International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 04-07-2025, Accepted: 03-08-2025, Published: 18-08-2025
Volume 10, Issue 8, 2025, Page No. 82-86

Non-chemical management of lesser grain borer (*Rhyzopertha dominica*) on wheat

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Abstract
To study efficacy of different oil for management of lesser grain borers six type of different oils @ 5 ml/500g of wheat grain were tested against *R. dominica*. Significantly minimum adult emergence was recorded in grains treated with neem oil @ 5 ml/500 g with 2.80 per cent after 15 days, 3.53 per cent after 30 days and 5.61 per cent after 45 days. Minimum grain damage was recorded in grains treated with neem oil @ 5 ml/500 g 3 per cent after 15 days, 4.65 per cent after 30 days and 7.28 per cent after 45 days. Minimum weight loss was recorded in grains treated with neem oil @ 5 ml/500 g with 0.69 per cent after 15 days, 1.73 per cent after 30 days and 3.26 per cent after 45 days.

Keywords: *Rhyzopertha dominica*, Different oil, wheat

Introduction

Wheat (*Triticum aestivum L.*) belongs to family Poaceae, is a staple food in the world. Lesser grain borer inflicts colossal loss to grains and grain products during storage. The amount of damage in quality, quantity loss could be prevented by use of chemicals or botanical insecticides. Synthetic chemical pesticides have been used for many years to control stored grain pests (Salem *et al*, 2007) [10]. Fumigation of stored food grains with toxic gases is effective but not feasible at the farm level because the storage structures are not airtight. Furthermore, control of insects by insecticides has serious drawbacks, such as the toxic residues on stored grains, development of resistance by target species, pest resurgence and lethal effects on non-target organisms in addition to direct toxicity to users and health hazard (Adedire and Lajide 2003; Adedire *et al.* 2011; Ileke and Oni 2011; Ileke and Olotuah 2012; Ileke and Bulus 2012) [1, 2, 5, 6, 7, 8]. This situation warrants the need of safe but effective, biodegradable insecticides with no toxic effects on non-target organisms for pest control in storage. Recently, there has been a steady increase in the use of botanicals as a cheaper and ecologically safer means of protecting stored products against infestation by insects (Ashamo and Odeyemi 2001; Oni and Ileke 2008; Akinkurolere *et al*. 2009; Ileke *et al.* 2012) [3, 4, 5, 6, 8, 9].

There is a need to find alternatives to the chemicals that can effectively prevent storage losses, are easily available, affordable, safer and least detrimental to the environment. There has been little emphasis on breeding for grain resistance to insect pests of stored products. In the countries where storage facilities are inadequate, stored grain resistance might be used either alone or along with other methods. Apart from this, traditionally different plant materials and inert dust have been used as admixtures and surface barriers against insects during storage. These materials are known to have many advantages as they are safe for the environment and consumers. The inability of the insect pests to develop resistance against them is an added advantage.

Materials and Methods

The different oils were mixed with grains. For mixing, 500g grains were placed in the plastic container and add desired doses of different oils. The oils were mixed thoroughly with grains. Simultaneously, an untreated control was also kept. The treatments were repeated three times. Ten pairs of newly emerged adults were released in treated grains. The experiment was carried out at PG laboratory, Department of Entomology, N. M. College of Agriculture, Navsari during 2023-2024 years.

The effects of edible and non-edible oils, against lesser grain borer were tested under laboratory condition. The oils were procured from local market. The known quantity of grains 500 g was kept in plastic container with capacity of 1 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 lid and stored in the laboratory for 60 days 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 15, 30 and 45 days. The study was carried out in 2003 with completely randomized design, seven treatments and three repetition

Table 1: Different Oils Used for Evaluated of *R. dominica*

Treatment	Oil Name	Dose ml/ 500g
T1	Castor oil	5
T2	Neem oil	5
T3	Coconut oil	5
T4	Mustard oil	5
T5	Sesame oil	5
T6	Soybean oil	5
T7	Control	-

To find out the effect of treatments on the infestation and weight loss, the treated as well as untreated grains were kept in plastic container**.** Ten pair of adults were released into each container. Observations were taken based on adult emergence, grain damage and weight loss.

