Bio-safety evaluation of some microbial insecticides against spiders and coccinellids

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ABSTRACT

Bio-safety of some microbial insecticides *viz.*, *Bacillus thuriengiensis* var kurstaki (*B.t.k.*- 55000 S.U./mg (Halt) and *B.t.k.*- 32000 I.U. /mg (Biolep), Vertimec (Avermectin-1.8% w/v) and a bassina (*Beauvaria bassiana*-1 x 10^7 spore / ml) were studied against *Menochilus Micraspis, Harmonia* sp., and spiders (*Lycosa, Oxeopes and Argeope* sp.) under field conditions. The avermectin was highly toxic to spider reducing 42.65% population within three days after application and 41.51% of coccinellids after seven days of spraying. Adverse effect of *B.t.k.*- 32000 I.U./mg was more pronounced than *B.t.k.*- 55000 S.U./mg both at 1000 ppm against coccinellid beetles decreasing 40.28 and 36.08% in occurrence on 7 DAS respectively. Whereas, a reverse order of toxicity was found against spiders affecting 33.04 and 29.74% decrement in existence on 3 DAS. *Beauvaria bassiana* exerted its effect after a certain lag period and reduced the incidence of coccinellid (33.57%) and spider populations (21.01%) on 14 days after spraying.

Key words: Bio-safety, microbial insecticides, natural predator.

INTRODUCTION

Raising consciousness to reduce pesticidal load in the environment and increasing demand for organic food, accentuates to undertake bio-intensive strategies for pest management. The most important component of such approach is the biological suppression of insect-pest by employing pathogens like bacteria, virus, and fungus. These microbials tend to be highly selective and established as an alternative to eco-destabilizing chemical insecticides especially against lepidopteran pests (Jeyanthi and Padmavathamma, 1997; Chatterjee, 2006). However, like conventional pesticides these biocides also may get contaminated in the vicinity area and nearby aquatic ecosystem of sprayed field. It is therefore very essential to select such microbials that are very selective in their action as well as safer to different beneficial natural predatory fauna as different coccinellid and spider species have immense potential to contain many insect-pests (Soni *et al*., 2004). The main limiting factor in large scale use of *Btk*. and avermectin is their high toxicity to beneficial insect like silk worm *Bombyx mori* L. (Chatterjee and Choudhury, 2003) and other non-target species (Chatterjee, 2005). In view of this, adverse effects of some commercial biological insecticides were investigated under field condition against two important species (coccinellid beetle and spider) of natural enemies.

MATERIALS AND METHODS

To study the bio-safety of microbials against two natural enemies, coccinellid beetles such as *Menochilus sexmaculatus*, *Micraspis* sp and *Harmonia octomaculata* and spiders such as wolf spider, *Lycosa psedudoan nulata*; Lynx spider, *Oxyopes* spp and a web forming spider, *Argiope* species were considered as they were very effective as well as frequently found in all agro-ecosystems. The experiment was conducted simultane ously in cabbage field with 5 treatments. Tested microbials were *Btk*.- 55000 S.U. / mg (Halt), *Btk*.- 32000 I.U. / mg (Biolep), Avermectin-1.8% w/v (Vertimec) and *Beauvaria bassiana*- 1x10^7 spore / ml (Bassina) (Biostadt Agri Sciences, Wockhardt ; Biotech International Ltd, New Delhi) and Novartis (Mumbai and Agro Evo India Ltd, Mumbai), respectively.

Spraying was done when moderate populations of the two predators were noticed, this was synchronized with the infestation of cabbage aphid, cabbage lopper, cabbage butterfly and diamond back moth. Pre-count observation based on actual number present in ten plants / plot at one day before spraying and subsequent post count data on 3, 7 and 14 days after spraying (DAS) were recorded, 3 species each of coccinellids and spiders taken together and considered as coccinelid and spider predator respectively. Data thus obtained were subjected to two factors RCBD analysis.

RESULTS AND DISCUSSION

Coccinellids

All the microbials evaluated under the present investigation were found toxic to cocconellid beetles such as *Menochilus* sp, *Micraspis* sp. and *Harmonia* sp.

Table 1. Safety evaluation of some microbials against coccinellid beetles in field condition

Treatments (dose)	Percentage reduction of coccinellid population after spraying				
	Pre-count (No./plant)	3 DAS	7 DAS	14 DAS	Overall reduction
Btk (55,000 SU mg^{-1}) (0.1%)	3.13	26.77*(30.82)**	36.08(36.90)	23.54(26.86)	28.80(31.53)
Btk (32,000 IU mg^{-1}) (0.1%)	3.23	33.42(35.21)	40.28(39.37)	30.16(33.20)	34.62(35.93)
Avermectin (1.8% w/v) (0.1%)	3.36	37.41(37.68)	41.51(40.10)	32.42(34.70)	37.11(37.49)
B. bassiana (1 x 10^{7} sp/ml) (0.2%)	3.33	10.13(35.37)	33.13(35.11)	33.57(35.37)	25.61(29.65)
Control (water spraying)	3.20	1.49(3.85)	7.79(13.25)	6.37(9.61)	5.22(8.90)
Mean		21.84(25.71)	31.85(33.00)	25.12(27.90)	
Source of variation	Treatment (T)	Days (D)	T x D		
S.Em (±)	2.56	1.98	4.43		
CD at 5%	7.41	5.73	NS		

