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Studies on Damage Potential and Integration of Some IPM Components Against Scutellerid Bug Infesting Jatropha in Eastern Uttar Pradesh of India

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Abstract: The present study was undertaken with aim to provide sustainable management of Scutellerid bugs by some IPM components due to major pest of Jatropha through out the world. The field experiments were carried out on *Jatropha curcas* L. plantation already made at Rajiv Gandhi South Campus, Barkachha, Mirzapur to evaluate damage potential and efficacy of some IPM components against scutellerid bug infesting Jatropha during 2009 and 2010. The experiment on the damage potential of *Scutellera nobilis* showed an increase in damage with increasing population. Two bugs/plants did not cause significant damage, while 20 bugs per pants resulted in more significant damage than previous one. Two foliar sprays given at monthly interval revealed that lambda-cyhalothrin 5 EC at 25 g a.i. ha^{-1} and imidacloprid 17.8 SL 100 mL ha^{-1} were most effective treatments followed by carbosulfan 25 EC at 250 g a.i. ha^{-1} and monocrotophos 36 SL at 500 g a.i. ha^{-1}. Next effective treatments were spinosad, endosulfan, *Beauveria bassiana*, *Metarhizium anisopliae* resulted in moderately reduction in pest population. All Insecticides showed maximum reduction of bug population during 3rd days after treatments in both sprays, whereas in case of botanical and bioagents maximum reduction was noticed during 7th days after treatments in both sprays. Chlorpyriphos 50 EC at 250 g a.i. ha^{-1} and neem oil (2%) were found least effective and exhibited minimum reduction in bug population as compared to other IPM components.

Key words: Damage, scutellerid bug, synthetic, bio-rational insecticides, bio-efficacy, Jatropha

INTRODUCTION

Jatropha curcas L. a genus of Euphorbiaceae is a native of Mexico and tropical America but Naturalized now throughout the world. Jatropha, fuel of the future is reported to be cultivated in Central and Western parts of India and also Southern states. By blending Jatropha oil based biofuel as an extender with diesel at a ratio of 1:5, the country can save annually Rs. 17,000 crores in foreign exchange. Globally more than 40 species of insects affecting Jatropha have been reported. A global list of phytophagous insects consisting of 60 species in 21 families and four orders has been compiled in Australia, where it is considered as a weed. Particularly noteworthy is the insect order Heteroptera that has at least

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15 species in Nicaragua, which can extract nutrients from physic nut (Manoharan *et al*., 2006). A global list of phytophagous insects consisting of 60 species in 21 families and four orders has been compiled in Australia, where it is considered as a weed (Manoharan *et al*., 2006). Serious damage by *Nephopteryx* larvae was observed at Pusa and Mandalay (Hampson, 1912). Manoharan *et al*. (2006) recorded more than dozen pests occurring in Jatropha (Devi *et al*., 2008) reported that the two insect pests that are emerging as a major problem in Jatropha cultivation are the scutellarid bug *Scutellera nobilis* Fabr. that causes flower fall, fruit abortion and malformation of seeds and *Pempelia morosalis* that causes webbing of inflorescence and capsule damage.

Scutellarid bug, *Chrysocoris purpureus* was recorded in North Western provinces, Sikkim, Calcutta, Assam and several parts of South India including Pondicherry (Kershaw and Kirkaldy, 1908). Several different species of true bugs have been found to feed on *Jatropha curcas* (Grimm and Maes, 1997). In India, the production is also hampered by a few hemipteran insect pests, of which scutellerid bugs, *Scutellera nobilis* (Fabricius) and *Chrysocoris purpureus* (Westw.) (Shanker and Dhyani, 2006) are found to be very serious. Hence, present investigation was undertaken to find out damage potential of Scutellerid bugs and their management by some IPM components.

MATERIALS AND METHODS

The present investigation was carried out on about 300 ha Jatropha plantation already made at Rajiv Gandhi South Campus, Barkachha, Mirzapur, Uttar Pradesh, India during April 2009 to May 2010.

Determination of Damage Potential

The damage potential of bug *S. nobilis* was assessed by confining a known number of nymphs on the green pods in the potted plants. Scutellerid nymphs prestarved for 4 h were released at the rate of 2, 3, 5, 9, 12, 15 and 20 per bunch in plant itself and covered with perforated polythene bags to confine the insects. Green pods of similar size were selected in the same plant and covered with perforated polythene bags, which served as control. The treatments were replicated five times. The damage was assessed on seventh and fourteenth day after the release of the bugs and the loss over control was computed by taking final weight of damaged pods.