1. Adult emergence

The adults of *R. dominica* that emerged from different treatments were counted daily and removed from the

respective containers. Counting was continued till they cease to emerge. Final data were pooled to get the total number of adults who emerged from each treatment and per cent adult emergence was calculated:

$$\text{Per cent adult emergence} = \frac{\text{Number of adult emergence}}{\text{Initial egg population (no.)}} \times 100$$

2. Weight loss

The weight loss was calculated by deducting the final weight of the sample from the initial weight and then converted to the percentage.

$$\text{Per cent Weight loss} = \frac{W1 - W2}{W1} \times 100$$

Where, W1 = Initial weight of grains
W2 = Final weight of grains

3. Grain damage

Damaged wheat grains were separated, counted and expressed as per cent grain damage. Data were statistically analyzed. The following formula was used to work out per cent grain damage.

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

Results and Disscution

In the experiment, six different type oils and control (No smearing) were evaluated to test their efficacy as protectants against the lesser grain borer, *R. dominica* under the laboratory condition. However, there was a wide variation in adult emergence, grain damage and weight loss present in different treatment.

1. Evaluation Based on Adult Emergence in Wheat Grains at Different Storage Periods

1.1 Adult emergence after 15 days

The result presented in Table 3 and Figure 1 indicated that each treatment found significantly superior than the untreated control (14.21%). Significant differences in per cent adult emergence (range 2.8 to 14.21 %) in wheat grains treated with different oils after 15 days of treatment. Maximum protection was obtained when grains were treated with neem oil (2.80%). It remained statistically at par with castor oil (3.98%). The treatment with coconut oil (11.68%) was found least effective. Whereas, treatment with mustard oil, sesame oil and soybean oil were found moderately effective with 5.99, 7.60 and 10.19 per cent adult emergence, after 15 days of treatment, respectively.

1.2 Adult emergence after 30 days

The result presented in Table 4.14 and Figure.4.4 showed that all the treatments give better protection than untreated control (22.27%) after 30 days of treatment which ranges between 3.53 to 22.27 per cent adult emergence. Maximum protection was obtained when grains were treated with neem oil (3.53%) and it was found statistically at par with the treatment of castor oil (5.01%). The treatment with coconut oil (16.02%) was found least effective. However, the treatment with mustard oil, sesame oil and soybean oil were found moderately effective with 7.80, 12.32 and 13.88 per cent adult emergence after 30 days of treatment, respectively.

1.3 Adult emergence after 45 days

The data on per cent adult emergence after 45 days of treatment are presented in Table 3 and reflected in Figure 1 showed that each treatment found superior then untreated control (24.24%). Maximum protection was recorded when wheat grains were treated with neem oil (5.61%). The treatment with coconut oil (17.45%) was found least effective. The treatment with castor oil, mustard oil, sesame oil and soybean oil were found moderately effective with 6.20, 9.81, 13.32 and 14.11 per cent adult emergence after 45 days of treatment, respectively.

In a study, Singh *et al.* (2016) reported that the wheat treated with neem oil had shown the lowest number of adults emerged of lesser grain borer (3.33%) after 30 days of storage. Kakde *et al.* (2014) observed that the gunny bags impregnated with neem oil @10 per cent provides complete protection over adult emergence.

Table 2: Effect of different oils on per cent adult emergence of *R. dominica* on wheat at different storage periods

Treatment @ 5 ml/500g		Per cent adult emergence		
		15 days	30 days	45 days
T_1	Castor oil	11.48 (3.98)	12.94 (5.01)	14.38 (6.20)
T_2	Neem oil	9.55 (2.80)	10.79 (3.53)	13.65 (5.61)
T_3	Coconut oil	19.97 (11.68)	23.57 (16.02)	24.70 (17.45)
4	Mustard oil	14.14 (5.99)	16.18 (7.80)	18.23 (9.81)
T_5	Sesame oil	16.01 (7.60)	20.54 (12.32)	21.39 (13.32)
T_6	Soybean oil	18.62 (10.19)	21.87 (13.88)	22.06 (14.11)
T_7	Control	22.13 (14.21)	28.16 (22.27)	29.50 (24.24)
SEm ±		0.64	0.71	0.74
CD at 5 %		3.38	3.75	3.92
CV %		7.00	6.47	6.30

