EFFECT OF PLANT OILS ON THE INFESTATION OF *RHYZOPERTHA DOMINICA* (FAB.) IN WHEAT, *TRITICUM AESTIVUM* LINN.

Kailash Chand Kumawat, Bhanwar Lal Naga*

Department of Entomology, Shri Karan Narendra College of Agriculture (SKRAU),
Jobner (Rajasthan)-303329, India

Received: April 20, 2012
Accepted: August 8, 2013

Abstract: Six oil treatments, *viz*., Neem (*Azadirachta indica* A. Juss), Castor (*Ricinus communis*), Karanj (*Pongamia pinnata*), mustard (*Brassica juncea*), Eucalyptus (*Eucalyptus melanophloia*) and Taramira (*Eruca sativa*) were evaluated at three dose levels (0.1, 0.5, and 1.0% v/w) against the lesser grain borer, *Rhyzopertha dominica* (Fab.) infesting wheat, *Triticum aestivum* Linn. An untreated check (the control) was maintained for comparison. The maximum protection was provided by Neem oil at 1.0 per cent (no adult emerged up to 270 days) followed by castor oil and Taramira oil at 1.0 per cent (no adult emerged up to 90 days of treatment). The maximum number of adults were recorded in the grain treated with Eucalyptus oil used at 0.1 per cent (9.3–22.0), Karanj oil at 0.1 per cent (6.0–20.7), and castor oil at 0.1 per cent (2.0–23.0). The maximum grain damage was recorded with use of Eucalyptus oil at 0.1 per cent (28.7–64.7), Karanj oil at 0.1 per cent (18.7–60.0%), and Eucalyptus at 0.5 per cent (18.0–58.0%). No grain damage was recorded in 1.0 per cent Neem oil-treated grain, for up to 270 days. For up to 90 days of treatment, no grain damage was recorded in 1.0 per cent castor oil treated grain, and no grain damage was recorded in 1.0 per cent Tarmira oil treated grain for up to 90 days of treatment. No adverse effect of plant oils was observed on seed viability for up to 270 days of treatments.

Key words: infestation, Karanj, Neem, *Rhyzopertha dominica* (Fab.), wheat

INTRODUCTON

A number of workers have suggested using fumigants and other chemicals to combat the population of the lesser grain borer, *Rhyzopertha dominica* (Fab.) in stored grains (Majumdar and Muthu 1960; Gillani *et al*. 1994; Yadav and Singh 1994; Arthur 1995), but toxic chemicals pose several problems. Such chemicals are associated with chronic and acute toxicity, development of insect resistance, environmental pollution *etc*. Therefore, the exploration of safer and low cost methods for managing the lesser grain borer pest was the prime objective of our study. To use plant derivatives to keep the pest population below economic injury level, it is essential to study the various life processes of the pest. The efficacy of indigenous plant products, extracts and oils has been evaluated. However, there is little definite information on mortality doses, efficacy of oil treatments by seed coating and mixing with the seed, and the residual life of the oil treatments, hence the need for a detailed investigation.

MATERIALS AND METHODS

Initially, the culture of the test insect *R. domonica* was started from a single gravid female. Subsequently, the stock culture was maintained in a Matka bin on wheat grain (variety, Raj. 3077) under controlled laboratory conditions (29+1.5°C temperature and 70±5% relative humidity – RH) in order to have large number of insects for the study. Prior to this, the wheat grains to be given as food were sterilized at a temperature of 55°C for 6 hours, in order to eliminate any hidden infestation. The wheat grains were conditioned for 48 hours at rearing environment. Six oil treatments, Neem (*Azadirachta indica* A. Juss), Castor (*Ricinus communis*), Karanj (*Pongamia pinnata*), mustard (*Brassica juncea*), Eucalyptus (*Eucalyptus melanophloia*), and Taramira (*Eruca sativa*) were evaluated at three dose levels (0.1, 0.5, and 1.0% v/w) to be used against the lesser grain borer, *R. dominica* infesting wheat, *Triticum aestivum* Linn. An untreated check (the control) was maintained for comparison. For evaluating the efficacy of plant oil), the required quantity of oils were mixed with 400 g of sterilized and conditioned wheat grains. The grains were put into the polythene bags and hand shaken horizontally and vertically so that every grain might have a thin oil coating. Three oil doses were used. The treated grains were considered as grain lot for taking out the requisite amount of grain needed in the case of future studies. The treated grains were stored in glass containers which had lids. These treated grains were also considered as grain lot for taking out the requisite amount of grain for the studies. An aliquot of 15 g grain from a powder mixed lot was drawn for experimentation in each treatment and kept in glass vials (10x2.5 cm); the treatment was replicated thrice. Two pairs of newly emerged beetles (equal