Evaluation of IPM Components Against Scutellerid Bug

The insecticidal trials were laid out in randomized block design with three replications, each in 12 ×6.5 m plots keeping 2 m row to row and 1.5 m plant to plant distance. Five plants were selected at random and tagged in each plot for determination of bio-efficacy of some IPM components against scutellerid bugs. All the agronomical practices were followed to raise the crop. There were thirteen treatments and the treatments consist of endosulfan 35 EC, cholpyriphos 50 EC, Monocrotophos 36 SL, profenophos 50 EC, spinosad 45% SC, Lambda-cyhalothrin 5 EC, indoxycarb 14.5% SC, carbosulfan 25 EC, imidacloprid 17.8 SL, neem oil, *Beauveria bassiana*, *Metarhizium anisopliae* and untreated control (water spray). The first insecticidal application was initiated when the population of *S. nobilis* reached at below Economic Injury Level (EIL) and repeated the second insecticidal spray at 30 days after first spray. In both the insecticidal sprays pre-spray count of scutellerid/plant was also taken. The percent reduction over control was recorded for each treatment. Five plants were selected at random and tagged in each plot for counting the bug population and weekly observations were recorded on the entire tagged plant throughout the crop season. Pre-treatment population of *S. nobilis* was recorded 24 h before the spray. Post treatment population was recorded at 3 and 7 days after spraying. Efficacy of different treatments in controlling the scutellerid bug was determined by calculating percent reduction with the formula given by Henderson and Tilton (1955) as under.

$$\text{Percent reduction in population} = \left[1 - \frac{T_a \times C_b}{T_b \times C_a}\right] \times 100$$

Where:

T_a = No. of insects after treatment

T_b = No. of insects before treatment

C_a = No. of insects in untreated check after treatment

C_b = No. of insects in untreated check before treatment

RESULTS AND DISCUSSION

Determination of Damage Potential

Considering the extent of damage of scutellerid bug on pods, two bugs/plant did not bring out in measurable weight loss of pods during both the years, while nine bugs per plant resulted in a mean weight reduction of 0.24 and 0.29 g pods within seven days during 2009 and 2010, respectively. This was progressively increased to 0.43 and 0.48 g in both the years, respectively when the bug population was 20 per plant. Results are shown in Table 1 for 2009 and 2 for 2010. However, the losses were assessed at 14 DAR, even two bugs perplant could reduce the pod weight to tune of 0.09 and 0.20 g in 2009 and 2010, respectively, while at 20 bugs per plant resulted in 0.56 and 0.60 g weight loss in both the years, respectively. The reduction in weight due to feeding was more during first 7 days period of feeding than the subsequent 7 days. The weight loss due to bug feeding was very less even if they were allowed for 14 days. The reason might be due to the longer period for causing the damage and ability of the plant to recoup the damage caused. Similar method for assessing the damage potential of pod bug and pod fly was reported by Kumar and Nath (2003). These results are in concurrence with the findings of Ambika *et al*. (2007), who computed damage potential of scutellerid bugs on Jatropha (Table 2).

