

Efficacy of Edible and Non-Edible Oils on the Infestation of *Rhizopertha dominica* (Fabricious) in Stored Wheat

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Abstract Eight plant oils @ 5 and 10 ml/kg of wheat grains were tested for their efficacy in protecting stored wheat against *R. dominica*. Minimum adult emergence was recorded in grains treated with neem oil @ 10 and 5 ml/kg with 1.00 and 1.16 adults at 40 DAS, 2.06 and 2.36 adults at 80 DAS, 2.26 and 2.63 adults at 120 DAS, respectively followed by karanj oil and castor oil @ 10 and 5 ml/kg wheat grains. Minimum grain damage was found in grains treated with neem oil @ 10 and 5 ml/kg dose level at 40, 80 and 120 DAS followed by karanj oil and castor oil @ 10 and 5 ml/kg wheat grains. Maximum of (93.50 and 91.50%) germination percentage was observed in grains

treated with neem oil @ 10 and 5 ml/kg dose level followed by karanj oil (90.25%) and castor oil (89.00%) @ 10 ml/kg wheat grains after 120 DAS.

Keywords Infestation, Plant oils, Management, *Rhizopertha dominica*, Wheat.

Introduction

Wheat belongs to the family *Gramineae* and is one of the most leading food grain crops cultivated extensively in all the continents. India is the second largest producer of wheat in the world. The growing species of wheat in India is bread wheat (*Triticum aestivum*) accounting more than 85% of the total wheat area. Lesser grain borer, *R. dominica* is a field to store pest and cause economic damage in the store (Adedire 2001). It not only reduces the quantity but also deteriorate the quality of grain and its products (Atwal 1994). The present, pest control measures in storage rely on the use of synthetic insecticides and fumigants. Their indiscriminate use in the storage, however, has led to a number of problems including insect resistance, toxic residues in food grains (Fishwick 1988), environment pollution (WMO 1995) and increasing cost of application. Moreover, the poor storage facilities of traditional farmers in the developing countries are unsuitable for effective conventional chemical control, as most of the storage types are open to re-infestation by insect pests (Tapondjou et al. 2002). To avert these problems, there is a need to develop management practices, which

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Table 1. Effect of different oils on the adult emergence of *R. dominica* in stored wheat. *Square root transformed values, Data in the parentheses are retransformed values, DAS=Days after storage.

Treatments	Plant oils	Dose ml/kg	Adult emergence		
			40 DAS	80 DAS	120 DAS
T ₁	Coconut oil	5	*2.43 (5.40)	*2.70 (6.76)	*2.95 (8.20)
T ₂	Coconut oil	10	2.26 (4.63)	2.62 (6.40)	2.82 (7.46)
T ₃	Groundnut oil	5	2.14 (4.06)	2.43 (5.40)	2.59 (6.23)
T ₄	Groundnut oil	10	2.01 (3.53)	2.42 (5.36)	2.50 (5.73)
T ₅	Mustard oil	5	1.75 (2.56)	2.34 (5.00)	2.47 (5.60)
T ₆	Mustard oil	10	1.65 (2.26)	2.20 (4.36)	2.29 (4.76)
T ₇	Sunflower oil	5	2.10 (3.90)	2.45 (5.50)	2.54 (5.96)
T ₈	Sunflower oil	10	1.97 (3.40)	2.29 (4.76)	2.33 (5.03)
T ₉	Neem oil	5	1.29 (1.16)	1.69 (2.36)	1.77 (2.63)
T ₁₀	Neem oil	10	1.22 (1.00)	1.58 (2.06)	1.66 (2.26)
T ₁₁	Karanj oil	5	1.41 (1.50)	1.99 (3.53)	2.14 (4.06)
T ₁₂	Karanj oil	10	1.35 (1.33)	1.94 (3.33)	2.04 (3.66)
T ₁₃	Castor oil	5	1.60 (2.06)	2.16 (4.16)	2.21 (4.40)
T ₁₄	Castor oil	10	1.46 (1.66)	2.08 (3.83)	2.15 (4.13)
T ₁₅	Jatropha oil	5	2.17 (4.23)	2.68 (6.70)	2.77 (7.16)
T ₁₆	Jatropha oil	10	1.91 (3.16)	2.60 (6.26)	2.65 (6.56)
T ₁₇	Control	–	3.49 (11.65)	4.25 (17.55)	4.56 (20.33)
	SEm ±		0.06	0.10	0.09
	CD (at 5%)		0.19	0.30	0.26
	CV %		6.65	8.02	6.62

