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Research Article

Efficacy of bio- and synthetic pesticides to *Lipaphis erysimi* Kalt. and its predator, *Ischiodon scutellaris* (Fabricius) in broccoli ecosystem

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ABSTRACT: Field experiment conducted to evaluate the toxicity of bio and synthetic pesticides to *Lipaphis erysimi* Kalt. and its predator, *Ischiodon scutellaris* (Fabricius) in broccoli crop at the experimental farm, ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram, India showed that application of synthetic pesticides recorded 100% reduction in the *L. erysimi* population. Synthetic pesticides were highly toxic to *I. scutellaris* and resulted in 100% mortality. Imidacloprid 17.8% SL was less toxic to *I. scutellaris* when compared to other synthetic pesticides. Neem oil formulations were effective against *L. erysimi* and did not have any detrimental effect on the maggots of *I. scutellaris*.

KEY WORDS: *Lipaphis erysimi*, *Ischiodon scutellaris*, biopesticides, synthetic pesticides, safety, toxicity

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INTRODUCTION

Broccoli, *Brassica oleracea* cv. *italica* is high in vitamin C, as well as dietary fiber; it also contains multiple nutrients with potent anti-cancer properties, such as di-indolylmethane, a potent modulator of the innate immune response system with anti-viral, anti-bacterial and anti-cancer activity. Broccoli is also an excellent source of indole-3-carbinol, a chemical which boosts DNA repair in cells and appears to block the growth of cancer cells.

Broccoli has been ravaged by more than 25 different insect pest species. Among them mustard aphid, *Lipaphis erysimi* Kalt. is the most dominant and destructive pest (Singh and Sachan, 1997). Nine species of syrphid flies actively preying on *L. erysimi* (Singh and Rohilla, 1997) were completely exterminated by the use of synthetic agrochemicals (Toda and Kashio, 1997). Synthetic insecticides were often harmful to the natural enemies and are a major antagonist factor for the conservation of natural enemies. The present study was undertaken to assess the bioefficacy of biological and synthetic pesticides against *L. erysimi* and their safety to the maggots of *Ischiodon scutellaris* (Fabricius) (Diptera: Syrphidae) in broccoli ecosystem.

MATERIALS AND METHODS

Field experiment was conducted at the experimental farm, ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, Mizoram, India during 2008-2009 to study the bioefficacy of biological and synthetic pesticides against *L. erysimi* and their safety to the maggots of *I. scutellaris*. The experiment was laid out in randomized block design with three replications.

Thirty days old broccoli seedlings *var.* Pushpa were transplanted with spacing of 60 x 45 cm in plot size of 20 m^2. FYM @ 20 tonnes and NPK fertilizers 100:60:80 kg per ha were applied. All the recommended agronomic practices, except insectide treatments were followed as per the package of practices.

All the insecticides were applied using high volume knapsack sprayer and the population of *L. erysimi* and its predator, *I. scutellaris* were recorded before spraying and 1, 3, 7 and 15 days after treatment (DAT) on five randomly selected and tagged plants per plot. The data collected were subjected to ANOVA using AGRES software.

RESULTS AND DISCUSSION

Bioefficacy of synthetic and biopesticides against *L. erysimi*

The results of the field experiment revealed that all synthetic insecticides were effective against the aphid, *L. erysimi* and recorded 100% reduction in population (Table 1). Among biopesticides tested, neem oil 1.0% EC

Table 1. Efficacy of biopesticides and insecticides against *Lipaphis erysimi*

Trt. No.	Treatment	Dose (per ha)	Before Spray	Mean number of *L. erysimi* per plant				Mean
				1 DAS	4 DAS	7 DAS	15 DAS	
T_1	Neem oil 0.03% EC	2000ml	251	85.00 (9.22)	1.00 (1.00)	0.00 (0.00)	0.00 (0.00)	21.50
T_2	Neem oil 0.3% EC	1000ml	47	2.00 (1.41)	4.00 (2.00)	0.00 (0.00)	0.00 (0.00)	1.50
T_3	Neem oil 1% EC	1000ml	39	21.00 (4.58)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	5.25
T_4	Dipel (*Bt*)	1000g	155	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_5	Endosulfan 35% EC	175ml a.i.	97	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_6	Malathion 50% EC	575ml	149	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_7	Monocrotophos 36% SL	625ml	360	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_8	Chlorpyriphos 20% EC	250ml a.i.	83	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_9	Dichlorvos 76% EC	500ml	189	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{10}	Phosphamidon 40% SL	500ml	157	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{11}	Dimethoate 30% EC	200ml a.i.	416	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{12}	Corbofuron 10% G	3000g	354	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{13}	Cypermethrin 5% EC	20ml a.i.	110	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{14}	Fenvalerate 20% EC	100ml	115	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{15}	Permethrin 25% EC	100ml	105	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{16}	Deltamethrin 2.8% EC	10ml a.i.	126	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{17}	Imidacloprid 17.8% SL	25ml a.i.	164	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{18}	Chlorpyriphos 50% EC + Cypermethrin 5% EC	500ml	436	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T_{19}	Untreated control		252	208.00 (14.42)	339.00 (18.41)	384.00 (19.60)	593.00 (24.35)	381.00
	Mean		189.74	16.63	18.11	20.21	31.21	21.54
	SEm±			7.624	4.340	1.833	1.833	
	CD $P \leq 0.01$			22.099	12.580	5.314	5.314	

Figures in parentheses are square root transformed values. DAS: Day after spray

and 0.3% EC recorded significantly least population of *L. erysimi* (1.50 aphids per plant), whereas control plot recorded maximum population of aphids (381.00 aphids per plant) (Table 1).