Table 1: Damage potential of Scutellerid bug on Jatropha during 2009

	Seven days after release				Fourteen days after release			
Bugs/ plant No.	Initial weight of pod (g)	Final weight of pod (g)	Difference in weight (g)	Weight loss over control (g)	Initial weight of pod (g)	Final weight of pod (g)	Difference in weight (g)	Weight loss over control (g)
2	12.57 (3.61)	14.21 (3.83)	1.63 (1.46)	0.04	11.96 (3.52)	14.13 (3.82)	2.17 (1.63)	0.09
3	14.31 (3.85)	16.02 (4.06)	1.69 (1.48)	0.10	13.88 (3.79)	16.18 (4.10)	2.30 (1.67)	0.22
5	10.71 (3.34)	12.47 (3.60)	1.76 (1.50)	0.17	11.10 (3.40)	13.48 (3.74)	2.38 (1.70)	0.30
9	12.25 (3.56)	14.08 (3.81)	1.83 (1.53)	0.24	12.01 (3.54)	14.42 (3.86)	2.41 (1.71)	0.33
12	11.72 (3.49)	13.67 (3.76)	1.95 (1.56)	0.36	10.56 (3.33)	13.06 (3.68)	2.50 (1.73)	0.42
15	10.13 (3.26)	11.71 (3.49)	1.98 (1.57)	0.39	10.07 (3.25)	12.65 (3.62)	2.58 (1.75)	0.50
20	13.50 (3.74)	15.52 (4.00)	2.02 (1.59)	0.43	12.08 (3.54)	14.72 (3.90)	2.64 (1.77)	0.56
Control	11.53 (3.47)	13.12 (3.69)	1.59 (1.44)	-	11.04 (3.40)	13.12 (3.69)	2.08 (1.71)	-
Statistical analysis								
SEM±	0.10	0.09	0.01	-	0.07	0.07	0.01	-
CD at 5%	0.35	0.32	0.05	-	0.25	0.23	0.05	-

Values in parenthesis are $\sqrt{X+0.5}$ transformed value

Table 2: Damage potential of Scutellerid bug on Jatropha during 2010

Bugs/ plant (No.)	Seven days after release: Initial weight of pod (g)	Final weight of pod (g)	Difference in weight (g)	Weight loss over control (g)	Fourteen days after release: Initial weight of pod (g)	Final weight of pod (g)	Difference in weight (g)	Weight loss over control (g)
2	13.42(3.73)	15.20(3.96)	1.78(1.51)	0.05	12.48(3.60)	14.78(3.91)	2.31(1.67)	0.20
3	11.65(3.46)	13.49(3.72)	1.85(1.53)	0.12	11.25(3.42)	13.62(3.75)	2.37(1.69)	0.26
5	14.09(3.81)	16.02(4.06)	1.94(1.56)	0.21	13.21(3.70)	15.63(4.01)	2.42(1.71)	0.31
9	10.11(3.25)	12.13(3.55)	2.02(1.59)	0.29	10.02(3.24)	12.50(3.60)	2.48(1.73)	0.37
12	12.31(3.57)	14.39(3.85)	2.07(1.60)	0.34	12.11(3.54)	14.66(3.89)	2.55(1.75)	0.54
15	15.40(3.99)	17.51(4.24)	2.11(1.61)	0.38	15.37(3.98)	17.97(4.30)	2.60(1.76)	0.59
20	11.93(3.52)	14.14(3.82)	2.21(1.64)	0.48	11.71(3.49)	14.37(3.86)	2.71(1.78)	0.60
Control	12.24(3.57)	13.97(3.80)	1.73(1.49)	-	12.24(3.57)	14.48(3.87)	2.11(1.65)	-
Statistical analysis								
SEM±	0.11	0.10	0.01	-	0.08	0.08	0.01	-
CD at 5%	0.36	0.34	0.05	-	0.29	0.27	0.05	-

Values in parenthesis are $\sqrt{X+0.5}$ transformed value

Table 3: Integration of some IPM components against Scutellerid bug infesting Jatropha during 2009