are more effective, economical safer and easier to adopt. The use of plant products are considered to be the novel approaches, though they are good age old methods. The plant products may prove superior to synthetic chemicals as they are ecologically safe, easily degradable, besides easy availability at low cost. Therefore, much effort has therefore, been focused on plant derived materials for potentially useful products as commercial insect control agents. However, it was a novel approach to use plant oils as a grain protectants against *R. dominica* on wheat hence keeping these points in mind a novel approach was undertaken to assess the effect of different plant oils on different parameters of *R. dominica* in stored wheat under four months storage period.

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Materials and Methods

The experiment was conducted in the storage grain

laboratory, Department of Entomology, College of Agriculture, Junagadh Agricultural University, Junagadh, during the year 2014–2015. The initial culture of test insect was maintained on disinfected grains at $30 \pm 1^\circ\text{C}$ in BOD incubator. A single pair of *R. dominica* was obtained from the stock culture. Clean grains of wheat were sterilized at the temperature of 50°C for 4 h in the oven to eliminate the hidden infestation and were conditioned. Twenty five pairs of one or two days old beetles from the initial culture was released in cylindrical glass jar measuring 20×15 cm containing 250 g grains. Subsequently adults emerged from this culture were used for further study.

The effect of edible and non-edible oils, against lesser grain borer was tested under laboratory conditions Figs. 1–3). The oils such as coconut oil, groundnut oil, mustard oil, sunflower oil, neem oil, karanj oil, castor oil, jatropha oil were procured from the local market and filtered through Whattmann filter paper. The known quantity of grains 1 kg was kept in plastic container with capacity of 1.5 kg, in which measured quantity of oil was added. Plastic containers were rotated in order to obtain uniform smearing of oil on the grains. The plastic containers were covered with

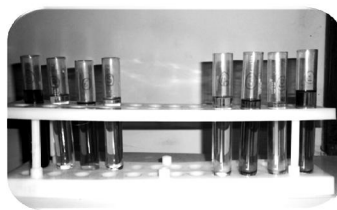


Plate I: Different types of oils used in experiment against *R. dominica* in stored wheat



Plate II: Efficacy of different edible and non-edible oils against *R. dominica* in stored wheat



Plate III: Germination test of wheat grains treated with different oils

Fig. 1. Different types of oils used in experiment against *R. dominica* in stored wheat, **Fig. 2.** Efficacy of different edible and non-edible oils against *R. dominica* in stored wheat, **Fig. 3.** Germination test of wheat grains treated with different oils.

lid and stored in the laboratory for 3 months for experimental purpose. A control was also maintained simultaneously. Three samples each of 25 g grains was drawn from each dose of different protectants as well as control and were kept in glass vials (10×2.5 cm). Five pairs of 1 to 2 day old adults were released in each glass vial. This exercise was done at 0, 40 and 80 day of treatment of the grain. The sets were kept in BOD incubator at $30 \pm 1^\circ\text{C}$ and $75 \pm 5\%$ relative humidity for 40 days. Observations were recorded for the emergence of first generation beetles at 40 day after release of the pair. The efficacy of each treatment was determined by comparing the F_1 progeny with those observed in untreated control during same period. For grain damage studies the damaged and healthy grains were sorted out and counted. One or more holes per seed were considered as damaged grains. The data, obtained were statistically analyzed.

The following formula was used to work out per cent grain damage.

$$\text{Per cent grain damage} = \frac{\text{Number of damage grain}}{\text{Total number of grain}} \times 100$$

Germination test was conducted at 120 day after storage of wheat grains to assess the effect of oils on viability of grains. 100 bold treated wheat grains along with untreated grains were selected and were treated with thiram. The grains was soaked with distilled water and kept in sterilized petridish consisting of wetted blotting paper at the bottom. One piece of wetted blotting paper was placed in to upper dish. Four replications each having 25 grains was examined. Blotting papers was kept moist by applying distilled water. Germination count was made after 10 days. The

Table 2. Effect of different plant oils on the per cent grain damage caused by *R. dominica* in stored wheat. *Arcsine transformed value, Data in the parentheses are retransformed value, DAS=Days after storage

