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Novel Insecticides in Relation to Safety towards Natural Enemies Associated with Tomato Ecosystem

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ABSTRACT

A field experiments was conducted at the Entomology Research Farm, ICAR Research Complex for North Eastern Hill Region, Umiam, Meghalaya to study novel insecticides in relation to safety towards natural enemies associated with tomato ecosystem. The field experiments were laid out in randomized block design with three replications for each treatment. Treatments *viz.,* flubendiamide 48% SC @ 30 g a.i./ ha, indoxacarb 14.5% SC @ 75 g a.i./ha, novaluron 10% SC @ 100 g a.i./ha, novaluron 5.25 % SC+ indoxacarb 4.5 % SC @ 45.94 +39.38 g a.i./ha, cypermethrin 10% EC @ 50 g a.i./ha, *Bacillus thuringiensis* SP @ 2.5 kg /ha, Azadirachtin 300ppm EC @ 1500 ml /ha, *Metarhizium anisopliae* Powder @ 2.5 kg /ha and *Beauveria bassiana* Powder @ 2.5 kg /ha were applied at 45 d after transplanting with the help of a knapsack sprayer using 500 L of spray mass per hectare and repeated after 15 d of first spray. The results revealed that all the treated plots with bio-rational insecticides had more or less higher incidence of the two predators *i.e.,* coccinellids and spiders. Novaluron treated plot showed the highest population of 8.03/ 5 plants of spider and *Bacillus thuringiensis* treated plot showed the highest population of 4.95/5 plants of coccinellids for both the years respectively.

Key Words: Natural enemies, Novel insecticides, Safety,Tomato.

INTRODUCTION

Tomato, *Lycopersicon esculentum* (Miller) is a popular vegetable for its outstanding antioxidant content. It is one of the most important protective foods because of its special nutritive value as the pulp and juice are digestible, mild aperients, promoter of gastric secretion and blood purifier. Meghalaya is known for production of good quality vegetables among north eastern states (Kumar and Badal, 2004). However, the productivity of tomato is low due to several reasons; the main being the damage caused by insect pests and diseases. Tomato is more prone to insect pests and diseases mainly due to its tenderness and softness as compared to other crops. It is devastated by an array of pests like jassids, aphids, tobacco caterpillar, leaf miner, flea beetles, spider, mites, and fruit borer (Katroju *et al*, 2014). Among these insest pests, fruit borer cause considerable damage to the crop. Tomato fruit borer, *Helicoverpa armigera* Hübner is a polyphagous pest with host range of over 360 plant species including cultivated crops of economic importance (Duraimurugan and Regupathy, 2005). It alone causes the loss in tomato yield to the tune of 50 to 80 per cent (Tewari and Krishnamoorthy, 1984). The extent of damage to crop and the consequent loss in yield due to this pest vary considerably amongst crops, regions and locations, and seasons (Wakil *et al*, 2010).

To control the insect pests and to save the crop, pesticides are being used in large quantities. The over dependence and indiscriminate use of chemical pesticides has resulted in several problems like development of resistance to pesticides, outbreak of secondary pest, reduction of natural enemies of insect pests. Pesticides may have sub-lethal effects,

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including changes in natural enemy distribution within the crop (Borgemeister *et al*, 1993), decreased fecundity (Umoru and Powell,

2002) and changes in host searching (Rafalimanana *et al*, 2002) or mating behavior. As chemical control is inevitable for adequate food production and without its application, complete protection is almost impossible, therefore, it was necessary to screen out the pesticides having new and novel mode of action, safer towards non-target organisms, easily biodegradable and less persistency as well as compatible with IPM programme.

MATERIALS AND METHODS:

Test insecticides

Flubendiamide 39.35 per cent SC, indoxacarb 14.5 per cent SC , novaluron 10 per cent SC , novaluron 5.25 per cent SC + indoxacarb 4.5 per cent SC (Plethora) cypermethrin 10 per cent EC *Bacillus thuringiensis* (Lipel SP, Agrilife), azadiracthin 300 ppm EC (Multineem, Multiplex Agricare Pvt. Ltd.), *Metarhizium anisopliae* (Pacer, Agrilife), and *Beauveria bassiana* (Racer, Agrilife) were purchased locally.

Field experiments

The field experiments were conducted at the Entomology Research Farm, ICAR Research Complex for NEH Region, Umiam, Meghalaya to study novel insecticides in relation to safety towards natural enemies associated with tomato ecosystem. Experiments were laid out in randomized block design (RBD) with ten treatments and three replications. Tomato (variety: Rocky) seedlings (30 d old) were transplanted in plot size of 4 × 3m with spacing of 50 × 40cm (R-R X P-P) during the two consecutive years.

