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EFFECTS OF CYPERMETHRIN, DELTAMETHRIN AND NIMBICIDINE ON POPULATION OF *TRIBOLIUM CASTANEUM* (HERBST)

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Abstract

Context: Pyrethroid insecticides and plant products can control the population of stored products insect pest *Tribolium castaneum* (Herbst).

Objective: To determine the influence of cypermethrin, deltamethrin and nimbicidine individually and combinedly on the population of *T. castaneum*.

Materials and Methods: One hundred *T. castaneum* adults (1:1) aged 10-20 days old were introduced into a beaker containing 100 g of either fresh or treated flour and kept in an incubator (30 ± 0.5ºC). After 4 months the total number of adults were assessed. Pupae and fourth to sixth instar larvae were also counted.

Results: The population of *T. castaneum* was significantly (P<0.01) reduced by cypermethrin, deltamethrin and nimbicidine alone and their combinations over a period of 4 months than control. Among chemicals, cypermethrin alone at 2 ppm was the most effective in reducing the total population (PRC 63.44), followed by 5 ppm dose of deltamethrin (PRC 55.81) and 24 ppm dose of nimbicidine (54.39). In case of adult population the maximum reduction was in 24 ppm of nimbicidine (PRC 76.17). However, the combined dose of cypermethrin, deltamethrin and nimbicidine significantly (P<0.01) reduced the pupal and adult population. The lowest larval population was found in the treatment of cypermethrin (2 ppm) (PRC 61.51) followed by the deltamethrin (5 ppm) (PRC 51.17).

Conclusion: In cypermethrin and deltamethrin the reduction of population was probably due to mortality of different life stages of *T. castaneum* but in case of nimbicidine it was most probably due to its growth regulatory activity.

Keywords: Cypermethrin, Deltamethrin, Nimbicidine, Population, *Tribolium*.

Introduction

Tribolium species can reproduce rapidly under natural environmental condition and cause huge loss to stored foods. Temperature and relative humidity play important role on the number of population (Michael 1984, Bry and Davis 1985). At 29ºC and 70% relative humidity the population of *T. castaneum* and *T. confusum* is optimum (Michael 1984). Generally, 30ºC is regarded as the optimum temperature for the development of *Tribolium* spp. The growth of *Tribolium* population is affected by many factors including the conditioning of the flour medium Mondal (1984) and cannibalism (Sonleitner 1961, Mondal and Akhtar 1989). The population of *Tribolium* spp. was also found to be suppressed by the insecticides viz. pirimiphos-methyl (Mondal 1984, Kamaruzzaman 2000), deltamethrin (Hasnat 2003), chlorpyrifos-methyl and methoprene (Arthur *et al.* 1990). Banu (2004) reported the reduction in the population of both *T. castaneum* and *T. confusum* due to azadirachtin. The population of malathion resistant and malathion susceptible strains of *T. castaneum* was significantly (P<0.001) suppressed by the neem seed and leaf extracts (Khanom 2004).

Jbilou *et al.* (2006) reported some plant materials inhibited the F_1 progeny production - the ultimate result was the reduction of population of *T. castaneum*. Similar results were also reported by Das *et al.* (2006) who also reported the reduction of adult population of *T. castaneum* when the eggs were treated with different doses of nimbicidine.

However, there is no information regarding the effect of cypermethrin, deltamethrin and nimbicidine alone or in combinations on the population of *T. castaneum*. This led to the present experiment.

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Materials and Methods

Adult *T. castaneum* emerged from the larvae reared on fresh medium were used in the test. One hundred adults (1:1 sex ratio) aged 10-20 days old were introduced into a beaker containing 100 g of flour medium either fresh or treated with cypermethrin, deltamethrin or nimbicidine alone and in combinations. The flour medium was treated with chemicals using the methods of Khatun *et al.* (2009). The beaker containing treated beetles was covered with a muslin cloth using rubber band and were kept in an incubator at 30ºC without light and relative humidity control. After every 30 days an additional 50 g of similar flour medium was added to the beaker to avoid the conditioning of flour medium due to overcrowding or shortage of food (Mondal 1985). The total number of adults was assessed after 4 months by sieving the medium with a 500 micrometer sieve. The number of pupae and also the larvae of fourth to sixth instars were also counted and the numbers were recorded.

Three different doses (sub lethal) of cypermethrin, deltamethrin and nimbicidine were used. A control batch (treated with acetone only as solvent) was also maintained. Three replications were used for each test consisting 100 adults (N=300). The percent reduction of population control (PRC) was calculated according to Mondal and Port (1995).