*Corresponding address:
kailashkumawat.2007@rediffmail.com

sex, 0–12 h old) were released in each glass vial. The vials were covered with muslin cloth. This exercise was done at 24 h, 90 days, 180 days, and 270 days of treatment of the grain.

The observations were recorded on adult emergence (F_1), grain damage and weight loss. The adult emergence was recorded on every alternate days. The grain damage by one generation of the pest was recorded on the basis of a visual count. Weight loss was recorded by exclusion of frass from the grain. The germination test of the treated grain samples was carried out by standard methodology to find out the adverse effect of oils, if any (Anonymous 1976). One hundred grains were placed in the petri dish between wet blotting papers. Three replications of each treated grain sample were maintained. The sprouted seeds having normal radicle and plumule were counted after four days. The per cent data on grain damage, weight loss, and germination were transformed into angular values and number of adult insects into log X +1 value for analysis of variance.

RESULTS AND DISCUSSION

Initially, the culture of test insect *R. domonica* was started from a single gravid female. The subsequent stock culture was maintained in a Matka bin.

Adult emergence (F_1)

For up to 270 days, no adult emergence was observed in which grain treated with 1.0 per cent Neem oil (Table 1). There was no adult emergence in 1.0 per cent castor oil, 1.0 per cent mustard oil, and 1.0 per cent Taramira oil up to 90 days of treatment. The adults released after 24 hours of grain treatment with Neem oil at 0.5 per cent, castor oil at 0.5 per cent, Karanj oil at 1.0 per cent and mustard oil at 0.5 per cent showed no F_1 adult emergence. Jilani and Saxena (1990) emphasized that because of its greater persistence, Neem oil was to be evaluated in the trials against storage grain pests. Verma *et al.* (1983) found that oils and cakes of Neem, castor, and mustard reduced the fecundity, hatching, and adult emergence.

The highest adult emergence (F_1) was recorded in the castor oil treatment at 0.1 per cent (2.0–23.0), the Eucalyptus oil treatment at 0.1 per cent (9.3–22.0), and the Karanj oil 0.1 per cent (6.0–20.7). The high adult emergences in these treatments were recorded due to their low dose level. These treatments were non-significant when compared with untreated (33.0) after 270 days of grain treatment. The other treatments were ranked in the middle as far as exhibiting of adult emergence was concerned.

Grain damage (Infestation)

No grain infestation was recorded in 1.0 per cent Neem oil treated grains for up to 270 days of treatment, whereas, the castor oil treatment used at 1.0 per cent, the mustard oil treatment used at 1.0 per cent and the Tarmira oil treatment used at 1.0 per cent showed no grain damage for up to 90 days of treatment (Table 1). The adults released after 24 h of grain treatment with 0.5 per cent Neem oil, 0.5 per cent castor oil, 1.0 per cent Karanj oil, and 0.5 per cent mustard oil revealed no grain damage. Singhamony *et al.* (1986) reported that the oil of Karanj at doses of 25–100 ppm provided excellent protection of wheat against *R. dominica*. Khatre *et al.* (1993) showed that the treatments with Neem, castor and Karanj showed a significant repellent action for egg laying by the adults.