		Mean percent reduction in population over control			
		First spray		Second spray	
Treatments	Dose	3 DAT	7 DAT	3 DAT	7 DAT
Endosulfan 35 EC	700 g a.i. ha^{-1}	48.92* (56.86)	44.50 (49.16)	50.86 (60.20)	48.81 (56.67)
Chlorpyriphos 50 EC	250 g g a.i. ha^{-1}	42.49 (45.67)	40.59 (42.38)	46.73 (53.01)	42.59 (45.83)
Monocrotophos 36 SL	500 gm a.i./ha	56.97 (70.35)	55.42 (67.83)	58.71 (73.08)	56.56 (69.64)
Profenophos 50 EC	400 g a.i. ha^{-1}	45.21 (50.40)	42.34 (45.34)	46.58 (52.81)	44.86 (49.82)
Spinosad 45% SC	45 g a.i. ha^{-1}	56.65 (69.78)	55.49 (67.49)	57.59 (71.27)	56.33 (69.30)
Lambda-cyhalothrin 5 EC	25 g a.i. ha^{-1}	61.59 (77.37)	56.39 (69.44)	61.65 (78.48)	60.44 (75.73)
Indoxycarb 14.5 % SC	60 g a.i. ha^{-1}	48.17 (55.56)	44.98 (50.00)	49.95 (58.62)	46.89 (53.33)
Carbosulfan 25 EC	250 g a.i. ha^{-1}	57.20 (70.70)	55.59 (68.10)	60.00 (75.20)	57.53 (71.10)
Imidacloprid 17.8 SL	100 mL ha^{-1}	61.45 (77.19)	57.65 (71.72)	62.63 (78.91)	59.64 (74.52)
Neem oil	2%	41.58 (44.12)	43.09 (46.69)	41.76 (44.37)	47.33 (54.10)
Beauveria bassiana	1×10^6 spores mL^{-1}	48.71 (56.54)	52.69 (63.33)	48.88 (56.83)	55.46 (67.90)
Metarhizium anisopliae	1×10^6 spores mL^{-1}	48.31 (55.78)	51.84 (61.85)	50.24 (59.13)	52.83 (63.52)
Control (Untreated)	Water spray	0.00	0.00	0.00	0.00
Statistical analysis					
SEM±	-	0.49	0.37	0.71	0.64
CD at 5%	-	1.43	1.10	2.08	1.89

*Arcsine-transformed values and in parenthesis are retransformed percent values, DAT: Days after treatment

First Spray 2009

Data presented in Table 3 showed that all the treatments were significantly superior over control at three and seven days after first spray during 2009. Third day after spraying, amongst the different IPM components investigated against scutellerid bug, lambda-cyhalothrin causing maximum percent reduction (77.37) in bug population which was statistically at par with the imidacloprid (77.19%). Carbosulfan (70.70%) was found statistically at par with the monocrotophos (70.35%) and spinosad (69.78%). Endosulfan (56.86%) and indoxycarb (55.56%) were found moderately effective against scutellerid bugs which showed non-significant reduction in bug population with the results obtained by *Beauveria bassiana* (56.54%) and *Metarhizium anisopliae* (55.78%). Next treatment was profenophos causing 50.40% reduction in scutellerid population. Chlorpyriphos (45.67) and neem oil (44.12) gave least percent reduction in bug population.

It is evident from Table 3 that 7th day after spraying, imidacloprid performed the best and the percent reduction was 71.72 and it was significantly superior to all other treatments. Lambda-cyhalothrin gave 69.44% reduction in population which was significantly superior to other IPM components except imidacloprid. Application of carbosulfan and monocrotophos brought about population reduction from 68.10 to 67.83%, respectively which were at par with each other and were found non-significant with spinosad (67.49%). Bioagents, i.e., *Beauveria bassiana* and *Metarhizium anisopliae* were found significant with each other resulted in percent reduction ranged from 63.33 to 61.85%, respectively. The efficacy of indoxycarb and endosulfan were 50 and 49.16%, respectively, which were statistically at par with each other. Neem oil (46.69%) and profenophos (45.34%) showed least percent reduction in bug population, which were statistically at par with each other. The lowest scutellerid bug population reduction (42.38%) was observed in chlorpyriphos.

Second Spray 2009

Data recorded in Table 3 showed that the highest percent reduction in bug population at 3rd day after spraying was found in imidacloprid (78.91) which was found statistically non-significant with lambda-cyhalothrin (78.48%). The Next effective treatment was carbosulfan resulted in 75.20% reduction in bug population. The spray of monocrotophos (73.08%) was found statistically at par with that of spinosad (71.27%). However, application of endosulfan, *M. anisopliae* and indoxycarb resulted in 60.20, 59.13 and 58.62% reduction in bug population, respectively which were at par with each other. *B. bassiana* (56.83%) was found statistically at par with that of indoxycarb. Chlorpyriphos exhibited least efficacy (53.01%), which was at par with profenophos (52.81%). Neem oil gave minimum 44.37% reduction.

All the treatments were found superior over control at 7th day after spraying (Table 3). Lambda-cyhalothrin, which gave 75.73% reduction followed by imidacloprid (74.52%) and they were statistically at par with each other. Spray of carbosulfan resulted in 71.10% reduction and showed non-significant results with that of monocrotophos (69.64%) and spinosad (69.30%). However, *B. bassiana* (67.90%) was found at par with monocrotophos and spinosad. The next effective treatment was *M. anisopliae* followed by endosulfan showed 63.52 and 56.67% reduction in bug population, respectively. Neem oil (54.10%) and indoxycarb (53.33%) were found statistically at par with each other. Chlorpyriphos showed minimum 45.83% reduction in scutellerid bug population.

