



EFFICACY OF PLANT OILS AS GRAIN PROTECTANTS AGAINST KHAPRA BEETLE, *TROGODERMA GRANARIUM* EVERTS IN WHEAT

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ABSTRACT

Laboratory experiments were conducted during 2003-04 and 2004-05 with wheat, *Triticum aestivum* L. to determine the efficacy of biopesticide (plant oils) as grain protectants against khapra beetle, *Trogoderma granarium* Everts. The duration of combined larval and pupal stages varied from 27.03 to 39.22 days, being maximum in neem oil (39.22 days) and minimum in sunflower oil (27.03 days). The adult emergence was lowest (23.77%) in neem oil treatment and highest in sunflower oil (43.99%). The number of eggs laid per female at different dose levels ranged from 28.18 to 38.52, the neem oil was the most effective in reducing the fecundity (24.44 eggs/female) and the least effective was sunflower oil (43.33 eggs/female). The grain damage ranged from 9.36 to 25.16% and, the most effective treatment was neem oil (9.36%). The weight loss at different dose levels ranged from 3.51 to 8.27 % and this gradually decreased with the increase in dose.

Key words: *Trogoderma granarium*, plant oils and wheat

Wheat is attacked by a number of insect pests under storage conditions of which, the khapra, *Trogoderma granarium* Everts (Coleoptera: Dermestidae) is a major pest. Only larval stage is destructive, feeding on the germ portion of the grains. causing great economic loss both in quantity and quality. Use of pesticides has been found ecologically unsound and associated with disadvantages like pest resistance, outbreaks of secondary pest, adverse effect on non-target organisms, toxic residues in food grains, pollution of storage environment and direct hazards to the user, and hence alternate methods are essential. The present study evaluates efficacy of few plant oils.

MATERIALS AND METHODS

The experiment was conducted under laboratory conditions during 2003-04 and 2004-05 with wheat, for evaluating plant oils as grain protectant against khapra beetle, *Trogoderma granarium*. Fifty newly hatched larvae were released in glass jar (15×10 cm) containing treated seeds and observations on the larval and pupal period combined, adult emergence and fecundity were recorded. The treatments were replicated three times. The duration of combined larval-pupal period was worked out by recording the dates of releasing newly hatched larvae and dates of adult emergence on treated food with different doses of oils. For observations on fecundity, newly emerged adults were kept in glass vials and the total number of eggs laid by the female counted daily till the death of female.

The weight loss and grain damage were also recorded. Before weighing all insect stages and frass were removed. A sample of 200 grains in each replication was used for recording the percentage of damaged grains.

RESULTS AND DISCUSSION

The mean duration of combined larval and pupal stages varied from 27.03 to 39.22 days, being maximum in neem oil (39.22 days) which was at par with karanj oil (38.85 days). It was followed by clove oil (36.54 days), cardamom oil (37.55 days), linseed oil (35.81 days), lemongrass oil (34.58 days) and castor oil (32.58 days). The least effective treatment was found to be sunflower oil (27.03 days), while in control it was 21.10 days (Table 1). These findings are in accordance with the results obtained by Hassan (2001) who reported that seed treatment with plant oils or extracts normally delayed the development of *T. granarium*. The mean per cent adult emergence from neem oil treatment was 23.77 followed by karanj oil (25.11%), cardamom (26.44%), clove oil (27.77%) linseed oil (29.33%), lemongrass oil (29.99%), castor oil (31.33%), juniper berry oil (32.88%), mustard oil (34.44%), eucalyptus oil (36.0%), groundnut oil (37.99%), palm oil (39.77%), sesamum oil (42.44%) and sunflower oil (43.99%). These are in conformity with Jood *et al.* (1993) who found significant reduction in adult emergence of *T. granarium* by neem oil. However, Bhargava and Meena (2002) and Meena and

