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Effect of *Trichosanthes palmata* seed extracts on the growth and development of *Tribolium castaneum* (Herbst) and *Tribolium confusum* J. duVal

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Abstract : The effect of different doses of *Trichosanthes palmata* (Makal) seed extract, viz. 1000, 2000, 4000, 8000 and 16000 ppm on the growth and development of *Tribolium castaneum* and *T. confusum* was assessed. All the treatments significantly reduced the weight of *T. castaneum* and *T. confusum*. Treatments significantly lengthened the larval and pupal periods of both the species. Significantly lower pupal recovery and adult emergence were also observed.

Key words: *Trichosanthes palmata* seed extract, *Tribolium castaneum, T. confusum,* growth, development.

Introduction

The genus *Tribolium* includes the species *T. castaneum* (Herbst) and *T. confusum* J. duVal, two of the most important pests (Sokoloff, 1972) in a wide variety of cereal products. Protection of grains, stored for food as well as seed, from the attack of insect pests without imparting toxic effect to human beings and other animals is desirable. Insecticides of plant origin do not usually produce toxic effects on non target organisms. Several workers reported the growth inhibitory effect of neem derivatives against some stored grain pests (Pereira & Wohlgemuth, 1982; Jilani & Amir, 1987; Cobbinah and Apploh, 1989; Makanjuola, 1989). The present work was aimed at studying the toxicity of *T. palmata* seed extract on the growth and development of *T. castaneum* and *T. confusum.*

Materials and Methods

Adults of *T. castaneum* and *T. confusum* were collected from the stock culture and a large number of beetles were put on a thin film of wholemeal flour previously passed through a 60-mesh sieve (ISS; 460) in a beaker for egg-collection. Eggs were collected on the following day and were incubated at 30º ±1.5º C.

T. palmata seed extract was prepared by using soxhlet apparatus (DURAN, Germany, 1000 ml) in petroleum ether (ANALAR BDH, England) as solvent. After completing extraction, the solvent was removed from the extracts with the help of a vacuum rotary evaporator (EYELA, Tokyo). Finally trace amount of the solvent was removed by evaporating on a water bath. Five different concentrations of the extracts, viz. 1000, 2000, 4000, 8000 and 16000 ppm were used. The required quantities of the extracts were mixed with 15 g of standard food and 15 ml distilled acetone for each concentration. Treated food was dried by fanning, kept in an incubator at 30°C for 24 hours and then put in a blender for proper mixing. One hundred neonate larvae for each concentration were collected with a fine camel hair brush and placed in a beaker (500 ml) containing fresh or treated food medium and secured at the top with a coarse cloth. Food was changed at 5 day intervals to avoid conditioning of the medium by the larvae themselves. One hundred newly hatched larvae were maintained as the control on a medium treated with distilled acetone only. All bioassays were performed three times.

Growth of the larvae was assessed at two stages: 10 days after treatment and at maturity (16-day old). Ten-day old larvae were collected by sieving, washed from adhered flour particles and were individually weighed on an electronic balance (SHIMADZU, Japan). Similarly, mature larvae were collected and weighed. The larval period was noted and freshly formed pupae were weighed and counted, and placed in separate Petri dishes for adult emergence. The pupal period was recorded. Freshly enclosed adults were weighed and counted in each treatment. The experiment was conducted at 30º±1ºC in an incubator (SANYO, Japan, 126 cu metre). The co-efficient of variation (CV) and growth index (G.I.) of *T. castaneum* and *T. confusum* on different concentrations were calculated. The following formula was used for calculating the growth index:

$$\text{G.I.} = \frac{\text{Adult recovery(\%)}}{\text{Total larval and pupal periods}}.$$

Results and Discussion

A perusal of the data reveals that *T. palmata* seed extract reduced the growth and development of the species of *Tribolium* (Tables 1 & 2). Again, treatments significantly reduced the pupal recovery and adult eclosion in the beetles (Table 3). Mukherjee & Ramachandran (1989) observed that, *Azadirachta* incorporated in wheat flour reduced the growth and survival of *T. castaneum* larvae. Similar results were obtained by Jilani *et al.* (1988) who reported the significant reduction of body weight of *T. castaneum* larvae, pupae and adults by turmeric, sweet flag and neem oil. Mondal (1986) reported prolonged larval period and reduced larval weight of *T. castaneum* through the use of pirimiphos methyl. Ahamad and Ahmed (1991) reported that powdered rhizome of *Zingiber officinale* admixed with wheat (3%$^{w}/_{w}$) reduced adult emergence of *S. oryzae* by 60%. Rachid *et al*. (2006) reported that methanolic extracts of *Peganum harmala* seed significantly inhibited the larval and adult growth of *T. castaneum.* They also reported that extracts of *P. harmala, Ajuga iva, Aristolochia baetica* and *Raphanus raphanistrum* disrupted the development of the insect. Huang *et al.* (1997) reported that F_1 progeny production of *T. castaneum* was totally suppressed by nutmeg oil. Some indigenous plant materials such as *Nicotiana, Azadirachta, Datura, Vitex negundo* and *Annona* seed oil prolonged the larval and pupal periods and reduced larval, pupal and adult weight of *Tribolium* (Mondal *et al*.1989; Khanam *et al*. 1990; Rahman, 1992; Malek and Wilkins, 1995). Azadirachtin incorporated in wheat flour, reduced growth and survival of *T. castaneum* larvae (Mukherjee & Ramachandran 1989). This study suggests that petroleum ether extracts of *T. palmata* possesses toxic principles with significant insecticidal effect and could be a potential grain protectant against *T. castaneum* and *T. confusum.*

Table 1. Effect of *T. palmata* seed extract on the growth of *T. castaneum and T. confusum.*(N=30).