First Spray 2010

Third day after spraying lambda-cyhalothrin was found significantly superior than all other treatments and showed 75.43% reduction in bug population (Table 4). The next effective treatment was imidacloprid which was statistically at par with carbosulfan resulted in reduction varied from 72.23 to 71.26%, respectively for both the treatments. Spray of monocrotophos (68.70%) was found at par with spinosad (67.57%). The results revealed that *M. anisopliae* resulted in 60.16% reduction and it was statistically at par with *B. bassiana* (59.88%). However, endosulfan offered 58.33% reduction, which was at par with *B. bassiana*. The efficacy of indoxycarb and profenophos were 54.55 and 53.70%, respectively, which were at par with each other. Chlorpyriphos exhibited 44.44% reduction in bug population. The minimum reduction (39.25%) was observed in neem oil.

Data presented in Table 4 showed that lambda-cyhalothrin recorded highest reduction (71.78%) in bug population followed by imidacloprid (70.84%) and were found statistically at par with each other during 7th day after spraying. In case of carbosulfan and *M. anisopliae* percent reduction ranged from 68.97 to 67.40, respectively and did not differ significantly. Monocrotophos and spinosad exhibited percent reduction from 67.14 to 66.64,

Table 4: Integration of some IPM components against Scutellerid bug infesting Jatropha during 2010

		Mean percent reduction in population over control			
		First spray		Second spray	
Treatments	Dose	3 DAT	7 DAT	3 DAT	7 DAT
Endosulfan 35 EC	700 g a.i. ha^{-1}	49.75 (58.33)	47.39 (54.17)	51.09 (60.63)	48.42 (55.98)
Chlorpyriphos 50 EC	250 g a.i. ha^{-1}	41.78 (44.44)	37.74 (37.49)	44.18 (48.57)	41.59 (44.09)
Monocrotophos 36 SL	500 g a.i. ha^{-1}	55.96 (68.70)	55.00 (67.14)	59.77 (74.70)	58.05 (72.01)
Profenophos 50 EC	400 g a.i. ha^{-1}	47.10 (53.70)	44.98 (50.00)	49.35 (57.65)	47.25 (53.97)
Spinosad 45% SC	45 g a.i. ha^{-1}	55.26 (67.57)	54.69 (66.64)	58.42 (72.59)	56.37 (69.35)
Lambda-cyhalothrin 5 EC	25 g a.i. ha^{-1}	60.27 (75.43)	57.93 (71.78)	58.63 (72.94)	57.15 (70.58)
Indoxycarb 14.5% SC	60 g a.i. ha^{-1}	47.58* (54.55)	46.28 (52.27)	51.58 (61.43)	48.00 (55.28)
Carbosulfan 25 EC	250 g a.i. ha^{-1}	57.58 (71.26)	56.14 (68.97)	59.25 (73.87)	58.15 (72.23)
Imidacloprid 17.8 SL	100 mL ha^{-1}	58.17 (72.23)	57.28 (70.84)	58.69 (73.01)	58.43 (72.62)
Neem oil	2%	38.76 (39.25)	42.28 (45.33)	44.17 (48.60)	47.97 (55.18)
Beauveria bassiana	1×10^6 spores mL^{-1}	50.69 (59.88)	53.04 (63.89)	51.56 (61.43)	54.61 (66.46)
Metarhizium anisopliae	1×10^6 spores mL^{-1}	50.84 (60.16)	55.13 (67.40)	51.27 (60.88)	56.37 (69.39)
Control (Untreated)	Water spray	0.00	0.00	0.00	0.00
Statistical analysis					
SEM±	-	0.60	0.57	0.54	0.51
CD at 5%	-	1.77	1.68	1.57	1.48

*Arcsine-transformed values and in parenthesis are retransformed percent values, DAT: Days after treatment

respectively and were at par with each other and also with bio-agent *M. anisopliae*. The next effective treatment was spray of *B. bassiana* which gave 63.89% reduction followed by endosulfan recorded 54.17% reduction in scutellerid population. The efficacy of indoxycarb and profenophos ranged significantly from 52.27 to 50%, respectively. In case of neem oil only 45.33% reduction was observed, while chlorpyriphos recorded minimum reduction (37.49%) in bug population.