** Data in the parenthesis are angular transformed value.

although there was variation in toxicity among the treatments. Results from table.1, showed that the four microbials differ among themselves significantly with respect to their toxicity. Avermectin was found most toxic to coccinellid beetle causing 37.11% overall reduction in beetle population followed by *Btk*-32000 IU/mg (34.62%), *Btk*-55000 SU/mg (28.8%) and *B. bassiana* (25.61%). Regarding persistent toxicity, the maximum reduction of coccinellid population was observed on 7 days after spraying where 41.51, 40.28, 36.08 and 33.13 % reduction was recorded in avermectin, *Btk*-32000 IU/mg, *Btk*-55000 SU/mg and bassina respectively. A similar trend of effect was noticed on14 days after spraying. Decrement in appearance of coccinellid beetles may also attributed to the mortality of their prey populations immediately after application of biopesticides as observed on 3 DAS. While, the percentage of reduction with respect to control plot were recorded as avermectin (36.57%) > Btk-32000 IU / mg (35.23%) > Btk-55000 SU / mg (30.68%) on 7 DAS whereas, *Beauvaria bassiana* exerted a maximum of 28.58% mortality of coccinellids sometime latter on 14 DAS. Moreover, there existed a significant difference among the three dates of observations, but the interaction between treatments and days after spraying was found insignificant. The trends of present investigation is very similar to the contention made by Zuo *et al.* (1994) where *B.t.* found to suppress the population of ladybird beetles and chrysopids after 3-7 days. But not in agreement with that of Olszak (1986) and Jayanthi and Padmavathamma. (1996) where safety of *Bt* against coccinellid predators were established.

Spiders

It is evident from the Table 2, that none of the biopesticides were found safe against three species of spider viz; *Lycosa*

Table 2. Safety evaluation of some microbials against spider species under field condition

Treatments (dose)	Percentage reduction of spider population after spraying				
	Pre-count (No./plant)	3 DAS	7 DAS	14 DAS	Overall reduction
Btk (55,000 SU mg^{-1}) (0.1%)	2.13	33.04(35.08)	29.74(33.04)	21.46(27.55)	28.08(31.89)
Btk (32,000 IU mg^{-1}) (0.1%)	2.03	29.74(33.05)	20.47(26.83)	16.12(23.57)	22.11(27.82)
Avermectin (1.8% w/v) (0.1%)	1.93	42.65(40.77)	37.2837.61)	23.41(28.85)	34.45(35.74)
B. bassiana (1 x 10^{7} sp/ml) (0.2%)	1.77	13.49(20.50)	12.16(20.23)	21.01(26.84)	15.55(22.53)
Control (water spraying)	1.83	5.50(13.55)	1.51(8.32)	14.52(22.15)	7.18(14.67)
Mean		24.88(27.86)	20.23(25.21)	19.30 (24..92)	
Source of variation	Treatment (T)	Days (D)	T x D		
S.Em (±)	2.11	1.63	3.66		
CD at 5%	6.12	4.72	NS		

** Data in the parenthesis are angular transformed value.

psedudoannulata; *Oxyopes;* and *Argiope*. The simple effect of different microbials and different exposure period was found significant however, their interaction was not statistically justified. Among the microbials avermectin again emerged as the most toxic compound to spider species reducing 34.45% population. The next order of toxicity was found as *Btk*-55000 SU/mg (28.08%)> *Btk*-32000 IU/mg (22.11%)> *B. bassiana* (15.15%). Maximum reduction of spider population was noticed after 3 days of spraying suggests that there was a direct effect of microbials on spider population rather than indirect effect by eliminating host species as observed in case of coccinellid beetles. When the effect was compared with the control plot it was noticed that 39.31% reduction in spider population was due to avermectin followed by 29.14% and 25.56% in *Btk*-55000 SU/mg and *Btk*-32000 IU/mg respectively on 3 DAS, whereas the fungus affected 10.81% reduction on 14 DAS. However, the population gradually increased afterwards and analogous pattern of decreasing toxicity were also recorded for the test microbials. The results are in accordance with the findings of Ghosh (1999) where avermectin and *B.t.*k. showed 38.16% and 27.97% reduction in spider population respectively.

So it can be concluded that though avermectin was considered as most potent microbial toxin towards lepidopteran pests and proved to be safer against non-target arthropods (Lasota and Dybas, 1991), the above discussion establishes that it is highly toxic to natural predatory fauna even at very low doses, and might be restricted its use in large scale.

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