The present investigation confirmed that neonicotinoids and other conventional insecticides could be highly effective and specific in their action against sucking pests and other insect pests (Vastrad, 2003). Spray of acetamiprid (0.02%) was earlier, proved effective against *L. erysimi* by Chinnabbai *et al*. (1999). Baral and Sethi (2001) reported that the application of chlorpyriphos (0.05%) or phosphamidon (0.04%) was proved effective against *L. erysimi*. Kular and Naveen Aggarwal (2008) reported that application of rogor and metasystox recorded more than 70% mortality in *L. erysimi*. Spray of 3% neem seed kernel extract (NSKE) was also effective in reducing the aphids population (Patel *et al*., 1996).

Safety of bio- and synthetic pesticides to *I. scutellaris*

Synthetic pesticides *viz*., chlorpyriphos 20% EC, phosphamidon 40% SL, carbofuron 10% G, permethrin 25% EC and deltamethrin 2.8% EC were found to be highly toxic to the maggots of *I. scutellaris* which recorded zero per cent survival of maggots, while, imidacloprid 17.8% SL recorded maximum population (0.88 maggots per plant) among the synthetic pesticides (Table 2). Different biopesticides were safe on the maggots of *I. scutellaris* and on par with control treatment (5.75 maggots per plant) and neem oil 0.3% EC application recorded maximum population (5.63 maggots per plant).

The synthetic pesticides which are presently used for the control of *L. erysimi* are highly toxic to the maggots of *I. scutellaris,* which will adversely affect the field population of the *I. scutellaris* resulting in increase of *L. erysimi* population. Toda and Kashio (1997) reported that most of the organophosphate insecticides tested against *Chrysoperla carnea* (Stephens) showed higher levels of toxicity. Chlorpyriphos and fluvalinate were harmful to adults of *Leptomastix dactylopii* (How.) and inhibited their emergence, when applied to pupae (Mani and Krishnamoorthy, 1991; Yigit *et al*., 1992). Among the insecticides tested, imidacloprid 17.8% SL and endosulfan 35% EC were less toxic as compared to other insecticides. Balikai and Lingappa (2004) reported that endosulfan was less toxic to the maggots of syrphids. The commercial neem formulations and dipel are not detrimental to the maggots of *I. scutellaris* and they can safely be integrated with the biocontrol of *L. erysimi*. Neem extracts are most suitable in insect pest management because, the compounds obtained from it are not hazardous to warm blooded animals and biocontrol agents and are in perfect harmony with environment (Raguraman, 2006 and 2007). Being easily biodegradable with low toxicity to mammals and bioagents, the bio pesticides have a great future for the management of insect pests with least chances of inducing resistance in insects and offer immense scope in integrated pest management.

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Table 2. Safety of biopesticides and insecticides against maggots of *Ischiodon scutellaris*

Trt No.	Treatment	Before Spray	Mean number of maggots of *I. scutellaris* per plant				Mean
			1 DAS	4 DAS	7 DAS	15 DAS	
T1	Neem oil 0.03% EC	7.50	5.00 (2.24)	5.50 (2.35)	4.50 (2.12)	2.50 (1.58)	4.38
T2	Neem oil 0.3% EC	24.50	12.00 (3.46)	9.00 (3.00)	1.00 (1.00)	0.50 (0.71)	5.63
T3	Neem oil 1% EC	15.00	10.00 (3.16)	1.50 (1.22)	1.50 (1.22)	0.50 (0.71)	3.38
T4	Dipel (Bt)	22.50	10.00 (3.16)	5.00 (2.24)	1.00 (1.00)	4.00 (2.00)	4.75
T5	Endosulfan 35% EC	11.50	2.00 (1.41)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.50
T6	Malathion 50% EC	22.00	0.50 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T7	Monocrotophos 36% SL	9.50	0.00 (0.00)	0.50 (0.71)	0.00 (0.00)	0.00 (0.00)	0.13
T8	Chlorpyriphos 20% EC	15.50	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T9	Dichlorvos 76% EC	4.00	0.50 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T10	Phosphamidon 40% SL	3.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T11	Dimethoate 30% EC	3.50	0.50 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T12	Corbofuron 10% G	10.50	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T13	Cypermethrin 5% EC	15.50	0.00 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T14	Fenvalerate 20% EC	8.00	0.00 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T15	Permethrin 25% EC	4.50	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T16	Deltamethrin 2.8% EC	3.00	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00
T17	Imidacloprid 17.8% SL	8.00	0.00 (1.87)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.88
T18	Chlorpyriphos 50% EC + Cypermethrin 5% EC	8.50	0.00 (0.71)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.13
T19	Control	19.00	10.00 (3.16)	6.50 (2.55)	3.50 (1.87)	3.00 (1.73)	5.75
	Mean	11.342	2.921	1.474	0.605	0.553	1.378
	SEm±		1.8694	0.7906	0.7566	1.3074	
	CD ($P \leq 0.05$)		3.9132	1.6549	1.5837	2.7367	

Figures in parentheses are square root transformed values. DAS: Days after spray

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