

## Efficacy of Different Leaf Powders on the Infestation of *Rhizopertha dominica* (Fabricious) in Stored Wheat

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**Abstract** The leaves of Citrus, Tulasi, Mint, Neem, Henna, Custard apple, Turmeric, Eucalyptus leaf powders at two dose levels (5 and 10 g/kg) were tested for their deterrent/repellency in powder form against *Rhizopertha dominica* (F.) infesting stored wheat. In evaluation of different eight leaf powders as grain protectant against *R. dominica*, minimum adult emergence and grain damage was recorded in grains treated with neem leaf powder @ 10 and 5 g/kg dose level at 40, 80 and 120 DAS followed by custard apple leaf powder and eucalyptus leaf powder @ 10 and 5 g/kg wheat grains. Maximum (91.00% and 89.50%)

germination percentage was observed in grains treated with neem leaf powder @ 10 and 5 g/kg wheat grains respectively.

**Keywords** Infestation, Leaf powders, 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. It is cultivated in about 26.50 million ha with annual production of 68.64 million metric tonnes and yield of 2.59 metric tonnes per ha in India [1]. 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, *Rhizopertha dominica* (Coleoptera: Bostrichidae), is the major pest in the storage causing heavy losses to the tune of 15 to 66%. *R. dominica* is a cosmopolitan insect pest of stored raw grains. This species is well adapted to dry conditions [2]. Females lay eggs on the surface of grain kernels, and upon hatching, the larva enters the kernel [3, 4] and remains inside until maturity [5]. This insect is a field to store pest which its infestation on wheat has led to the reduction in quality, quantity and marketability of this important crop [6]. Plant materials constitute a rich source of bio-active chemicals, hence they could lead to the development of new classes of safer in-

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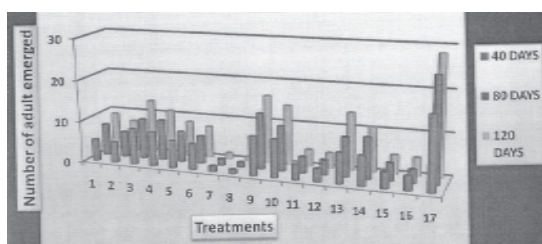
**Table 1.** Emergence of *Rhizopertha dominica* adult (F<sub>1</sub>) in leaf powders treated wheat grain, subsequent grain damage and germination percentage. \*Square root transformed values. \*\*Arcsine transformed value. Data in the parentheses are retransformed value. DAS=Days after storage.