Treat-ment (ppm)		Mean Weight ± S.E. (mg).					
		10 days old larvae	Mature larvae	Pupae (male)	Pupae (female)	Adult (male)	Adult (female)
Control	a	2.08 ± 0.02	3.84 ± 0.03	2.83 ± 0.05	2.91 ± 0.05	1.92 ± 0.04	2.09 ± 0.05
	b	1.41 ± 0.04	2.90 ± 0.06	2.21 ± 0.04	2.64 ± 0.04	1.89 ± 0.04	2.16 ± 0.05
1000	a	1.59 ± 0.06	3.47 ± 0.07	2.50 ± 0.06	2.79 ± 0.05	1.78 ± 0.05	2.00 ± 0.06
	b	1.29 ± 0.04	2.78 ± 0.04	2.11 ± 0.04	2.50 ± 0.04	1.78 ± 0.04	1.98 ± 0.04
2000	a	1.41 ± 0.05	2.92 ± 0.02	2.33 ± 0.05	2.72 ± 0.04	1.72 ± 0.04	1.94 ± 0.03
	b	1.22 ± 0.04	2.68 ± 0.04	2.03 ± 0.04	2.34 ± 0.04	1.71 ± 0.03	1.87 ± 0.05
4000	a	1.32 ± 0.05	2.80 ± 0.05	2.26 ± 0.03	2.64 ± 0.07	1.64 ± 0.05	1.86 ± 0.03
	b	1.16 ± 0.03	2.59 ± 0.05	1.96 ± 0.05	2.33 ± 0.03	1.02 ± 0.05	1.81 ± 0.04
8000	a	1.22 ± 0.04	2.69 ± 0.05	2.16 ± 0.04	2.54 ± 0.07	1.52 ± 0.06	1.79 ± 0.06
	b	1.05 ± 0.03	2.52 ± 0.03	1.88 ± 0.02	2.25 ± 0.03	1.54 ± 0.03	1.76 ± 0.04
16000	a	1.09 ± 0.06	2.60 ± 0.06	2.08 ± 0.04	2.42 ± 0.04	1.41 ± 0.05	1.71 ± 0.05
	b	0.95 ± 0.05	2.40 ± 0.04	1.78 ± 0.04	2.19 ± 0.04	1.45 ± 0.04	1.70 ± 0.04
C.D. at 5%	a	0.452	0.416	0.337	0.176	0.152	0.148
	b	0.133	0.139	0.119	0.119	0.124	0.138
1%	a	0.634	0.583	0.472	0.247	0.212	0.208
	b	0.186	0.196	0.168	0.166	0.174	0.193

Note: a: *T. castaneum,* b:*T. confusum.*

Table 2. Effects of *T. palmata* seed extract on the duration (days) of larval and pupal periods of *T. castaneum and T. confusum.*

Treatment (ppm)		Larval period				Pupal period			
		No.	Mean ± S.E	C. V.(%)	t- values	No.	Mean ± S.E	C. V. (%)	t- values
Control	a	277	17.12 ± 0.55	5.56		272	6.11 ± 0.16	4.52	
	b	283	17.11 ± 0.28	2.84	–	277	6.44 ± 0.05	1.44	–
1000	a	259	18.54 ± 0.62	5.83	1.72	247	6.77 ± 0.25	6.36	2.30
	b	262	19.03 ± 0.41	3.73	3.95	223	6.98 ± 0.12	2.98	4.39
2000	a	256	20.16 ± 0.76	6.52	3.29	218	7.08 ± 0.15	3.62	4.47
	b	247	19.98 ± 0.46	4.02	5.46	194	7.35 ± 0.05	1.21	12.22
4000	a	247	21.78 ± 0.35	2.78	7.33	200	7.20 ± 0.16	3.87	4.81
	b	223	21.04 ± 0.34	2.80	8.97	188	7.59 ± 0.05	1.07	16.12
8000	a	244	23.97 ± 0.84	6.05	6.99	175	7.33 ± 0.13	3.07	5.95
	b	187	22.05 ± 0.20	1.57	14.58	175	7.78 ± 0.09	2.07	12.94
16000	a	223	25.19 ± 0.27	1.89	13.85	163	7.74 ± 0.25	5.70	5.58
	b	170	23.26 ± 0.38	2.82	13.22	122	7.92 ± 0.07	1.59	16.50

Note: a: *T. castaneum*, b:*T. confusum*

Table 3. Effect of *T. palmata* seed extract on pupal recovery and adult eclosion (%) of *T. castaneum* and *T. confusum.*

Treatment (ppm)		No. of larvae used	Pupation (%)	d-values	Adult emergence (%)	d- values	Growth Index, (G.I)
Control	a	300	277 (92.33)		272 (90.67)		3.90
	b	300	283 (94.33)	–	277 (92.33)	–	3.92
1000	a	300	259 (86.33)	2.39	247 (82.33)	3.01	3.25
	b	300	262 (87.33)	2.99	223 (74.33)	6.10	2.86
2000	a	300	256 (85.33)	2.46	218 (72.67)	5.31	2.67
	b	300	247 (82.33)	4.11	194 (64.67)	7.40	2.37
4000	a	300	247 (82.33)	3.33	200 (66.67)	6.41	2.30
	b	300	223 (74.33)	5.97	188 (62.67)	7.55	2.19
8000	a	300	244 (80.67)	3.68	175 (58.33)	8.21	1.86
	b	300	187 (62.33)	8.50	175 (58.33)	8.53	1.96
16000	a	300	223 (74.33)	5.29	163 (54.33)	8.98	1.65
	b	300	170 (56.67)	9.41	122 (40.67)	12.86	1.30

Note: a: *T. castaneum*, b:*T. confusum.*

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