Note: outside data are arcsine transformed values, data in parentheses are retransformed values

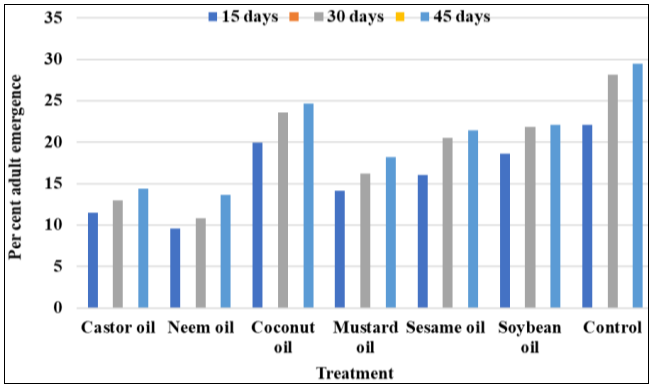

Fig 1: Effect of different oils on per cent adult emergence of *R. dominica* on wheat varieties at different storage periods

Evaluation Based on Per Cent Damage in Wheat Grains at Different Storage Periods

1. Grain damage after 15 days

The result presented in Table 3 depicted in Figure 1 revealed that each treatment having significantly better results than untreated control (17.13% grain damage). There were significant differences in grain damage ranged from 3 to 17.13 per cent in wheat grains treated with different oils after 15 days of treatment. Grains treated with neem oil were found effective with less grain damage (3%). It remained statistically at par with castor oil (4.05%). Further, significantly maximum grain damage was recorded in grains treated with coconut oil (10.44%). However, the treatment

mustard oil, sesame oil and soybean oil were found moderately effective with 5.93, 6.62 and 8.00 per cent grain damage after 15 days of treatment, respectively.

2. Grain damage after 30 days

Data presented in Table 3 and depicted in Figure 2 revealed that all the treatments shown significant in grain damage as compared to untreated control (25%). However, these treatments found significant different in grain damage ranged between 4.65 to 25 per cent in wheat grains treated with different oils after 30 days of treatment. Grains treated with neem oil was found effective with less grain damage (4.65). Further, significantly higher grain damage was recorded when the grains were treated with coconut oil (17.81%). However, the treatment castor oil, mustard oil, sesame oil and soybean oil were found moderately effective with 6.87, 10.68, 12.16 and 13.98 per cent grain damage after 30 days of treatment, respectively.

3. Grain damage after 45 days

The result presented in Table 3 and showed in Figure 2 indicated that all the treatments performed better than untreated control (26.97%). However, they found significantly differed in grain damage ranging between 7.28 to 26.97 per cent in wheat grains treated with different oils after 45 days of treatment. Grains treated with neem oil were found effective with less grain damage (7.28%). Maximum grain damage was recorded in grains treated with coconut oil (19.89%) it was found statistically at par with the treatment of soybean oil (17.78%) and sesame oil (15.89%). However, the treatment of castor oil and mustard oil were found moderately effective with 11.48 and 14.32 per cent grain damage after 45 days of treatment, respectively.

In past, Singh and Singh (2005) they observed that grain damage was as high as 65.07% in untreated control, which decreased considerably to 2.80% grain treated with neem oil. Singh *et al.* (2016) reported that grain treated with neem oil showed lower grain damage 0.30 per cent after 30 days of storage.