Treatments	Plant oils	Dose ml/kg	Percent grain damage		
			40 DAS	80 DAS	120 DAS
T ₁	Coconut oil	5	*17.77 (9.33)	*18.56 (10.13)	*20.38 (12.13)
T ₂	Coconut oil	10	17.46 (9.00)	17.78 (9.33)	18.69 (10.27)
T ₃	Groundnut oil	5	15.68 (7.33)	16.43 (8.00)	16.77 (8.33)
T ₄	Groundnut oil	10	14.18 (6.00)	14.79 (6.53)	15.54 (7.20)
T ₅	Mustard oil	5	13.46 (5.47)	14.50 (6.27)	15.25 (6.93)
T ₆	Mustard oil	10	13.34 (5.33)	13.76 (5.67)	14.57 (6.33)
T ₇	Sunflower oil	5	13.85 (5.73)	13.85 (5.73)	15.98 (7.60)
T ₈	Sunflower oil	10	13.51 (5.47)	13.68 (5.60)	15.84 (7.47)
T ₉	Neem oil	5	9.47 (2.73)	10.61 (3.40)	11.13 (3.73)
T ₁₀	Neem oil	10	8.13 (2.00)	9.36 (2.67)	9.97 (3.00)
T ₁₁	Karanj oil	5	12.54 (4.73)	13.42 (5.40)	14.02 (5.87)
T ₁₂	Karanj oil	10	12.10 (4.40)	12.98 (5.07)	13.67 (5.60)
T ₁₃	Castor oil	5	13.00 (5.06)	13.81 (5.73)	14.72 (6.46)
T ₁₄	Castor oil	10	12.80 (4.93)	13.51 (5.47)	14.17 (6.00)
T ₁₅	Jatropha oil	5	16.57 (8.13)	17.11 (8.67)	18.31 (9.87)
T ₁₆	Jatropha oil	10	16.28 (7.86)	16.42 (8.02)	17.89 (9.46)
T ₁₇	Control	–	23.47 (15.86)	25.20 (18.13)	28.41 (22.66)
	SEm ±		0.47	0.42	0.69
	CD (at 5%)		1.37	1.47	2.00
	CV %		5.98	5.15	7.84

data thus obtained were statistically analyzed.

Results and Discussion

Efficacy of different edible and non-edible oils against *R. dominica* in stored wheat

The observations were recorded at 40, 80 and 120 days after storage. The data pertaining to adult emergence and grain damage in wheat grains treated by various leaf powders at 40, 80 and 120 days after storage and observation on germination test after 120 days after storage were presented in Tables 1, 2 and 3.

Adult emergence

At 40 day after storage the adult emergence was ranged from 1.00 to 5.40 adult beetles in different oils. All the oils were found effective in reducing adult emergence as compared to control (Fig. 4). Minimum adult emergence was recorded in grains treated with neem oil @ 5 and 10 ml/kg (1.16 and 1.00 adults) fol-

lowed by karanj oil @ 10 ml/kg (1.33 adults). Kumawat and Naga (2013) they reported that maximum protection was provided by neem oil @ 1.0%. While, coconut oil @ 5 and 10 ml/kg grains (4.63 and 5.40 adults) was found at par with jatropha oil @ 5 ml/kg (4.23 adults). At 80 days after storage adult emergence was ranged from 2.06 to 6.76 adult beetles Minimum adult emergence was observed in grains treated with neem oil (2.06 and 2.36 adults) @ 10 and 5 ml/kg wheat

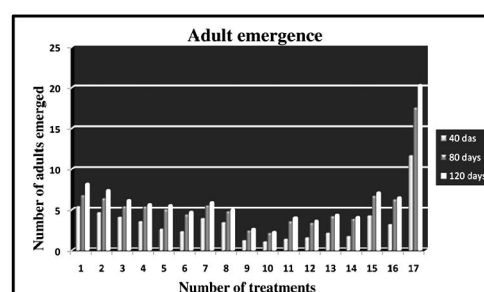


Fig. 4. Effect of different oils on the adult emergence of *R. dominica* in stored wheat.

Table 3. Effect of different oils on the germination percentage of stored wheat infested with *R. dominica*. *Arcsine transformed values, Data in the parentheses are retransformed values, DAS=Days after storage.