Treat- ments	Leaf powders	Dose g/kg	Adult emergence			Per cent grain damage			Germination (%)
			40 days	80 days	120 days	40 days	80 days	120 days	120 DAS
T <sub>1</sub>	Citrus leaf powder	5	*2.40 (5.26)	*2.85 (7.66)	*3.11 (9.16)	**15.82 (7.47)	**17.91 (9.47)	**20.56 (12.33)	**62.74 (79.00)
T <sub>2</sub>	Citrus leaf powder	10	2.33 (4.93)	2.58 (6.16)	2.86 (7.66)	15.34 (7.00)	14.93 (6.67)	17.77 (9.33)	64.58 (81.50)
T <sub>3</sub>	Tulasi leaf powder	5	3.02 (8.60)	3.19 (9.66)	3.58 (12.33)	18.75 (10.33)	19.49 (11.13)	21.97 (14.00)	59.70 (74.50)
T <sub>4</sub>	Tulasi leaf powder	10	2.95 (8.20)	3.21 (9.83)	3.34 (10.66)	17.92 (9.47)	18.43 (10.00)	19.97 (11.67)	58.08 (72.00)
T <sub>5</sub>	Mint leaf powder	5	2.64 (6.46)	2.80 (7.33)	3.00 (8.50)	16.77 (8.33)	17.77 (9.33)	18.43 (10.00)	60.01 (75.00)
T <sub>6</sub>	Mint leaf powder	10	2.59 (6.23)	2.67 (6.66)	2.86 (7.66)	16.43 (8.00)	17.10 (8.67)	17.91 (9.47)	61.01 (76.50)
T <sub>7</sub>	Neem leaf powder	5	1.35 (1.33)	1.41 (1.50)	1.41 (1.50)	9.22 (2.60)	9.36 (2.67)	9.56 (2.73)	71.39 (89.50)
T <sub>8</sub>	Neem leaf powder	10	1.22 (1.00)	1.22 (1.00)	1.29 (1.16)	9.01 (2.47)	9.01 (2.47)	8.63 (2.58)	72.87 (91.00)
T <sub>9</sub>	Henna leaf powder	5	3.12 (9.26)	3.72 (13.33)	3.92 (14.83)	20.85 (12.67)	23.04 (15.33)	24.60 (17.33)	56.20 (69.00)
T <sub>10</sub>	Henna leaf powder	10	3.08 (9.00)	3.34 (10.66)	3.39 (11.00)	19.05 (10.67)	19.66 (11.33)	21.51 (13.47)	58.08 (72.00)
T <sub>11</sub>	Custard apple leaf powder	5	2.02 (3.56)	2.08 (3.83)	2.13 (4.06)	12.65 (4.80)	13.07 (5.13)	14.49 (6.27)	66.82 (84.50)
T <sub>12</sub>	Custard apple leaf powder	10	1.89 (3.06)	2.01 (3.56)	2.04 (3.66)	11.02 (3.67)	11.54 (4.00)	12.42 (4.67)	68.16 (86.00)
T <sub>13</sub>	Turmeric powder	5	2.77 (7.16)	3.13 (9.33)	3.54 (12.00)	17.95 (9.53)	18.48 (10.06)	23.04 (15.33)	58.08 (72.00)
T <sub>14</sub>	Turmeric powder	10	2.74 (7.00)	3.19 (9.66)	3.29 (10.33)	17.30 (8.87)	17.97 (9.53)	20.26 (12.00)	58.71 (73.00)
T <sub>15</sub>	Eucalyptus leaf powder	5	2.08 (3.83)	2.18 (4.26)	2.25 (4.56)	15.17 (6.87)	15.92 (7.53)	16.73 (8.33)	63.43 (80.00)
T <sub>16</sub>	Eucalyptus leaf powder	10	1.98 (3.43)	1.93 (3.23)	2.21 (4.36)	14.72 (6.46)	15.47 (7.13)	16.49 (8.06)	65.29 (82.50)
T <sub>17</sub>	Control	-	4.22 (17.33)	5.02 (24.66)	5.37 (28.33)	27.03 (20.66)	28.87 (23.33)	31.08 (26.66)	53.13 (64.00)
SEm ±			0.08	0.08	0.10	0.46	0.52	0.51	1.63
CD (at 5%)			0.24	0.25	0.28	1.34	1.52	1.49	4.66
CV %			6.30	8.85	6.13	5.21	5.66	5.05	5.21

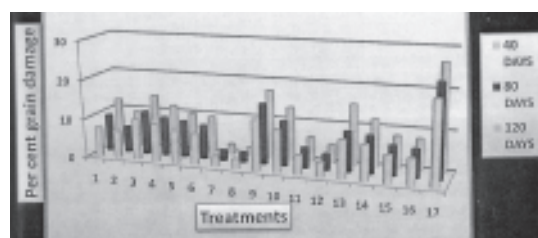
sect control agents. Much effort has therefore, been focused on plant derived materials for potentially useful products as commercial insect control agents. Indigenous plant materials are cheaper and hazard free in comparison with chemical insecticides. There are encouraging reports on the use of certain indigenous plant products as grain protectants.

Therefore, much effort has therefore, been fo-

cused on plant derived materials for potentially useful products as commercial insect control agents. However, it was a novel approach to use leaf powders 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 leaf powders on different parameters of *R. dominica* in stored wheat under four months storage period.



**Fig. 1.** Effect of different leaf powders on the adult emergence of *R. dominica* in stored wheat.



**Fig. 2.** Effect of different leaf powders on the per cent grain damage caused by *R. dominica* in stored wheat.

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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  $50^\circ\text{C}$  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  $20 \times 15$  cm containing 250 g grains. Subsequently adults emerged from this culture were used for further study.

