	4.93	1.38	577
T_3 - *M. anisopliae* @ 2 kg/ha	3.2	2.4	1.1	0.9	0.6	0.5	5.67	1.32	550
T_4 - *B. thuringiensis* @ 750 g/ha	3.5	1.5	0.9	0.3	0.1	0.1	4.87	1.34	560
T_5 - *B. bassiana* @ 2 kg/ha	3.3	2.3	1.2	0.9	0.2	0.4	5.60	1.31	545
T_6 - Chlorpyriphos 20 EC 1 l/ha (Chemical check)	3.0	0.1	0.0	0.0	0.0	0.0	4.33	1.40	585
T_7 - Untreated control	3.1	3.7	4.0	3.9	4.0	3.6	14.27	1.23	513
S. Ed	0.164	0.081	0.054	0.055	0.043	0.065	0.374	0.025	9.392
CD (P=0.05)	0.358	0.177	0.118	0.119	0.093	0.142	0.815	0.053	20.464

PTC - Pre treatment count; DAT - Days after treatment

number of pod borer, *E. zinckenella* per plant, followed by neem oil 3 per cent, *B. thuringiensis* @ 750 g/ha and *B. bassiana* @ 2 kg/ha, which were statistically on par in their efficacy. *M. anisopliae* @ 2 kg/ha recorded minimum efficacy, harbouring more number of pod borers per plant. Pod borer count at one day after treatment (DAT) was as low as 1.1 in neem seed kernel extract 5 per cent treated fields, followed by 1.4, 1.5, 2.3 and 2.4 in neem oil 3 per cent, *B. thuringiensis* @ 750 g/ha, *B. bassiana* @ 2 kg/ha and *M. anisopliae* @ 2 kg/ha treated fields, respectively. However, chlorpyriphos 20 EC was significantly superior over all other treatments, recording the lowest number of pod borer (0.1) at one day after treatment and the untreated control was significantly inferior, recording 3.7 pod borers per plant. The order of superiority was maintained in the same way in the post treatment counts on third, fifth, seventh and fourteenth day after treatments (Table 1). Results recorded during 2015-2016 on the efficacy of biopesticides on pod damage revealed that *B. thuringiensis* @ 750 g/ha was found to be promising with maximum efficacy and minimum pod damage at 14 DAT, followed by neem seed kernel extract 5 per cent, neem oil 3 per cent, *B. bassiana* @ 2 kg/ha, which were statistically on par in their efficacy. *M. anisopliae* @ 2 kg/ha recorded maximum pod damage of 5.67 per cent. However, chlorpyriphos 20 EC was significantly superior over all other treatments, with minimum pod damage of 4.33 per cent as against the maximum pod damage of 14.27 per cent in untreated control (Table 1). Results of field experiments conducted during 2015-2016 on efficacy of bio-pesticides on leaf and pod yield of *C. angustifolia* revealed that neem seed kernel extract 5 per cent treated plots recorded maximum dry leaf and pod yield followed by *B. thuringiensis* @ 750 g/ha,

Table 2. Efficacy of biopesticides in the management of pod borer, *Etiella zinckenella* infesting senna (*Cassis angustifolia*) during 2016-2017

Treatments	Number of pod borer, *Etiella zinckenella*/ plant						Pod damage at 14 DAT (Per cent)#	Dry leaf yield	
	PTC	1 DAT	3 DAT	5 DAT	7 DAT	14 DAT		kg/24m^2	kg/ha
T_1 - Neem oil 3 %	2.77	1.37	0.83	0.63	0.30	0.27	5.10	1.37	570.8
T_2 - NSKE 5%	3.00	1.23	0.47	0.27	0.13	0.10	4.47	1.40	583.3
T_3 - *M. anisopliae* @ 2 kg/ha	3.07	2.13	1.03	0.90	0.63	0.47	5.27	1.32	550.0
T_4 - *B. thuringiensis*@750 g/ha	2.97	1.87	0.97	0.30	0.13	0.07	4.47	1.37	570.8
T_5 - *B. bassiana* @ 2 kg/ha	3.10	2.40	1.47	0.87	0.37	0.47	6.27	1.35	562.5
T_6 - Chlorpyriphos 20 EC 1 l/ha (Chemical check)	2.93	0.05	0.03	0.03	0.03	0.03	4.13	1.44	600.0
T_7 - Untreated control	3.03	3.27	3.67	3.90	3.73	3.03	13.70	1.24	516.7
S. Ed	NS	0.099	0.123	0.118	0.157	0.119	0.079	0.021	8.9
CD (P=0.05)	NS	0.215	0.267	0.257	0.341	0.258	0.172	0.046	19.3