The treatments which showed higher grain damage by *R. dominica* were Eucalyptus oil used at 0.1 per cent (28.7–64.7%), Karanj oil used at 0.1 per cent (18.7–60.0%), Eucalyptus oil used at 0.5 per cent (18.0–58.0%), and castor oil used at 0.1 per cent (7.0–55.0%). When these products were used, there was higher grain damage due to

Table. 1. Emergence of *Rhyzopertha dominica* adult (F_1) in plant oil treated wheat grain, subsequent grain damage and weight loss after certain period of storage

Plant oils	Dose [ml/ 100 g]	Adult emergence*				Grain damage [%] **				Weight loss [%] **			
		24 h	90 days	180 days	270 days	24 h	90 days	180 days	270 days	24 h	90 days	180 days	270 days
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Neem	0.1	2.0	4.7	9.3	15.0	6.0	15.7	27.0	43.7	1.9	4.9	9.7	15.4
		(0.5)*	(0.8)	(1.0)	(1.2	(13.9)	(23.3)	(31.3)	(41.4)	(8.0)*	(12.8)	(18.2)	(23.0)
	0.5	0.0	2.0	5.0	8.0	0.0	9.3	14.7	24.7	0.0	7.3	5.2	8.4
		(0.0)	(0.6)	(0.8)	(1.0)	0.0	(17.7)	(22.5)	(29.8)	(0.0)	(10.0)	(13.2)	(16.8)
	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Castor	0.1	2.0	7.3	12.7	23.0	7.0	23.3	38.3	55.0	2.0	7.3	12.9	22.2
		(0.5)	(0.9)	(1.1)	(1.4)	(15.2)	(28.2)	(38.2)	(47.9)	(8.1)	(15.6)	(21.1)	(28.1)
	0.5	0.0	6.7	12.0	16.0	0.0	20.7	33.0	46.7	0.0	7.3	12.6	16.7
		(0.0)	(0.9)	(1.1)	(1.2)	0.0	(27.0)	(35.0)	(43.1)	(0.0)	(15.6)	(20.8)	(24.1)
	1.0	0.0	0.0	3.0	5.7	0.0	0.0	8.3	15.3	0.0	0.0	3.1	5.3
		(0.0)	(0.0)	(0.6)	(0.8)	(0.0)	(0.0)	(16.7)	(23.0)	(0.0)	(0.0)	(10.1)	(13.2)
Karanj	0.1	6.0	11.7	16.0	20.7	18.7	34.3	44.0	60.0	6.2	11.9	15.9	20.7
		(0.8)	(1.1)	(1.2)	(1.3)	(25.6)	(35.8)	(41.6)	(50.8)	(14.4)	(20.2)	(23.5)	(27.1)
	0.5	3.0	7.0	10.7	15.7	8.7	22.3	32.0	44.7	3.0	7.2	10.5	15.1
		(0.6)	(1.0)	(1.1)	(1.2)	(17.0)	(28.2)	(34.4)	(41.9)	(9.9)	(15.5)	(18.9)	(22.9)
	1.0	0.0	6.7	9.0	13.7	0.0	18.7	32.0	44.0	0.0	6.4	9.0	13.4
		(0.0)	(0.9)	(1.0)	(1.2)	(0.0)	(25.5)	(34.4)	(41.5)	(0.0)	(14.6)	(17.4)	(21.5)

