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Research Article

STUDIES ON SOME BIO-RATIONAL INSECTICIDES FOR THE MANAGEMENT OF FRUIT BORER (*Spodoptera litura*) IN GREEN CHILLI

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Abstract- Green chilli is one of the most popular vegetable cum spice crop widely cultivated in different parts of West Bengal subject to suffer with lots of biotic stress among which fruit borer (*Spodoptera litura*) is now gaining importance as one of the major constraints in green chilli production. Highly polyphagous and voracious nature makes it difficult to manage efficiently. New generation insecticides have good role regarding managing the crops with less toxicity. To obtain a conclusion about efficacy of some new chemistry (spinosyn, abamectin derivative, diamide) against this pest field experiments were conducted to observe, the efficacy of some bio rational insecticides (spinosad, emamectin benzoate, flubendiamide) for the management of *Spodoptera litura* on chilli during the *rabi* season of 2013 and 2014. Results showed that flubendiamide 20% WG @ 60 g a.i. ha^{-1} were found to be superior over other treatments against *Spodoptera* on chilli, with 95.50% mean reduction after two spraying, lowest fruit infestation (1.07%), 92.43% protection over control and highest marketable fruit yield (18.19 q ha^{-1}). Emamectin benzoate was recorded as next effective insecticide (1.96% fruit infestation by borer and 86.21% protection over control) which is closely followed by flubendiamide @ 50 g a.i. ha^{-1} and spinosad (85.61% and 85.03% protection over control plot).

Keywords- Chilli, Emamectin benzoate, Flubendiamide, *Spodoptera litura*, Spinosad

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Introduction

In human diets vegetable has the top most contribution. Among the solanaceous vegetables green chilli (*Capsicum annum* L.) is one of the imperative vegetable in terms of demand for its nutritive status as a source of vitamins, calories and minerals. Due to having pungency chilli is also considered as important spices crop. Likewise, other crop a potent numbers of insect pest found to attack in chilli. It was recorded that 293 insect and mite pests attack chilli plant starting from nursery to harvest [1], of which though thrips, mites and whitefly is important one, but in recent climate during fruiting stage tobacco caterpillar (*S. litura*) is becoming as one of the major concern as prevalence and build-up of these insect pests of chilli is mostly governed by weather parameters. As reported by Reddy and Reddy [2] due to severe attack of fruit borers lead to 90% flower and fruit drop in chilli. High fecundity, polyphagous nature, quick adaptation against insecticides makes it difficult and rather impossible to control with any single potent toxicant for a long time. Now it develops cross resistance to many insecticides. In the past decade, management of arthropods depended mostly on inexpensive and efficient insecticides. Conventional insecticides such as chlorinated hydrocarbons, organophosphates, carbamates and pyrethroids were successful in controlling insect pests during the past five decades, minimizing thereby losses in agricultural yields. These chemicals are harmful to man and beneficial organisms and cause ecological disturbances. In recent years, the populations of many pests including *S. litura* have developed resistance to many commercially available pesticides [3,4]. ICRISAT reported between 1991 and 1996 revealed the occurrence of resistance to cypermethrin, fenvalerate and quinalphos, by 197-, 121-, 29- and 362-fold, respectively [5]. This has promoted the necessity for the development of new, safer, biodegradable insecticides with known insecticidal alternatives affecting specifically harmful pests, while sparing beneficial insect species and other organisms that could be feasible and effective for insect pest management. Venkateswarlu et al., [6] reported new insecticides have been tested to deal with resistant strains of this month and some promising results are coming forward.

Materials and Methods

Field experiments were under taken for two consecutive years during *rabi* seasons of 2013 and 2014 at C Block Farm of Bidhan Chandra Krishi Viswavidyalaya, Nadia, West-Bengal (22.98^0 N latitude, 88.45^0 E longitude). The whole experiment was laid out in a randomised block design (RBD) with 6 numbers of insecticides and each treatment was four times replicated along with untreated control. Treatments comprises of Flubendiamide 20% WG (trade name: Fem) @ 60 g a.i./ha, Flubendiamide 20% WG @ 50 g a.i./ha, Flubendiamide 20% WG @ 40 g a.i./ha, Spinosad 45% SC (trade name: Spintor) @ 60 g a.i./ha and Emamectin benzoate 5 SG (trade name: Proclaim) @ 11 g a.i./ha along with the untreated control plot [Table-I]. Chilli cultivar '*Bullet*' was grown in plot of size 12 m^2 at spacing of 60 cm. × 60 cm. with recommended package of practices excluding plant protection.