PTC - Pre treatment count; DAT - Days after treatment; NS - Non-significant

neem oil 3 per cent and *M. anisopliae* @ 2 kg/ha and were found to be statistically on par. Among the biopesticides, *B. bassiana* @ 2 kg/ha treated plots yielded minimum leaf and pod yield of 1.31 kg/24m^2 and 585.0 kg/ha. Chemical standard check chlorpyriphos 20 EC 1.0 l/ha was significantly superior among all the treatments yielding 1.40 kg/24m^2 and 585.0 kg/ha as against the 512.7 kg/ha in untreated control (Table 1). Results of field experiments conducted during 2016-2017 revealed that pre-treatment count of pod borer ranged between 2.77 and 3.10 per plant, which were statistically non-significant. Among the five bio-pesticides evaluated, the post treatment counts recorded on 1, 3, 5, 7 and 14 days after spraying revealed that neem seed kernel extract 5 per cent registered maximum efficacy with the least number of pod borer, *E. zinckenella* per plant, followed by neem oil 3 per cent, *B. thuringiensis* @ 750g/ha and *B. bassiana* @ 2 kg/ha, which were statistically on par in their efficacy. *M. anisopliae* @ 2 kg/ha recorded minimum efficacy, harbouring more number of pod borers per plant. The pod borer count at one DAT was as low as 1.23 in neem seed kernel extract 5 per cent treated fields, followed by 1.37, 1.87, 2.13 and 2.40 in neem oil 3 per cent, *B. thuringiensis* @ 750 g/ha, *M. anisopliae* and *B. bassiana* @ 2 kg/ha treated fields, respectively. However, chlorpyriphos 20 EC (standard check) @ 1.0 l/ha was significantly superior over all other treatments, recording the lowest number of pod borer (0.05) at one day after treatment and the untreated control was significantly inferior, recording 3.27 pod borers per plant. Order of superiority was maintained in the same way in post treatment counts on third, fifth, seventh and fourteenth day after treatments (Table 2). Observations recorded during 2016-2017 on the efficacy of biopesticides on pod damage by the pod borer, *E. zinckenella* revealed that *B. thuringiensis* @ 750 g/ha and neem seed kernel extract 5 per cent showed promising efficacy with the minimum pod damage at 14 DAT, followed by neem oil 3 per cent, *M. anisopliae* @ 2 kg/ha, which were statistically on par in their efficacy. *B. bassiana* @ 2 kg/ha recorded maximum pod damage of 6.27 per cent. However, chlorpyriphos 20 EC (standard check) @ 1.0 l/ha was significantly superior over all other treatments, with minimum pod damage of 4.13 per cent as against the maximum pod damage of 13.70 per cent in untreated control (Table 2). Results of field experiments conducted during 2016-2017 revealed that neem seed kernel extract 5 per cent treated plots recorded maximum leaf and pod (dry) yield of 1.40 kg/24m^2 and 583.3 kg/ha followed by neem oil 3 per cent and *B. thuringiensis* @ 750 g/ha with the leaf and pod yield of 1.37 kg/24m^2 and 570.8 kg/ha. *B. bassiana* @ 2 kg/ha recorded the