Treatments	Plant oils	Dose ml/kg	Germination % 120 DAS
T ₁	Coconut oil	5	*60.01 (75.00)
T ₂	Coconut oil	10	63.11 (79.50)
T ₃	Groundnut oil	5	64.18 (81.00)
T ₄	Groundnut oil	10	65.95 (83.34)
T ₅	Mustard oil	5	68.48 (86.50)
T ₆	Mustard oil	10	70.02 (88.32)
T ₇	Sunflower oil	5	64.93 (82.00)
T ₈	Sunflower oil	10	67.25 (85.00)
T ₉	Neem oil	5	73.07 (91.50)
T ₁₀	Neem oil	10	75.91 (93.50)
T ₁₁	Karanj oil	5	69.73 (88.00)
T ₁₂	Karanj oil	10	71.92 (90.25)
T ₁₃	Castor oil	5	68.70 (86.76)
T ₁₄	Castor oil	10	70.69 (89.00)
T ₁₅	Jatropha oil	5	63.92 (80.66)
T ₁₆	Jatropha oil	10	64.55 (81.50)
T ₁₇	Control	–	56.18 (69.00)
	SEm ±		1.93
	CD (at 5%)		5.50
	CV %		5.69

grains similarly less adults were also observed in grains treated with karanj oil @ 10 and 5 ml/kg (3.33 and 3.53 adults) and castor oil @ 10 and 5 ml/kg (3.83 and 4.16 adults). The maximum (6.76 adults) adult emergence was observed in grains treated with coconut oil @ 5 ml/kg wheat grains followed by jatropha oil @ 5 ml/kg (6.70 adults) and coconut oil @ 10 ml/kg dose level (6.40 adults). At 120 days after storage the adult emergence was ranged from 2.26 to 8.20 adult beetles. Minimum adult emergence (2.26 and 2.63 adults) was recorded in grains treated with neem oil @ 10 and 5 ml/kg wheat grains. Kakde et al. (2014) observed that the gunny bags impregnated with neem oil @ 10% and mustard oil @ 10% provides complete protection over the adult emergence. Less adult emergence was also recorded in wheat grains treated with karanj oil @ 10 and 5 ml/kg wheat grains (3.66 and 4.06 adults) followed by castor oil @ 10 and 5 ml/kg wheat grains (4.13 and 4.40 adults).

Per cent grain damage

All the oils were found effective in reducing grain

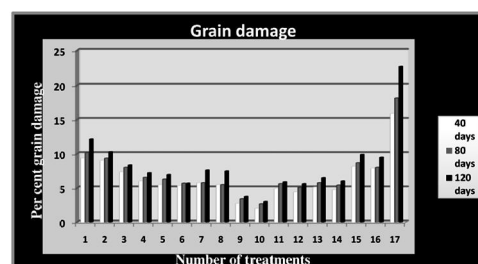


Fig. 5. Effect of different oils on the per cent grain damage caused by *R. dominica* in stored wheat.

damage over control. At 40 day after storage the grain damage ranged from 2.00 to 9.33% in different oils (Fig. 5). Minimum grain damage was recorded in the grains treated with neem oil @ 10 and 5 ml/kg (2.00 and 2.73%) wheat grains followed by karanj oil @ 10 and 5 ml/kg with (4.40 and 4.73%) grain damage was observed. While, significantly maximum (9.33 and 9.00%) grain damage was observed in grains treated with coconut oil @ 5 and 10 ml/kg wheat grains respectively, which was at par with jatropha oil @ 5 and 10 ml/kg wheat grains with 8.13 and 7.86% grain damage respectively. At 80 day after storage the grain damage ranged from 2.67 to 10.13%. Minimum grain damage was recorded in the grains treated with neem oil @ 10 and 5 ml/kg wheat grains (2.67 and 3.40%) followed by karanj oil @ 10 and 5 ml/kg with (5.07 and 5.40%) grain damage was observed. At 120 day after storage. The grain damage was ranged from 3.00 to 12.13% in different oils. Minimum grain damage was found in the grains treated with neem oil @ 10 and 5 ml/kg (3.00 and 3.73%). Less grain damage (5.60 and 5.87%) was observed in karanj oil treated @ 10 and 5 ml/kg wheat grains respectively which was at par with castor oil @ 10 ml/kg wheat grains with 6.00% grain damage. Significantly maximum (12.33% and 10.27%) grain damage was observed in grains treated with coconut oil @ 5 and 10 ml/kg wheat grains respectively, which was followed by jatropha oil @ 5 and 10 ml/kg wheat grains (9.87 and 9.46%). Singh and Singh (2005) showed that grain damage was decreased considerably in grain treated with neem oil.