### Methodology

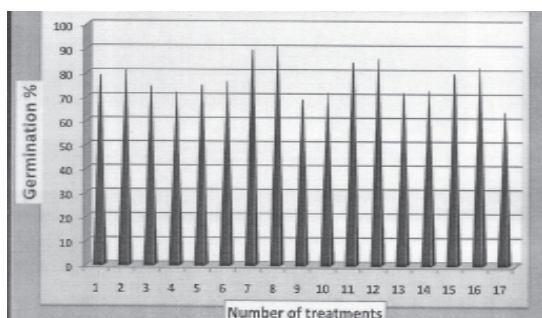
The effect of different leaf powder i.e. Citrus, Tulasi, Mint, Neem, Henna, Custard apple, Turmeric, Eucalyptus leaf powders were tested for the adult emergence, grain damage and germination percentage against lesser grain borer under laboratory conditions. The plant material was dried in shade and powdered in electric grinder. Wheat grains were treated with different leaf powders. Known quantity 1 Kg of wheat

kernels was put in the plastic container and measured quantity of leaf powder was added. Plastic container was then shaken normally to obtain uniform distribution of leaf powders on the kernels. The plastic containers were covered with 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 ( $10 \times 2.5$  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.

### 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 leaf powders on viability of grains. 100 bold treated wheat



**Fig. 3.** Effect of different leaf powders on the germination percentage of stored wheat infested by *R. dominica* after 120 DAS.

grains along with untreated grains were selected and were treated with thiram. The grains were 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 were kept moist by applying distilled water. Germination count was made after 10 days. The data thus obtained were statistically analyzed.

## Results and Discussion

### Efficacy of different leaf powders against *R. dominica* in stored wheat

The observations were recorded at 40, 80 and 120 day 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 Table 1.

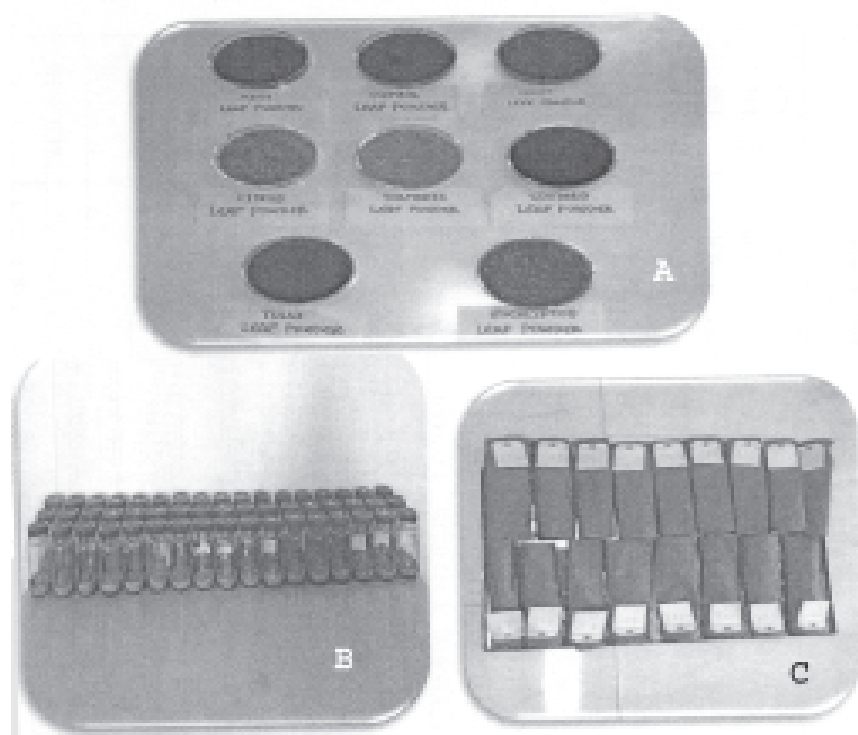
### Adult emergence

At 40 day after storage the adult emergence ranged from 1.00 to 9.26 adult beetles in different treatments treated with leaf powders (Fig. 1). All the leaf powders were found effective in reducing adult emergence as compared to control. Minimum adult emergence