Table 3: Effect of different oils on per cent grain damage by *R. dominica* on wheat at different storage periods

Treatment @ 5 ml/500g		Per cent grain damage		
		15 days	30 days	45 days
T_1	Castor oil	11.58 (4.05)	15.17 (6.87)	19.79 (11.48)
T_2	Neem oil	9.87 (3)	12.37 (4.65)	15.63 (7.28)
T_3	Coconut oil	18.86 (10.44)	24.95 (17.81)	26.49 (19.89)
T_4	Mustard oil	14.07 (5.93)	19.07 (10.68)	22.23 (14.32)
T_5	Sesame oil	14.91 (6.62)	20.33 (12.16)	23.45 (15.89)
T_6	Soybean oil	16.43 (8.00)	21.94 (13.98)	24.90 (17.78)
T_7	Control	24.44(17.13)	30.01 (25)	31.30 (26.97)
SEm±		0.63	0.90	0.93
CD at 5 %		3.33	4.75	4.91
CV %		6.99	7.64	6.93

Note: outside data are arcsine transformed values, data in parentheses are retransformed values

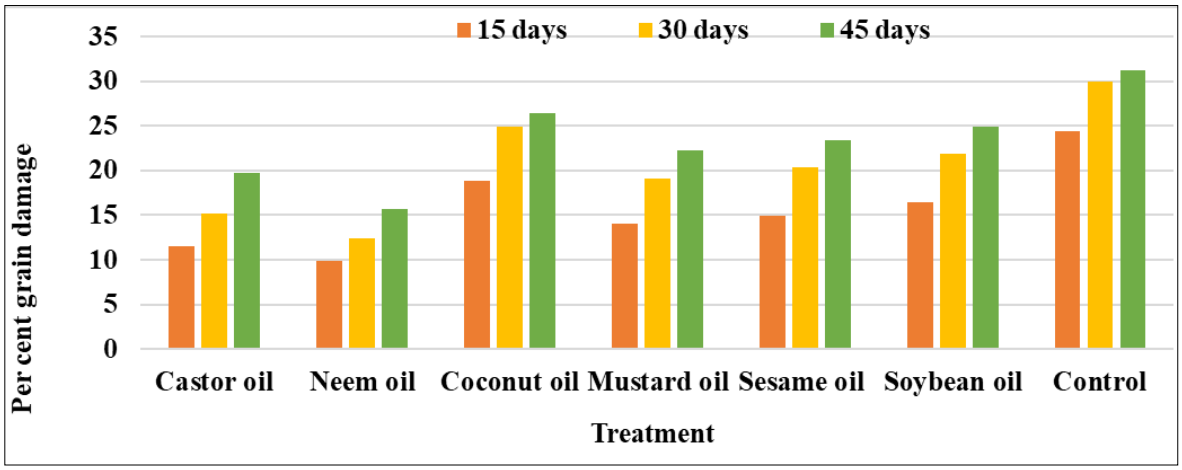

Fig 2: Effect of different oils on per cent grain damage by *R. dominica* on wheat verities at different storage period

Evaluation Based on Weight Loss in Wheat Grains at Different Storage Periods

1. Weight loss after 15 days

The result presented in Table 4 indicated significant difference in weight loss ranged from 0.69 to 7.63 per cent in wheat grains treated with different oils after 15 days of treatment. All treatments were found superior in reducing weight loss as compared to untreated control (7.63%). Maximum protection was noticed when grains were treated with neem oil (0.69%). The treatment with coconut oil (3.39%) was found least effective. However, the treatment castor oil, mustard oil, sesame oil and soybean oil were found moderately effective with 1.06, 1.68, 2.55 and 2.73 per cent weight loss after 15 days of treatment, respectively.

2. Weight loss after 30 days

The result presented in Table 4 indicated significant differences in per cent weight loss ranged from 1.73 to 16.18 in wheat grain treated with different oils after 30 days of treatment. All the treatments with various oils gave a good performance in the reduction of weight loss than untreated control (16.18%). Maximum protection was

noticed when grains were treated with neem oil (1.73%). The treatment with coconut oil (10.19%) was found least effective. However, the treatment with castor oil, mustard oil, sesame oil and soybean oil were found moderately effective with 2.4, 6.57, 7.22 and 8.43 per cent weight loss after 30 days of treatment, respectively.