yield of 1.35 kg/24m^2 and 562.5 kg/ha and were found to be statistically on par. Among the biopesticides, *M. anisopliae* @ 2 kg/ha treated plots yielded minimum leaf and pod yield of 1.32 kg/24m^2 and 550 kg/ha. Chemical check chlorpyriphos 20 EC 1.0 l/ha was significantly superior among all the treatments yielding 1.44 kg/24m^2 and 600 kg/ha as against 1.24 kg/24m^2 and 516.7 kg/ha in untreated control (Table 2). Increased efficacy of neem based biopesticides in the management of senna pod borer might be due to the presence of tritepenoids in neem which exhibit high antifeedant property. The results of present investigation are in line with findings of Varghese (2003) who reported that nimbicidine five per cent spray was found to be highly effective in reducing thrips on chillies. Neem cake application @ 500 kg/ha and seedling root dip with 1 per cent neem oil followed by neem oil spray at weekly intervals reduced the thrips population to lower levels in chilli (Mallikarjunarao *et al.,* 1999). Similarly, GCKE 5 per cent (garlic chilli kerosene extract) along with half dose of nimbecidine (2.5 ml/l) registered the lowest incidence of thrips in chilli (Lingappa *et al.,* 2002). According to Badge *et al.* (1999), NSKE 7 per cent resulted in cent per cent mortality of *Spodoptera litura* and prolonged the pupal period. Rathikannu (2005) reported that NSKE 5% and Neemazal 1% @ 900 ml/ha were found to be effective against the insect pests of *Gloriosa superba* with the highest reduction of 53.34 per cent in the population of *S. litura* in NSKE 5% after 5 days of application. Meshram *et al.,* (2015) reported that *B. thuringensis* 1% followed by neem based pesticide 1% was found to be effective against *Polytela gloriosae* on *G. superba*. Considering the importance of *Cassia angustifolia* as an important medicinal plant, use of chemical pesticides may be restricted. Hence, from the above results, foliar application of neem seed kernel extract 5 per cent is recommended to have maximum efficacy in terms of the least number of pod borer, *Etiella zinckenella*, minimum pod damage and maximum yield.

ACKNOWLEDGEMENT

The author is highly grateful to the Directorate of Medicinal and Aromatic Plant Research, Boriavi, Anand, Gujarat for the financial support provided through All India Co-ordinated Research Project on Medicinal and Aromatic Plants and Betelvine to carry out the research.

REFERENCES

Badge, M. A., Sarnaik, D. N. and Satpute, S. K. 1999. Influence of neem seed extract in combination with some fertilizers on *Spodoptera litura* (Fabricius). *Pestology*. **23**: 57-59.

Bhatnagar, A. and Sharma, V. K. 1995. Relative efficiency and residual toxicity of margosa (*Azadirachta indica*) and Indian beech (*Pongamia pinnata*) oils to stem borer (*Chilo partellus*) of maize (*Zea mays*). *Indian Journal of Agriculture Science*. **65**: 691-693.

Exim Bank. 2018. *www.eximbankindia.in*

Gowri, S., Rao, G. R. and Nagalingam, B. 2002. Evaluation of certain new neem formulations against okra fruit borer, *Earias vittella* (Fab.) and their effect on yield. *Journal of Entomological Research*. **26**: 245-247.

Jhansi Rani, B. and Sridhar. V. 2005. Record of aphids (Homoptera: Aphididae) and their natural enemies on some medicinal and aromatic plants. *Pest Management in Horticultural Ecosystems*. **11**(1): 71-73.

Karmarkar, M. S. and Bhole, S. R. 2000. Studies on efficacy of some neem products against second and fourth instar larvae of *Spodoptera litura* Fab. *Pestology*. **24**: 55-57.

Lingappa, S., Tatagar, M. H., Kulkarni, K. A., Giraddi, R. S. and Mallapur, C. P. 2002. Status of integrated management of chilli pests - An over view. *Brain Storming Session on Chilli*. IISR, Calicut.

Mallikarjunarao, N., Muralidhararao, G. and Tirumalarao, K. 1999. Efficacy of neem products and their combinations against chilli thrips, *Scirtothrips dorsalis* (Hood). *Pestology*. **23**: 10-12.