A blanket of application was done for checking of sucking insect pest by acetamiprid 20 SP @ 25 g a.i. ha^{-1}. After population built up the test insecticides were sprayed and thereafter two sprays at fifteen days interval with a high volume knapsack sprayer using 500 litres of spray fluid per hectare. The control plot was sprayed with water only. Observation taken on five (out of 35 plant $plot^{-1}$) randomly selected pre tagged plants per plot, to count the number of *S.litura* at one day before and 3 and 7 days after each insecticide application. The rate of infestation on fruits by *S.litura* was taken into account of each picking.

Results and Discussion

There was no significant difference in the pre-application count of borer population between the treatments as well as control during the experiment, which is ranged from 1.43 to 1.70 per plant. All the treated plots with chemicals were significantly superior in their performance over control plots at 3 and 7 days after application of insecticides. Experimental data of the year 2013 is represented in [Table-I]. The data showed that, on 7 days after spraying, highest percentage of reduction (95.59%) of *S. litura* population was recorded in flubendiamide @ 60 g a.i. ha^{-1} followed by emamectin benzoate (93.95%), spinosad (90.35%), flubendiamide @ 50 g a.i. ha^{-1} (90.20%) and flubendiamide @ 40 g a.i. ha^{-1} (78.53%). It is clear from the Table that there was +40.02% increase of borer population in control plot. Regarding mean reduction of *Spodoptera* population after two sprays, flubendiamide @ 60 g a.i. ha^{-1} recorded maximum reduction of borer population (95.40%), followed by emamectin benzoate (92.49%), flubendiamide @ 50 g a.i. ha^{-1} (88.21%), spinosad (88.10%). Percentage of fruit infested by *S. litura* larvae was also lowest (1.12%) in flubendiamide @ 60 g a.i. ha^{-1}. Maximum marketable fruit yield (18.85 q ha^{-1}) was also recorded in flubendiamide @ 60 g a.i. ha^{-1} treated plot with 92.41% protection over untreated plot [Table-I]. In the year 2014, similar trend was followed as in the case of the previous year in respect to all parameters [Table-II]. Flubendiamide @ 60 g a.i. ha^{-1} was recorded as best effective insecticidal treatment with maximum mean reduction of borer population (95.60%), minimum fruit infestation (1.02%), highest protection over untreated plot (92.44%) and uppermost marketable fruit yield (17.52 q ha^{-1}). Comparing the mean data of two consecutive years [Table-III], highest mean percent reduction of *S. litura* population (95.50%) was recorded in flubendiamide @ 60 g a.i. ha^{-1} closely followed by emamectin benzoate (91.93%), spinosad (88.76%), flubendiamide @ 50 g a.i. ha^{-1} (88.20%) and flubendiamide @ 40 g a.i. ha^{-1} (78.03%) respectively. Flubendiamide @ 60 g a.i. ha^{-1} recorded lowest fruit infestation (1.07%) by *S. litura* larvae with 92.43% protection over control plot, followed by emamectin benzoate, flubendiamide @ 50 g a.i. ha^{-1}, spinosad and flubendiamide @ 40 g a.i. ha^{-1} with 86.21%, 85.61%, 85.03% and 78.94% protection over control respectively. Flubendiamide @ 50 g a.i. ha^{-1}, spinosad were on par in all aspect. A steady increase in the *Spodoptera* population was observed in untreated control plot throughout the experiment (+39.54%). Maximum marketable fruit yield was also in flubendiamide @ 60 g a.i. ha^{-1} treated plot (18.19 q ha^{-1}) as compared to untreated control plot (7.86 q ha^{-1}). Emamectin benzoate and spinosad was also recorded remarkable fruit yield.