3. Weight loss after 45 days

The result presented in Table 4 indicated significant differences in weight loss ranged from 3.26 to 24.78 per cent in wheat grains treated with different oils after 45 days of storage. All oils treated grains remain well protected as compared to untreated control (24.78%). Maximum protection was noticed when grains were treated with neem oil (3.26%). The treatment comprises of coconut oil (13.25%) was found least effective. However, the treatments of castor oil, mustard oil, sesame oil and soybean oil were found moderately effective with 4.15, 7.64, 9.44 and 10.89 per cent weight loss after 45 days of treatment, respectively. Singh *et al.* (2016) found neem is highly effective in prohibiting the adult emergence of grain on wheat, with higher inhibition rate and showed a reduction in the grain damage and per cent weight loss over other treatments.

Table 4: Effect of different oils on per cent weight loss by *R. dominica* on wheat at different storage periods

Treatment @ 5 ml/500g		Per cent Weight loss		
		15 days	30 days	45 days
T_1	Castor oil	5.91 (1.06)	8.88 (2.4)	11.69 (4.15)
T_2	Neem oil	4.61 (0.69)	7.52 (1.73)	10.39 (3.26)
T_3	Coconut oil	10.62 (3.39)	18.60 (10.19)	21.32 (13.25)
T_4	Mustard oil	7.44 (1.68)	14.78 (6.57)	16.03 (7.64)
T_5	Sesame oil	9.18 (2.55)	15.29 (7.22)	17.89 (9.44)
T_6	Soybean oil	9.52 (2.73)	16.85 (8.43)	19.24 (10.89)
T_7	Control	16.04 (7.63)	23.73 (16.18)	29.87 (24.78)
SEm±		0.38	0.69	0.73
CD at 5 %		2.03	3.64	3.85
CV %		7.44	7.96	7.04

Note: outside data are arcsine transformed values, data in parentheses are retransformed values

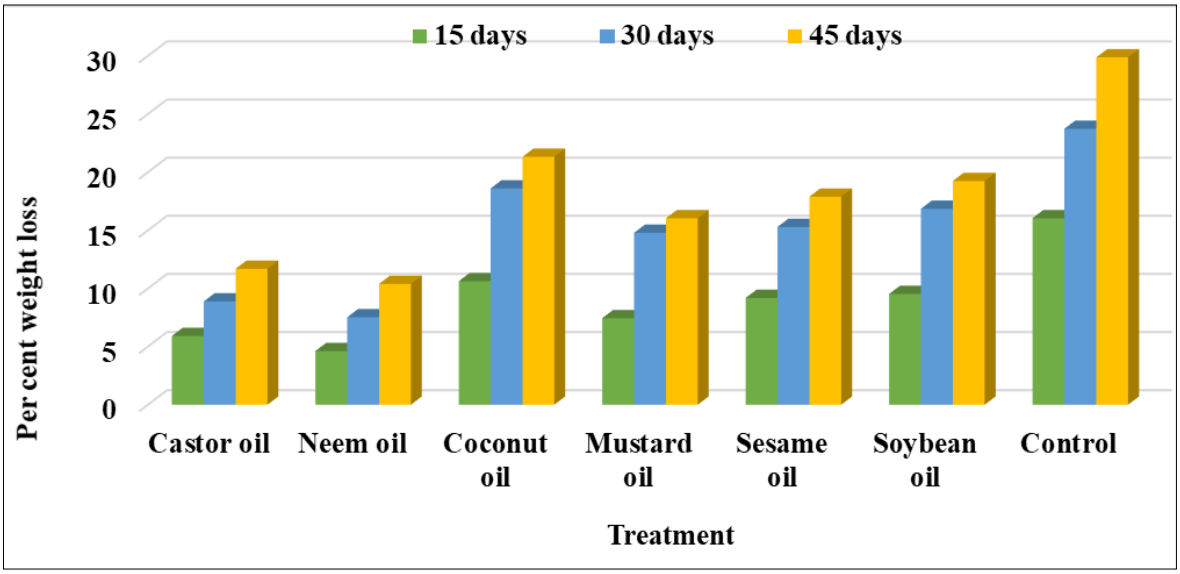

Fig 3: Effect of different oils on per cent weight loss by *R. dominica* on wheat varities at different storage periods

Conclusion

Among six different types of oils treated with wheat grains less adult emergence, less per cent grain damage and per cent weight loss was observed in wheat grain treated with neem oil@ 5ml in 500 g of grain.

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