Mustard	0.1	3.0	6.3	9.7	15.0	8.3	20.3	26.7	40.0	3.3	6.0	10.0	16.0
		(0.6)	(0.9)	(1.0)	(1.2)	(17.0)	(26.8)	(31.1)	(39.2)	(10.4)	(14.2)	(18.4)	(23.6)
	0.5	0.0	4.3	6.7	10.7	0.0	12.7	19.3	31.7	0.0	3.3	7.0	10.9
		(0.0)	(0.7)	(0.9)	(1.1)	(0.0)	(20.8)	(26.1)	(34.2)	(0.0)	(10.4)	(15.3)	(19.3)
	1.0	0.0	0.0	3.3	6.0	0.0	0.0	8.3	17.7	0.0	0.0	3.9	6.2
		(0.0)	(0.0)	(0.6)	(0.8)	(0.0)	(0.0)	(16.7)	(24.8)	(0.0)	(0.0)	(11.4)	(14.4)
Eucalyptus	0.1	9.3	13.3	16.3	22.0	28.7	38.3	48.0	64.7	8.9	9.5	16.0	21.4
		(1.0)	(1.2)	(1.2)	(1.4)	(32.3)	(38.3)	(43.9)	(53.6)	(17.3)	(17.9)	(23.6)	(27.6)
	0.5	5.7	9.3	13.0	19.0	18.0	28.0	38.7	58.0	5.6	5.0	13.4	19.2
		(0.8)	(1.0)	(1.2)	(1.3)	(25.0)	(31.9)	(38.5)	(49.6)	(13.7)	(12.9)	(21.4)	(26.0)
	1.0	3.0	5.0	8.3	14.7	9.7	16.0	23.0	39.0	3.0	2.7	7.0	15.0
		(0.6)	(0.8)	(1.0)	(1.2)	(18.0)	(23.5)	(28.6)	(38.6)	(10.0)	(9.4)	(17.1)	(22.7)
Taramira	0.1	3.7	5.7	9.3	16.7	9.7	16.3	25.0	46.7	3.2	3.5	9.8	16.3
		(0.7)	(0.8)	(1.0)	(1.3)	(18.0)	(23.7)	(30.0)	(43.1)	(10.3)	(10.7)	(18.2)	(23.8)
	0.5	1.3	4.3	8.0	14.0	4.7	12.0	22.3	35.0	1.8	1.9	8.3	13.9
		(0.4)	(0.7)	(0.9)	(1.2)	(12.4)	(20.2)	(28.1)	(36.3)	(7.7)	(7.9)	(16.7)	(22.0)
	1.0	0.0	0.0	6.0	11.3	0.0	0.0	18.3	32.0	0.0	0.0	6.2	11.6
		(0.0)	(0.0)	(0.84)	(1.1)	(0.0)	(0.0)	(25.3)	(34.4)	(0.0)	(0.0)	(14.4)	(19.6)
Untreated		32.0	34.0	31.3	33.0	86.2	86.0	86.0	87.3	30.3	32.0	33.0	33.0
		(1.5)	(1.5)	(1.5)	(1.5)	(68.1)	(68.1)	(68.1)	(69.2)	(33.4)	(34.5)	(35.1)	(35.1)
±SE	–	0.1	0.0	0.0	0.1	1.2	1.3	1.3	1.4	0.5	0.6	0.7	0.6
CD (p = 0.05)	–	0.1	0.1	0.1	0.2	3.5	3.6	3.6	3.9	1.3	1.8	1.9	1.8

*figures in parentheses are log X +1 values; **figures in parentheses are angular transformation values; ±SE – standard error

the fact that these products were used at low dose levels. Nevertheless, the treatment in which these products were used were found significantly superior over the untreated (68.1–69.2%). The other plant oil treatments (plant oils) ranked in the middle order as far as revealing grain damage was concerned.

Weight loss

The weight loss revealed by grain treated with Neem oil at 1.0 per cent was zero up to 270 days of treatment. The castor oil at 1.0 per cent, mustard oil at 1.0 per cent and Taramira oil at 1.0 per cent completely protected the grain for up to 90 days (there was no weight loss). There was also no weight loss recorded with the Neem oil at 0.5 per cent, castor oil at 0.5 per cent, Karanj oil at 1.0 per cent and mustard oil at 0.5 per cent when adults were released after 24 h of grain treatment.

The maximum weight loss was observed in grain treated with Eucalyptus at 0.1 per cent (8.9–21.4%), Karanj oil at 0.1 per cent (6.2–2.7%), and castor oil at 0.1 per cent (2.0–22.2%). Nevertheless, these treatments differed significantly over untreated (30.3–33.0%). The low efficacy of these treatments was due to their low dose. The other treatments ranked in the middle order. Allahvaisi *et al.* (2011) reported that plant product, *Syzigium aromaticum* oil caused repellency to *Sitotroga cerealella* and *Ephestia kuehniella*. Abd-Elhaldy (2012) found essential oil of *Artemisia judiaca* effective against cowpea weevil, *Callosobruchus maculates*.

Effect on viability of wheat seed

The data on the germination of wheat seed ranged from 83.00–86.7 per cent after 270 days of treatment which were on par with each other statistically (Table 2). These results revealed that revealed that plant oils did not influence the viability of the seed adversely. The findings conform with Verma *et al.* (1983) who observed no adverse effect on the seed viability as a result of treatments with Neem or castor or mustard oils.