Results

All the treatments significantly reduced the total population of *T. castaneum* in comparison with that of control (untreated) and acetone only (control as solvent). Among chemicals cypermethrin alone at 2 ppm was the most effective in reducing the total population (PRC 63.44), followed by 5 ppm deltamethrin (PRC 55.81) and 24 ppm nimbicidine (54.39). In case of adult population the maximum reduction was in 24 ppm nimbicidine (PRC 76.17), followed by 2 ppm cypermethrin (PRC 67.93) and 5 ppm deltamethrin (PRC 59.52). However, the combined dose of cypermethrin (0.5 ppm), deltamethrin (1.25 ppm) and nimbicidine (12 ppm) significantly reduced the adult population with a PRC value of 68.93. The pupal population was also significantly reduced in all treatments with the maximum PRC value of 49.20 in combined dose of deltamethrin (1.25 ppm) and nimbicidine (12 ppm) whilst it was 48.07 in combined dose of cypermethrin, deltamethrin and nimbicidine (Table 1). In case of nimbicidine treatment, the larval population was comparatively higher than those of insecticidal treatments which indicates its insect growth regulatory activity

Table 1. The population of *T. castaneum* four months after introducing newly emerged unmated adults on fresh flour (control) and flour medium treated with different combinations of cypermethrin, deltamethrin and nimbicidine (initial number: 100 adults, 1:1).

Treatment	Dose (ppm)	Average number of total population							
		Larvae	PRC	Pupae	PRC	Adults	PRC	Total	PRC
Control (Untreated)	-	490.33		294.33		1851.67		2636.33	
Control(solvent)	-	441.67	9.92	293.33	0.33	1758.67	5.0	2493.67	5.41
Cypermethrin	0.5	295	33.21	301	-2.61	1510	14.14	2106	15.55
	1.0	259	41.36	247.33	15.68	997.67	43.27	1504	39.69
	2.0	170	61.51	177.67	39.43	564	67.93	911.67	63.44
Deltamethrin	1.25	233.33	47.17	240	18.18	1709.67	27.86	2183	12.46
	2.5	225.67	48.90	218.33	25.57	1223.67	30.42	1667.67	33.12
	5.0	215.67	51.17	172.67	41.13	713.67	59.52	1102.01	55.81
Nimbicidine	12	479	-8.45	206	29.77	1172	33.36	1857	25.53
	18	503.33	13.96	173.33	40.91	848.67	51.74	1525.33	38.84
	24	565	27.92	153.33	47.73	419	76.17	1137.33	54.39
Cypermethrin + Deltamethrin	0.5+1.25	305	30.94	248.33	15.34	1283.67	27.01	1837	26.33
Cypermethrin + Nimbicidine	0.5+12	358.67	18.79	191	34.88	992	43.59	1541.67	38.18
Deltamethrin +Nimbicidine	1.2+12	319	27.77	149	49.20	924.33	47.44	1392.33	44.16
Cypermethrin +Deltamethrin + Nimbicidine	0.5+1.25+12	376.67	14.72	152.33	48.07	546.33	68.93	1075.33	56.88

Discussion

The population of *T. castaneum* in the present experiment was significantly reduced by the pyrethroid insecticides - both cypermethrin and deltamethrin. This result is similar to those of Mondal (1984), Kamaruzzaman (2000) and Amin (2000) who reported the reduction of *T. castaneum* population due to pirimiphos-methyl. Sevin was also found to reduce the population of *T. castaneum* in comparison with those of control (Amin 2000). White *et al.* (1997) reported that pirimiphos-methyl (6 ppm) on maize killed > 90% population of *T. castaneum* in 8 months. The present result is also similar to that of Hasnat (2003) who found the population of *T. castaneum* reduced significantly compared with that of control due to deltamethrin (technical grade a.i 98%) either alone or in combination with the dimilin - an IGR. The efficacy of the combined doses of insecticides and nimbicidine in reducing the population is similar to that of Arthur *et al.* (1990) who reported that a combination of 6 ppm chlorpyrifos-methyl (insecticide) and 1 ppm methoprene (IGR) effectively inhibited the population of *T. castaneum*. Besides, Desmarchelier (1978) and Bengston *et al.* (1980) reported the effective control of *S. zeamais* and *Tribolium* spp. population for 32, 38, and 52 weeks by fenitrothion, pirimiphos-methyl, chlorpyrifos-methyl and bendiocarb respectively.

The present result is similar to that of Banu (2004) who found the reduced population of *T. castaneum* and *T. confusum* in azadirachtin treated flour medium. Similar results were also observed by Khanom (2004) that both neem leaf and seed extracts inhibited the adult population of *T. castaneum*. The present result agrees with those of Xiaoqing *et al.* (1998) who reported the effective reduction of *T. castaneum* population due to several botanical extracts. Xiaoqing *et al.* (1998) reported that F_1 progeny production of *T. castaneum* was totally suppressed by nutmeg oil. Similar results were reported by Jbilou *et al.* (2006).

The present results indicate that in case of cypermethrin and deltamethrin the reduction of population was probably due to mortality of different life stages of *T. castaneum*, but in case of nimbicidine it was most probably due to its growth retardation activity (Verkerk and Wright 1993, Haque *et al.* 2000, Banu 2004, Das *et al.* 2006).

Conclusion

In the present experiment the population of *T. castaneum* was effectively reduced by nimbicidine either alone or in combination with insecticides - cypermethrin and deltamethrin. In cypermethrin and deltamethrin the reduction of population was probably due to mortality of different life stages of *T. castaneum* but in case of nimbicidine it was most probably due to its growth regulatory activity.

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