Meshram, P. B., Mawai, N. S. and Malviya, R. 2015. Biological Control of Insect Pests of Medicinal Plants - *Abelmoschus moschatus*, *Gloriosa superba* and

Withania somnifera in Forest Nursery and Plantation in Madhya Pradesh, India. *American Journal of Agriculture and Forestry*, **3**: 47-51. doi: 10.11648/j.ajaf.20150302.16.

Murali Baskaran, R. K., Rajavel, D. S., Shanthi, M., Suresh, K. and Kumar, S. 2007. Insect Diversity and Damage Potential in Medicinal Plants Ecosystem. *Insect Environment,* **13**(2): 76-79.

Murali Baskaran, R. K., Senthil Kumaran, S., Rajavel, D. S. and Suresh, K. 2008. Effect of organic sources of nutrients on defoliator, *Catopsilia pyranthe* (L.) (lepidoptera: Pieriidae) of senna. *Pest Management in Horticultural Ecosystems.* **14**: 99-109.

Panse, V. G. and Sukhatme, P. V. 1969. *Statistical Methods for Agricultural Workers*, ICAR. 328 **P**.

Rao, B. S., Reddy, G. P. V., Murthy. and Deva Prasad, V. 1993. Efficacy of neem products in the control of bhendi pest complex. *Indian Journal of Plant Protection*, **19**: 49-52.

Rathikannu, S. 2005. Bio-ecology, Management of pests of *Gloriosa superba* (Linn) and *Phyllanthus amarus* (Schum and Thonn) and influence of insect damage on the medicinal properties. *M.Sc (Ag.) Thesis*, Tamil Nadu Agricultural University, Coimbatore.

Sarode, S. V., Jumbe, Y. S., Deotale, R. O. and Thakare, H. S. 1995. Evaluation of neem seed kernel extract (NSKE) at different concentrations for the management of *Helicoverpa armigera* (Hub.) on pigeonpea. *Indian Journal of Entomology.* **57**: 385-388.

Shankar, G., Mallikarajunappa, S. and Ganesh Bhat. 1993. Field evaluation of *Bacillus thuringiensis* Berliner var. *kurstaki* for the control of cotton bollworm, *Helicoverpa armigera* Hubner. *Pestology*. **17**: 18-22.

Srinivasnaik, S., Suganthy, M., Mohan Kumar, S. and Jegadeeswari, V. 2017. Development and evaluation of integrated pest management strategy against sucking pest complex of cocoa, *Theobroma cacao* L. *International Journal of Current Microbiology and Applied Sciences.* **6**: 859-867.

Suganthy, M., Philip Sridhar, R. and Sundareswaran, S. 2010. Efficacy of botanicals on life stages of *Plutella xylostella* (Plutellidae: Lepidoptera). *South Indian Horticulture*. **58**: 272-274.

Suganthy, M. and Sakthivel, P. 2012. Field efficacy of biopesticides against *Plusia signata* (Fab.) on *Gloriosa superba. Madras Agricultural Journal*. **99**: 368-370.

Suganthy, M. and Sakthivel, P. 2013. Field evaluation of botanicals on pest complex of *Solanum nigrum* Linn. *Madras Agricultural Journal*. **100**: 592-596.

Suganthy, M. and Sakthivel, P. 2014. Field evaluation of biopesticides against tobacco caterpillar, *Spodoptera litura* Fab. infesting *Gloriosa superba.* (Linn.). *Journal of Biopesticides*. **6**: 90-95.

Usha Rani, B. and Kalyanasundaram, M. 2005. Insect pests of senna (*Cassia angustifolia*) and their management. *Indian Journal of Arecanut, Spices and Medicinal Plants.* **8**(1)**: 7-9.**

Varghese, T. S. 2003. Management of thrips, *Scirtothrips dorsalis* Hood and mite, *Polyphagotarsonemus latus* (Banks) on chilli using biorationals and imidacloprid. *M.Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad.

Suganthy

Department of Silviculture and Natural Resource Management, Forest College and Research Institute, Tamil Nadu Agricultural University, Mettupalayam - 641 301, Tamil Nadu, India

***Corresponding author**

E-mail: suganthytnau@gmail.com