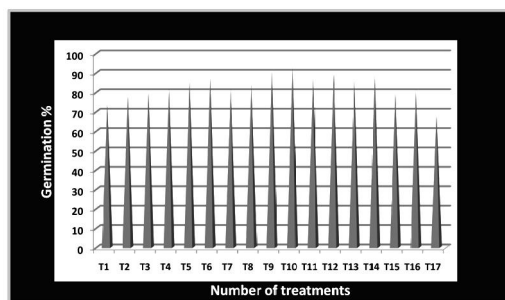


Fig. 6. Effect of different oils on the germination percentage of stored wheat infested by *R. dominica* after 120 DAS.

Germination (%)

After 120 days of treatment, significant difference on the germination of wheat grains was observed. All the treatments differed significantly in respect of per cent germination from the control (Fig. 6). The germination ranged from 75.00 to 93.50% in different treatments as compared to 69.00% in control. The maximum 93.50 and 91.50% germination was observed in wheat grains treated with neem oil @ 10 and 5 ml/kg dose level followed by karanj oil @ 10 ml/kg (90.25%), castor oil @ 10 ml/kg (89.00%) dose level and these treatments were highly significant over control. Nema and Bhargava (2005) showed that no adverse effect of tested oils was noted on the germination of wheat grains. The minimum average per cent germination was observed on wheat grains treated with coconut oil (75.00 and 79.50%) @ 5 and 10 ml/kg dose level followed by jatropha oil (80.66 and 81.50%) at same dose level.

Conclusion

Considering the hazardous effects of chemicals used

for control of stored insect pests, it is necessitated to use the ecofriendly approaches such as botanicals for their management. However, it is a novel approach to use plant oils as grain protectants against *R. dominica* on wheat. However, it could be concluded that neem oil, karanj oil, castor oil, mustard oil, sunflower oil and jatropha oil @ 5 and 10 ml/kg were found highly effective plant oils for the management of *R. dominica* and as seed protectants. These studies clearly demonstrated the potential and possibilities of using plant oils in overall IPM strategies for the control of storage insect pests in wheat.

References

- Adedire CO (2001) Pests of stored cereals and pulses in Nigeria. In : Ofuya TI, Lale NES (eds). Biology, ecology and control of insect pests of stored grains. Nigeria: Dave Collins Publ, pp 59—94.
- Atwal AS (1994) Insect pest of stored grain and other products: Agricultural pest of India and South East Asia, National Book Foundation. 2nd (edn), pp 402—405.
- Fishwick FB (1988) Pesticide residues in grain arising from post-harvest treatments. Aspects of Appl Biol 17 : 37—46.
- Kakde SP, Dhonde SV, Sarda AL, Khillare PW, Deshwal HL (2014) Screening of wheat varieties and eco-friendly management of *Rhizopertha dominica* (Fab.) on wheat. PI Arch 14(1) : 431—437.
- Kumawat KC, Naga BL (2013) Effect of plant oils on the infestation of *Rhizopertha dominica* (Fab.) in wheat (*Triticum aestivum*). J Pl Prot Res 53(3) : 301—304.
- Nema R, Bhargava MC (2012) Management of *Rhizopertha dominica* (Fab.) on wheat with essential oils. J Insect Sci 25(4) : 388—390.
- Singh RK, Singh AK (2005) Efficacy of different indigenous plant products as grain protectant against *Rhizopertha dominica* (Fab.) on wheat. Ind J Ent 67(3) : 196—198.
- Tapondjou LA, Adler C, Bouda H, Fontem DA (2002) Efficacy of powder and essential oil from *Chenopodium ambrosioides* leaves as post-harvest grain protectants against six-stored product beetles. J Stored Prod Res 38(4) : 395—402.
- WMO (1995) Scientific assessment of ozone depletion: World meteorological organization global ozone research and monitoring project. Report No. 37, WMO, Geneva, Switzerland.