was recorded in grains treated with neem leaf powder @ 10 and 5 g/kg grain (1.00 and 1.33 adults). Less adult emergence was recorded in grains treated with custard apple leaf powder @ 10 g/kg grains with 3.06 adults followed by eucalyptus leaf powder @ 10 g/kg dose level with 3.43 adults. At 80 day after storage adult emergence ranged from 1.00 to 13.33 adult beetles in different treatments treated with leaf powders. Minimum adults emergence (1.00 and 1.50 adults) was observed in grains treated with neem leaf powder @ 10 and 5 g/kg wheat grains respectively and less (3.23 adults) adult emergence was observed in grains treated with eucalyptus leaf powder @ 10 g/kg dose level followed by custard apple leaf powder @ 10 g/kg (3.56 adults) dose level. At 120 day after storage the adult emergence was ranged from 1.16 to 14.83 adult beetles in different treatments treated with leaf powders. The minimum (1.16 and 1.50 adults) adult emergence was recorded in grains treated with neem leaf powder @ 10 and 5 g/kg wheat grains followed by custard leaf powder @ 10 and 5 g/kg wheat grains (3.66 and 4.06 adults) which was found at par with eucalyptus leaf powder @ 10 and 5 g/kg dose level with 4.36 and 4.56 adults. Kakde et al. [7] indicated that the average number of *R. dominica* adult emergence (1.33) was observed in grains treated with neem leaf powder used @ 2.0%. The maximum (14.83 adults) adult emergence was observed in grains treated by henna leaf powder @ 5 g/kg followed by tulasi leaf powder @ 5 g/kg with 12.33 adults which was at par with turmeric powder @ 5 g/kg wheat grains (12.00 adults). These findings are supported with the results of Samyal and Sharma [8] who reported that the neem leaf powder suppressed the progeny emergence even at lower dose (1.5%) and in completely protected the seeds from *R. dominica*.

### Per cent grain damage

All the leaf powders were found significantly effective in reducing grain damage as compared to control (Fig. 2). At 40 days after storage the grain damage ranged from 2.47 to 12.67% in different leaf powder treatments. The grains treated with neem leaf powder @ 10 and 5 g/kg wheat grain was found effective with less grain damage (2.47 and 2.60%). Minimum grain damage was also recorded in grains treated with custard apple leaf powder @ 10 and 5 g/kg dose level



**Fig. 4A.** Different types of leaf powders used in experiment against *R. dominica* in stored wheat. **Fig. 4B.** Efficacy of different leaf powders against *R. dominica* in stored wheat. **Fig. 4C.** Germination test of wheat grains treated with different leaf powders.

with 3.67% and 4.80% grain damage followed by eucalyptus leaf powder @ 10 and 5 g/kg dose level with 6.46 and 6.87% grain damage. At 80 days after storage the grain damage ranged from 2.47 to 15.33% in different leaf powder treatment. Minimum grain damage was recorded in the grains treated with neem leaf powder @ 10 and 5 g/kg (2.47 and 2.67%) wheat grains. Less grain damage was recorded in grains treated with custard apple leaf powder @ 10 and 5 g/kg dose level with (4.00 and 5.13%) grain damage which was at par with eucalyptus leaf powder @ 10 and 5 g/kg dose level with 7.13 and 7.53% grain damage. At 120 days after storage the grain damage ranged from 2.58 to 17.33% in different leaf powder treatments. Significantly minimum grain damage was found in the grains treated with neem leaf powder @ 5 and 10 g/kg (2.58 and 2.73%) similarly less grain damage (4.67 and 6.27%) was observed in custard apple leaf powder

treated @ 10 and 5 g/kg wheat grains followed by eucalyptus leaf powder @ 10 and 5 g/kg wheat grain with (8.06 and 8.33%) grain damage. Singh and Singh (2005) [9] reported that among seven botanicals significantly less grain damage was found in neem seed kernel powder @ 10 g/kg grain due to *R. dominica* in wheat. Significantly maximum (17.33 and 13.47%) grain damage was observed in grains treated with henna leaf powder @ 5 and 10 g/kg wheat grains, respectively.

#### Germination (%)

After days of treatment, significant difference on the germination of wheat grains was observed (Fig. 3). All the treatments differed significantly in respect of per cent germination from the control. The germination ranged from 69.00 to 91.00% in different treat-

ments as compared to 64.00% in control. The maximum 91.00 and 89.50% germination was observed in wheat grains treated with neem leaf powder @ 10 and 5 g/kg dose level respectively, followed by custard apple leaf powder @ 10 and 5 g/kg 86.00 and 84.50%, and eucalyptus leaf powder @ 10 and 5 g/kg (82.50% and 80.00%) dose level and these treatments were highly significant over control. Kumawat (2009) [10] who reported that mixing of neem leaf and custard apple seed powder with wheat grains had no adverse effect on germination up to 270 days (Fig. 4).

### 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 leaf powder as grain protectants against *R. dominica* on wheat. However, it could be concluded that neem leaf powders, custard apple leaf powder, eucalyptus leaf powder @ 5 and 10 g/kg were found highly effective leaf powders for the management of *R. dominica* and as seed protectants. These studies clearly demonstrated the potential and possibilities of using leaf powders in overall IPM strategies for the control of storage insect pests in wheat.

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