Our experimental result is with the agreement of the findings of Tatagar *et al*. [7]. Flubendiamide that belongs to a chemical family of benzenedicarboxamides or phthalic acid diamides with insecticidal activity through the activation of the ryanodine-sensitive intracellular calcium release channels, leading to the cessation of feeding immediately after ingestion of the compound. Flubendiamide shows extremely strong insecticidal activity essentially against lepidopteran pests including resistant strains [8] which is in the line with our findings. Ghosal *et al*. [9] and Masanori *et al*. [10] reported that flubendiamide is highly effective against lepidopteran insects. Emamectin benzoate (4"-deoxy-4"-methylamino derivative of abamectin a 16-membered macrycyclic lactone produced by the fermentation of the soil actinomycete *Streptomyces avermitilis*.), belongs to a new class of insecticide 'avermectins', act as both contact and stomach poison and it is very effective against lepidopteran pest. The molecule interferes with the nervous system of insect and cause paralysis. Firake and Pande [11] reported that Proclaim (E. benzoate) was 60.29 times more toxic than that of endosulfan against *S. litura.* Harish *et al*. [12] reported that emamectin benzoate was the most effective in the reduction of *S. litura* population densities at 3, 7 and 15 days after spraying on soyabean. Spinosad (an extract of the fermentation product of soil actinomycetes, *Saccharopolyspora spinosa*, containing a naturally occurring mixture of spinosyn A and spinosyn D) uniquely combines the efficacy of synthetic products with the benefits of biological insect pest control products. Beneficial effect of spinosad and flubendiamide upon noctuid lepidopteran insect was also reported by Ghosal *et al.* (2012). New molecules such as spinosad and emamectin benzoate have shown promising results against *S. litura* [13]. Chatterjee and Mondal [14] tested a number of new chemicals and their application methods on different vegetable crops in India and South-East Asia against lepidopterous pests and found flubendiamide, spinosad and chlorfenapyr to be the most effective are in the conformity with the findings of the present author.

Table-I *Effect of insecticides on S. litura of chilli and on yield, 2013.*

Treatment	Dose g a.i. ha^{-1}	Pre treatment count (borers $plant^{-1}$)	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable Yield (q ha^{-1})
			3rd	7th				
Flubendiamide 20% WG	60	1.59	95.21 (77.34)	95.59 (77.89)	95.40	1.12	92.41	18.85
Flubendiamide 20% WG	50	1.43	86.21 (68.19)	90.20 (71.76)	88.21	2.29	84.49	16.63
Flubendiamide 20% WG	40	1.60	75.21 (60.13)	78.53 (62.38)	76.87	3.68	75.07	14.42
Spinosad 45% SC	60	1.45	85.84 (67.86)	90.35 (71.95)	88.10	2.45	83.40	16.75
Emamectin benzoate 5 SG	11	1.70	91.02 (72.54)	93.95 (75.82)	92.49	2.33	84.21	17.01
Control	-	1.48	+34.52 (35.97)	+45.52 (42.36)	+40.02	14.76		8.52
SE. m ±	-	-	1.83	1.33	-	0.22	1.78	0.78
CD (0.05)	-	NS	6.31	5.06	-	1.23	6.02	3.02

*Figures in the parenthesis are angular transformed values. **NS- Non significant

Table-II *Effect of insecticides on S. litura of chilli and on yield, 2014.*

Treatment	Dose g a.i. ha^{-1}	Pre treatment count (borers $plant^{-1}$)	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable Yield (q ha^{-1})
			3rd	7th				
Flubendiamide 20% WG	60	1.53	95.01 (77.08)	96.19 (78.76)	95.60	1.02	92.44	17.52
Flubendiamide 20% WG	50	1.43	85.22 (67.37)	91.16 (72.74)	88.19	1.79	86.73	15.26
Flubendiamide 20% WG	40	1.46	76.34 (60.87)	82.03 (64.90)	79.19	2.32	82.80	13.52
Spinosad 45% SC	60	1.55	87.42 (69.21)	91.42 (72.95)	89.42	1.80	86.66	15.77
Emamectin benzoate 5 SG	11	1.39	90.16 (71.76)	92.57 (74.21)	91.37	1.59	88.21	16.28
Control	-	1.38	+36.02 (36.87)	+42.09 (40.98)	+39.06	13.49	-	7.19
SE. m ±	-	-	1.53	1.35	-	0.09	1.28	0.57
CD (0.05)	-	NS	6.03	5.16	-	1.18	3.54	2.88

*Figures in the parenthesis are angular transformed values. **NS- Non significant

Table-III *Effect of insecticides on S. litura of chilli and on yield (Pooled data of two year).*