Table 1. Effect of plant oils on *Trogoderma granarium* in wheat

Plant oils	Larval + pupal period (days)				Adult emergence (%)				Fecundity (No.)			
	Concentrations (ml/ 100 g seeds)				Concentrations (ml/ 100 g seeds)				Concentrations (ml/ 100 g seeds)			
	0.1	0.5	1.0	Mean	0.1	0.5	1.0	Mean	0.1	0.5	1.0	Mean
Neem oil	37.50	39.05	41.12	39.22	30.67 (33.62)	22.66 (28.43)	18.00 (25.10)	23.77 (29.05)	29.33	24.66	19.33	24.44
Castor oil	31.75	32.21	33.80	32.58	38.67 (38.45)	30.00 (33.21)	25.33 (30.22)	31.33 (33.96)	37.33	32.00	28.00	32.44
Linseed oil	34.80	35.65	37.00	35.81	36.66 (37.36)	28.00 (31.95)	23.33 (28.88)	29.33 (32.73)	34.00	29.33	25.33	29.55
Eucalyptus oil	29.70	30.85	31.50	30.68	43.33 (41.17)	34.67 (36.07)	30.00 (33.21)	36.00 (36.81)	41.33	36.66	32.00	36.66
Groundnut oil	28.50	29.45	30.05	29.33	45.33 (42.32)	36.66 (37.27)	32.00 (34.45)	37.99 (38.01)	42.66	37.33	33.33	37.77
Karanj oil	37.01	38.85	40.70	38.85	32.00 (34.45)	24.00 (29.33)	19.33 (26.08)	25.11 (29.95)	30.66	26.00	20.66	25.77
Mustard oil	30.80	31.00	32.90	31.56	41.33 (40.01)	33.33 (35.26)	28.66 (32.37)	34.44 (35.88)	40.00	35.33	30.66	35.33
Palm oil	27.55	28.60	28.01	28.51	46.67 (43.09)	38.00 (38.06)	34.66 (36.06)	39.77 (39.07)	47.33	42.00	36.00	41.77
Sunflower oil	26.10	27.00	28.95	27.03	52.66 (48.53)	41.33 (40.01)	38.00 (38.06)	43.99 (42.20)	48.66	43.33	38.00	43.33
Sesamum oil	27.00	28.01	32.69	27.03	51.53 (45.77)	40.00 (39.23)	36.00 (36.87)	42.44 (40.62)	48.00	42.66	31.33	40.66
Juniper berry oil	31.00	31.90	39.69	31.86	40.00 (39.23)	31.33 (34.04)	27.23 (31.52)	32.88 (34.93)	38.66	34.00	28.66	33.77
Cardamom oil	36.10	37.50	39.05	37.55	33.33 (35.26)	25.33 (30.22)	20.66 (27.04)	26.44 (30.84)	32.00	27.33	22.00	27.11
Lemon- grass oil	33.80	34.95	35.01	34.58	37.33 (37.66)	28.00 (31.95)	24.66 (29.77)	29.99 (33.12)	36.00	30.66	26.00	30.88
Clove oil	35.80	36.69	37.15	36.54	34.66 (36.06)	26.66 (31.09)	22.00 (27.97)	27.77 (31.70)	33.33	28.00	23.33	28.22
Mean	31.95	32.97	34.09		40.28 (39.49)	31.42 (34.00)	27.14 (31.25)		38.52	33.52	28.18	
Control	25.10				64.00 (53.13)							
Treatment	SEm±	CD at 5%	CV %		SEm±	CD at 5%	CV %		SEm±	CD at 5%	CV %	
Concentration	0.32	0.91			0.38	1.06			0.48	1.34		
TxC	0.15	0.42			0.17	0.49			0.22	0.62		
	0.56	NS	2.94		0.65	1.83	3.2.5		0.82	2.32	4.27	

* Data based on 150 eggs (three replications of 50 eggs in each)

*** Percentage transformed to angular; outside values are its back transformation to percentage

Table 2. Effect of plant oils on grain damage and weight loss in wheat by *Trogoderma granarium*