Second Spray 2010

The spray of Monocrotophos at 3rd day after treatment application was found most effective against scutellerid bug resulted in 74.70% reduction followed by carbosulfan (73.87%) and both the treatments were found statistically at par with each other (Table 4). While, in case of imidacloprid 73.01% reduction was observed and did not differ significantly with carbosulfan. Effectiveness of imidacloprid and spinosad were 72.94 and 72.59% and showed non-significant results with each other and that of imidacloprid. Indoxycarb and *B. bassiana* recorded similar reduction (61.43%) in bug population and efficacy of both the treatments were at par with the results obtained by *M. anisopliae* (60.88%) and endosulfan (60.63%). Profenophos (57.65%) was found significantly superior to neem oil (48.60%) and chlorpyriphos (48.57%). Neem oil and chlorpyriphos were at par with each other.

The data recorded on percent reduction in bug population (Table 4) indicated that management schedule consisting of spray of imidacloprid showed maximum reduction (72.62%) and was found at par with that of carbosulfan (72.23%) and monocrotophos (72.01%) at 7th day after spray. The next effective treatment was lambda-cyhalothrin resulted in 70.58 % reduction and did not differ significantly with lambda-cyhalothrin. *M. anisopliae* and spinosad maintained their effectiveness showing 69.39 and 69.35% reduction in scutellerid population and were at par with each other and that with lambda-cyhalothrin. The efficacy of *B. bassiana* was 66.46%. The mean reduction in bug population in endosulfan and indoxycarb ranged from 55.98 to 55.28%, respectively and were found statistically at par with each other and that of neem oil (55.18%). The spray of profenophos recorded 53.97% reduction and did not differ significantly with indoxycarb and neem oil. Chlorpyriphos gave minimum population reduction (44.09%) of scutellerid which was found significantly inferior to all other treatments.

Tuncer *et al.* (2002) have also reported that lambda-cyhalothrin was the most effective in controlling bugs (*Palomena prasina* and *Gonocerus acuteangulatus*. Singh *et al.* (2008a) conducted bioassay to evaluate bio-efficacy of 11 insecticides and found that Carbosulfan (0.02%) and lambda-cyhalothrin (0.007%) were the most effective, resulting in 100% mortality within 24 h under all modes of treatment. Dikshit and Lal (2002) have evaluated the bioefficacy of imidacloprid (Confidor 20 SL) against black citrus aphid (*T. aurantii*) at 1.25 ml L^{-1} and reported 53.78% aphid control after 24 h of application while after 3 days, an excellent control (99.21%) was noticed and remained effective thereafter up to 15 days. Vega Bernal (2003) was also found confidor 70 WG most effective against whitefly in tomato crop. Gupta and Shanker (2007) have also reported that imidacloprid (22.5 g a.i. ha^{-1}) showed maximum reduction (79%) in mealy bug population in tea plantation. These observations are in consistent with Das *et al.* (2000) and Kumar *et al.* (2005), who observed monocrotophos and carbosulfan to reduce the tea mosquito bug population effectively on cashew. Ambika *et al.* (2007) observed that carbosulfan 0.025% was found to be effective followed by monocrotophos 0.045% for controlling the scutellerid pests (*S. nobilis* and *C. purpureus*) in Jatropha.

In present experiments bio-efficacy of insecticides was more at 3rd days after spraying as compared to neem oil and other bioagents and at 7th days after spraying it was continuously decreased resulted in less reduction in pest population. Whereas, in case of neem oil and other bioagents at 3rd days after spraying percent reduction in bug population was less and it was continuously increased and found maximum at 7th days after spraying. However, the findings of the present study were further strengthened by earlier observation of Singh *et al.* (2008b), who reported maximum reduction of okra jassid by insecticides at 3rd days after insecticidal spray. The present findings are in agreement with those of Mandal *et al.* (2007) when insect treated with *B. bassiana* reduced the feeding rate within 7 days after application resulted in maximum reduction in pest population at 7th day after spray. The biocontrol agents tested were slow acting on scutellerid bugs (Sridevi *et al.*, 2004).

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