Treatment	Dose g a.i. ha-1	Pre treatment count (borers plant-1)	% reduction or increase (+) in borers after spray		Mean of % reduction or increase (+) in borers after spray	% fruit infested by borer	% protection over control	Marketable Yield (q ha-1)
			3rd	7th				
Flubendiamide 20% WG	60	1.56	95.11 (77.21)	95.89 (78.32)	95.50	1.07	92.43	18.19
Flubendiamide 20% WG	50	1.43	85.72 (67.78)	90.68 (72.24)	88.20	2.04	85.61	15.95
Flubendiamide 20% WG	40	1.53	75.78 (60.53)	80.28 (63.65)	78.03	3.00	78.94	13.97
Spinosad 45% SC	60	1.50	86.63 (68.53)	90.89 (72.44)	88.76	2.13	85.03	16.26
Emamectin benzoate 5 SG	11	1.55	90.59 (72.15)	93.26 (75.00)	91.93	1.96	86.21	16.65
Control	-	1.43	+35.27 (37.05)	+43.81 (41.44)	+39.54	14.13	-	7.86
SE. m ±	-	-	1.98	2.01	-	0.31	1.35	0.98
CD (0.05)	-	NS	6.21	6.29	-	1.12	3.68	3.54

*Figures in the parenthesis are angular transformed values. **NS- Non significant

Conclusion

The finding of the present author clearly showed that flubendiamide, emamectin benzoate and spinosad were highly effective against *Spodoptera litura* on chilli and thus it can be concluded that flubendiamide @ 60 g a.i. ha^{-1} was excellent insecticide against *Spodoptera* and as the result showed that flubendiamide, emamectin benzoate and spinosad recorded nearly similar level of protection we can consider them as an insecticidal treatment against *Spodoptera.*

Application of research: In this study, insecticides have novel mode of action with quick knock down property and less effect on beneficial organism like bees and natural enemies it can be incorporated in integrated pest management programme of chilli.

Research Category: Plant Protection

Abbreviations:
RBD: randomised block design
WG: Wettable Powder
SC: Soluble Concentrate
SG: Soluble Granular
SP: Soluble Powder

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References

[1] Butani D.K. (1976) *Pesticides*, 10, 38-41.
[2] Reddy M.R.S. and Reddy G.S. (1999) *Insect Environment*, 4, 143-144.
[3] Ramakrishnan N., Saxena V.S. and Dhingra S. (1984) *Pesticides*, 18(9), 23, 27.
[4] Naeem Abbas S., Shad S.A., Muhammad R., Abdul W. and Muhammad A. (2014) *Crop Protection*, 58, 49-54.
[5] Wightman J.A., Dick K.M., Ranga Rao G.V., Shanower T.G., Gold C.S. (1990) In: Singh SR, ed. Insect Pests of Food Legumes. New York, USA: John Wiley & Sons, 243-322.
[6] Venkateswarlu U., Madhumathi T. and Rao P.A. (2005) *Pesticide Research Journal*, 17(1), 33-35.
[7] Tatagar M.H., Mohankumar H.D., Shivaprasad M. and Mesta R.K. (2009) *Karnataka Journal of Agricultural Sciences*, 22(3), 579-581.
[8] Tohnishi M., Nakao H., Furnya T., Seo A., Kodama H., Tsubata K., Fujioka S., Kodama H., Hirooka T. and Nishimastsu T. (2005) *Journal of Pesticide Science,* 30, 354-360.
[9] Ghosal A., Chatterjee M.L. and Manna D. (2012) *Journal of Crop and weed,* 8, 126-129.
[10] Masanori T., Hayami N. and Fujioka S. (2005) *Journal of Pesticide Science,* 30, 354-360.
[11] Firake D.M. and Pande R. (2009) *Current Biotica,* 3, 445-449.
[12] Harish G., Patil R.H. and Giraddi R.S. (2009) *Karnataka Journal of Agricultural Sciences,* 22(4), 914-917.
[13] Gadhiya H.A., Borad P.K. and Bhut J.B. (2014) *The Bioscan*, 9(1), 23-26.
[14] Chatterjee M.L. and Mondal S. (2012) *International Symposium on Sustainable Vegetable Production in Southeast Asia, Salatiga, Indonesia*, 958,147-153.