Plant oils	Grain damage (%)				Weight loss (%)			
	Concentrations (ml/ 100 g seed)							
	0.1	0.5	1.6	Mean	0.1	0.5	1.0	Mean
Neem oil	15.20	8.25	4.65	9.36	4.55	3.20	1.25	3.00
	(22.95)	(16.69)	(12.45)	(17.03)	(12.32)	(10.31)	(6.41)	(9.86)
Castor oil	20.95	13.00	7.85	13.93	7.95	5.85	3.00	5.60
	(27.24)	(21.13)	(16.27)	(21.54)	(16.37)	(14.00)	(9.98)	(13.45)
Linseed oil	19.05	11.50	7.00	12.51	6.33	5.00	2.65	4.66
	(25.88)	(19.82)	(15.34)	(20.34)	(14.57)	(12.92)	(9.37)	(12.28)
Eucalyptus oil	25.35	17.40	10.40	17.71	10.25	7.35	4.00	7.20
	(30.22)	(24.65)	(18.81)	(24.56)	(18.67)	(15.73)	(11.54)	(15.31)
Groundnut oil	28.50	2200	15.95	22.15	10.60	8.25	4.65	7.83
	(32.27)	(27.97)	(23.54)	(27.92)	(19.00)	(16.69)	(12.45)	(16.04)
Karanj oil	16.15	9.10	5.20	10.15	4.90	3.65	1.85	3.46
	(23.69)	(17.56)	(13.18)	(18.14)	(12.79)	(11.01)	(7.81)	(10.53)
Mustard oil	24.10	16.05	9.00	16.38	9.63	6.95	3.65	6.74
	(29.40)	(23.62)	(17.46)	(23.49)	(18.08)	(15.28)	(11.01)	(14.79)
Palm oil	29.95	23.25	17.00	23.40	11.00	9.67	5.35	8.67
	(33.18)	(28.82)	(24.35)	(28.78)	(19.37)	(18.11)	(13.37)	(16.95)
Sunflower oil	31.60	25.00	18.90	25.16	12.00	11.00	6.67	9.89
	H34.20)	(30.00)	(25.77)	(29.99)	(20.27)	(19.37)	(14.95)	(18.19)
Sesamum oil	30.65	24.40	17.85	24.30	11.70	10.30	5.80	9.26
	(33.61)	(29.60)	(24.99)	(29.40)	(20.00)	(18.72)	(13.94)	(17.55)
Juniper berry oil	22.15	14.10	8.55	14.93	9.00	6.35	3.35	6.23
	(28.07)	(22.06)	(16.99)	(22.37)	(17.46)	(14.59)	(10.55)	(14.20)
Cardamom oil	17.30	10.05	6.00	11.11	5.20	4.00	2.00	3.73
	(24.58)	(18.48)	(14.18)	(19.08)	(13.18)	(11.54)	(8.13)	(10.95)
Lemon- grass oil	20.00	12.20	7.20	13.13	7.05	5.45	2.80	5.10
	(26.56)	(20.44)	(15.56)	(20.85)	(15.39)	(13.50)	(9.63)	(12.84)
Clove oil	18.00	11.00	6.35	11.78	5.65	4.33	2.25	4.07
	(25.10)	(19.37)	(14.58)	(19.68)	(13.75)	(12.01)	(8.62)	(11.46)
Mean	22.78	15.52	10.13		8.25	6.52	3.51	
	(28.13)	(22.87)	(18.10)		(16.51)	(14.55)	(10.55)	
Control	39.00				14.00			
	(38.65)				(21.97)			
	SEm±	CD at 5%	CV%		SEm	CD at 5%	CV%	
Treatment	0.24	0.67			0.17	0.49		
Concentration	0.11	3.31			0.08	123		
T×C	0.41	1.16	3.10		0.30	0.85	3.77	

*Data based on 150 eggs (three replications of 50 eggs in each)

** Percentage transformed to angular; outside values are its back transformation to percentage

Bhargava (2003) reported significant reduction in adult emergence.

All the doses were observed to be significantly better in reducing the egg laying capacity. The fecundity got progressively decreased with the increase in dose (Table 1). The mean number of eggs laid per female ranged from 28.18 to 38.52. It was evident that neem oil was the most effective in reducing the fecundity (24.44 eggs/ female) which was at par with karanj oil (25.77 eggs/ female) but differed significantly from other treatments. It was followed by cardamom, clove, linseed, lemongrass, castor, juniper berry, mustard, eucalyptus, groundnut, sesamum, palm and sunflower oils with 27.11, 28.22, 29.55, 30.88, 32.44, 33.77, 35.33, 36.66, 37.77, 40.66, 41.77 and 43.33 eggs/female, respectively. The neem oil has been found to reduce the egg laying capacity in other insects like *R. dominica* (Chander, 2003). Reddy *et al.*, (1999) found that karanj oil caused a significant reduction in oviposition of *C. chinensis*.

The mean per cent grain damage ranged from 9.36 to 25.16, the most effective treatment neem oil. It was followed by karanj, cardamom, clove, linseed, lemongrass, castor, juniper berry, mustard, eucalyptus, groundnut, palm and sunflower oils. The data presented in Table 2 reveal that the mean weight loss at different dose levels ranged from 3.00 to 9.89%. The per cent weight loss gradually decreased with the increase in dose. In neem oil the weight loss was 4.55% at the initial dose level (0.1 ml/100g seeds) which decreased to 1.25% at the highest dose of 1.0 ml/100g seeds. Similar trend was also observed in other treatments. Insecticidal properties of neem products against *T. granarium* and other stored grain pests had been

reported by Chellayan and Karnavar (1990) and Jood *et al.*, (1993), which support the present findings.

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