Table 2. Effect of plant oils treatment on the germination of wheat after 270 days of treatment

No.	Plant oils	Dose [g/100 g]	Germination [%]
1.	Margosa	0.1	85.00 (67.23)
		0.5	85.00 (67.26)
		1.0	84.00 (66.41)
2.	Castor	0.1	84.66 (67.03)
		0.5	83.66 (66.28)
		1.0	83.66 (66.15)
3.	Karanj	0.1	85.33 (66.76)
		0.5	86.66 (68.38)
		1.0	86.66 (68.46)
4.	Mustard	0.1	86.66 (68.51)
		0.5	83.00 (65.74)
		1.0	83.33 (65.76)
5.	Eucalyptus	0.1	84.33 (66.57)
		0.5	84.66 (66.89)
		1.0	85.65 (67.73)
6.	Taramira	0.1	85.66 (67.90)
		0.5	86.66 (68.83)
		1.0	86.66 (68.59)
7.	Untreated		86.00 (68.02)
	±SE	–	1.29
	CD (p = 0.05)	–	ns
	CD (p = 0.01)	–	ns

Figures in the parentheses are angular values;
±SE – standard error; ns – not significant

ACKNOWLEDGEMENT

The authors are highly grateful to the Dean of Shri Karan Narendra College of Agriculture, Jobner and Vice-Chancellor, Swami Keshwanand Rajasthan Agricultural University for providing the necessary facilities to conduct the studies.

REFERENCES

Abd–Elhaldy H.K. 2012. Insecticidal activity and chemical composition of essential oil from *Artemisia judiaca* L. against *Callosobruchus maculates* (F.) (Coleoptera: Bruchidae). J. Plant Prot. Res. 52 (3): 347–352.

Allahvaisi S., Maroufpoor M., Abdolmaleki A., Hoseini S.A., Ghasemzadeh S. 2011. The effect of plant oils for reducing contamination of stored packaged foodstuffs, J. Plant Prot. Res. 51 (1): 82–86.

Anonymous. 1976. Germination method. Part I. Agriculture and Horticulture Seeds. Seed Sci. Tech. 4: 120.

Arthur F.H. 1995. Aeration alone versus chlorphyriphos-methyl treatment followed by aeration for wheat stored in Georgia: Simulated test. J. Econ. Entomol. 88 (6): 1764–1770.

Gillani W.A., Irshad M., Hashmi A.A. 1994. Comparison of selected insecticides against stored pests. p. 565–567. In: Proc. Pakistan Congress of Zoology. Twelfth Pakistan Congress of Zoology held under Auspices of Zoological Society of Pakistan Government College, Lahore, Zoological Society of Pakistan, April 1994, 668 pp.

Jilani G., Sexena R.C. 1990. Repellent and feeding deterrent effects of turmeric oil, *Neem* oil and *Neem* based insecticides against lesser grain borer (Coleoptera: Bostrichidae). J. Econ. Entomol. 83 (2) : 629–634.

Khatre V.M., Kachare B.V., Mote U.N. 1993. Effect of vegetable oils on mortality of pulse beetle in pegionpea seeds. Seed Rese. 21 (2): 78–81.

Majumdar S.K., Muthu M. 1960. Recent progress in prophylactic treatment for pest control in stored food stuffs in India. Food Sci. 9 (3): 89–95.

Singhamony S., Aneer I., Chandrakala T., Osmani Z. 1986. Efficacy of certain indigenous plant products as grain protectants against, *Sitophilus oryzae* (L.) and *R. dominica* (F.). J. Stored Prod. Res. 22: 21–23.

Verma S.P., Singh B., Singh Y.P. 1983. Studies on the comparative efficacy of certain grain protectants against *Sitotroga cerealella* (Olivier). Bull. Grain Tech. 21: 37–42.

Yadav T.D., Singh S. 1994. Persistence toxicity and efficacy of four insecticides as jute fabric treatment to protect cereal and legume seeds. Indian J. Entomol. 56 (2): 146–155.