Treatments

Treatments *viz.,* flubendiamide 48% SC @ 30 g a.i./ha, indoxacarb 14.5% SC @ 75 g a.i./ ha, novaluron 10% SC @ 100 g a.i./ha, novaluron 5.25 per cent SC+ indoxacarb 4.5 per cent SC @ 45.94 +39.38 g a.i./ha, cypermethrin 10% EC @ 50 g a.i./ha, *Bacillus thuringiensis* SP @ 2.5 kg/ ha, azadirachtin 300ppm EC @ 1500 ml/ha, *Metarhizium anisopliae* Powder @ 2.5 kg/ha and *Beauveria bassiana* Powder @ 2.5 kg/ha were applied at 45 d after transplanting with the help of a knapsack sprayer using 500 L of spray mass per hectare and repeated after 15 d of first spray.

Observations

Natural enemies associated with tomato ecosystem such as different species of coccinellid beetles, spiders etc. were recorded 1 day before spraying of insecticides and 3, 7 and 14 d after each spray.

RESULT AND DISCUSSION

The experiment during 2015 (Table 1) revealed that all the treated plots with bio-rational insecticides had more or less higher incidence of all the two predators i.e. coccinellids and spiders. These results were in agreement with the findings of Zehnder *et al*, (2007) who reported that the synthetic insecticides kills non targeted species of beneficial insects including (predators, parasite and parasitoids) while the bio pesticides have no effect on the beneficial insects. The mean of both the sprays revealed that novaluron treated plot showed the highest population of 8.03/ 5 plants of spider and *B.thuringiensis* treated plot showed the highest population of 4.95/5 plants of coccinellids. This was similar with the findings of Dhaka *et al*, (2010), who reported that highest number of predatory coccinellids was recorded in control plots and this number was recorded to be comparable with *Bt* and novaluron treated plots. Flubendiamide, plethora, *M. anisopliae*, indoxacarb, *B. bassiana* and azadirachtin treated plot were found to be safe but less protective, while cypermethrin recorded to be moderately toxic against these natural enemies. This finding was in conformity with Abdullah *et al*, (2001) who work on effects of various insecticides on number of *Menochilus sexmaculatus* and spider and they observed that cypermethrin treated plot showed less number of *Menochilus sexmaculatus*

Table 1. Effect of different pesticides and bio-pesticides on non-target organism (2015) (Mean of two sprays).

Treatment	Dose ml/ L	Spider population per 5 plants				Coccinellid population per 5 plants			
		3	7	14	Mean	3	7	14	Mean
Flubendiamide 48 SC	0.3	7.55 (2.83)	8.25 (2.95)	7.00 (2.73)	7.60	4.75 (2.29)	4.25 (2.17)	4.00 (2.12)	4.33
Indoxacarb 14.5 SC	1	6.30 (2.6)	7.00 (2.73)	8.25 (2.95)	7.18	3.60 (2.02)	4.00 (2.12)	2.75 (1.8)	3.45
Novaluron 10 SC	0.75	8.00 (2.91)	9.35 (3.13)	6.75 (2.69)	8.03	5.00 (2.34)	4.50 (2.23)	3.75 (2.06)	4.41
Novaluron + Indoxacarb	2	7.75 (2.87)	6.20 (2.58)	8.25 (2.95)	7.4	4.25 (2.17)	3.60 (2.02)	3.75 (2.06)	3.86
Azadirachtin	3	5.50 (2.44)	7.30 (2.79)	7.00 (2.73)	6.60	4.00 (2.12)	3.25 (1.93)	3.00 (1.87)	3.41
Bacillus thuringiensis	2	8.40 (2.98)	7.65 (84.05)	7.25 (2.78)	7.76	5.25 (2.39)	4.60 (2.25)	5.00 (2.34)	4.95
Metarhizium anisopliae	3	6.20 (2.58)	7.00 (2.73)	8.25 (2.95)	7.15	4.70 (2.28)	4.25 (2.17)	5.25 (2.39)	4.73
Beauveria bassiana	3	7.55 (2.83)	8.40 (2.98)	7.25 (2.78)	7.73	3.75 (2.06)	4.20 (2.16)	4.60 (2.25)	4.18
Cypermethrin 10 EC	1	6.25 (2.59)	6.00 (2.54)	5.60 (2.46)	5.95	2.00 (1.58)	1.75 (0.70)	2.25 (1.65)	2.00
Control	-	7.50 (2.82)	7.00 (2.73)	8.00 (2.91)	7.5	4.50 (2.23)	4.00 (2.12)	5.75 (2.5)	4.75
SE. m ±		0.55	0.74	0.88		0.68	0.58	0.72	
P= (0.05)		1.66	2.24	2.66		2.06	1.75	2.18	

Figures in parentheses are square root (√x+0.5) transformed value

and spider. There was no much difference in density of the predators in treated plots and untreated control plots.

Similar trends of population recorded during 2016 (Table 2) showed the effect of insecticides on natural enemies used in the field experiment for the management of major pest of tomato. It was evident from the data that all the tested insecticides especially flubendiamide, *B. thuringiensis*, *B. bassiana*, plethora, indoxacarb, *M. anisopliae,* azadirachtin and novaluron were comparatively safer to natural enemies – spider, coccinellids;

Table 2. Effect of different pesticides and bio-pesticides on non-target organism (2016) (Mean of two sprays).

Treatment	Dose ml/ L	Spider population per 5 plants				Coccinellid population per 5 plants			
		3	7	14	Mean	3	7	14	Mean
Flubendiamide 48 SC	0.3	11.25 (3.42)	10.60 (3.33)	9.75 (3.20)	10.53	5.25 (2.39)	5.00 (2.34)	6.40 (2.62)	5.55
Indoxacarb 14.5 SC	1	10.25 (3.27)	9.40 (3.14)	10.75 (3.35)	10.13	4.80 (2.30)	4.00 (2.12)	5.20 (2.38)	4.66
Novaluron 10 SC	0.75	11.70 (3.49)	11.00 (3.39)	10.30 (3.28)	11.00	5.40 (2.42)	5.00 (2.34)	6.25 (2.59)	5.55
Novaluron + Indox-acarb	2	9.60 (3.17)	9.00 (3.08)	10.25 (3.27)	9.61	4.75 (2.29)	5.10 (2.36)	5.00 (2.34)	4.95
Azadirachtin	3	8.75 (3.04)	9.40 (3.14)	9.00 (3.08)	9.05	4.00 (2.12)	4.75 (2.29)	4.75 (2.29)	4.5
Bacillus thuringien-sis	2	10.50 (3.31)	9.80 (3.20)	10.75 (3.35)	10.35	5.60 (2.46)	6.70 (2.68)	6.85 (2.71)	6.38
Metarrhizium aniso-pliae	3	11.00 (3.39)	9.25 (3.12)	10.50 (3.31)	10.25	4.60 (2.25)	5.80 (2.50)	6.75 (2.69)	5.71
Beauveria bassiana	3	9.25 (3.12)	10.60 (3.33)	10.25 (3.27)	10.03	4.85 (2.31)	5.70 (2.48)	6.25 (2.59)	5.60
Cypermethrin 10 EC	1	8.25 (2.95)	8.00 (2.9)	9.25 (3.12)	8.50	4.00 (2.12)	3.25 (1.93)	4.70 (2.28)	3.98
Control	-	10.60 (3.47)	11.40 (3.44)	11.00 (3.39)	11.00	5.60 (2.46)	6.75 (2.69)	6.80 (2.70)	6.38
SE. m ±		0.82	0.79	0.95		0.72	0.63	0.86	
CD at 5%		2.48	2.39	2.87		2.18	1.90	2.60	

Figures in parentheses are square root (√x+0.5) transformed value

except cypermethrin which has moderate toxicity on these associated natural enemies. This was similar to the findings of Tohnishi *et al*, (2005) who reported that flubendiamide shows safety to non-target organisms. Abdullah *et al*, (2001) also reported that neem extract and *B. thuringiensis* treated plot showed higher number of coccinellids and spiders in both seasons.

The plots treated with bio-rational insecticides had more or less higher incidence of all the two predators *i.e.* coccinellids and spiders. Novaluron treated plot showed the highest population of spider and *B. thuringiensis* treated plot showed the highest population of coccinellids.

CONCLUSION

It may be concluded that all the tested novel insecticides especially flubendiamide, *B. thuringiensis*, *B. bassiana*, plethora, indoxacarb, *M.anisopliae,* azadirachtin and novaluron were comparatively safer to natural enemies – spider and coccinellids and quickly degraded to non toxic products and have potential use in Integrated Pest Management systems in North Eastern hill region.

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