



SCREENING OF WHEAT VARIETIES AND ECO-FRIENDLY MANAGEMENT OF *RHYZOPERTHA DOMINICA* (FAB.) ON WHEAT

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Abstract

An investigation was conducted in the laboratory of Department of Entomology, College of Agriculture, Bikaner during January to June 2010 at 29 ± 1.5 °C temperature and 70 ± 5 per cent relative humidity. The minimum adults emerged (7.00, 14.00 and 17.33) was recorded on variety Raj -3765, Raj-1482 and HD-2329 respectively. The minimum grain damage (33.66, 51.66 and 58.66%) and weight loss (11.00, 16.67 and 18.00%) was recorded on variety Raj -3765, Raj- 911 and HD-2329 respectively. The management of *R. dominica* was studied with plant leaf, plant oils and seed extract. The minimum adult emerged in grain treated with neem 2 per cent (1.33) followed by dharek 2 per cent (2.33). The grain damage and weight loss was minimum in neem 2 per cent (1.00 and 1.33%) followed by dharek 2 per cent (6.67 and 1.66%).

The gunny bags impregnated with neem oil 10 per cent and mustard oil 10 per cent provided complete protection over the adult emergence, grain damage and weight loss by *R. dominica*. The maximum protection was also provided by castor oil 10 per cent and NSKE 10 per cent in which adult emerged was 1.33, whereas, maximum adult emerged, grain damage and weight loss was recorded in karanj seed extract 5 per cent 8.33, 11.33% and 6.33% respectively. The effect of plant leaves, seed extract and plant oils on viability of the seed was not adverse.

Key words : Varietal resistance, screening of varieties, eco-friendly management, *R. dominica*, adult emergence, grain damage, weight loss, plant leaf, plant oil, seed extract.

Introduction

Wheat (*Triticum aestivum* L.) is *rabi* season crop belongs to family Poaceae. It contains about 8-15% proteins mainly gluten essential for bakery industries. Besides staple food for human beings, it is an important cereal crop of USA, Canada, Latin America, Europe, Asia and Oceania. India is the second largest producer and consumer of wheat in the world. In India, during 2007-08 it occupied an area of 28 million hectares with an annual production of 78.57 million tones. The major wheat growing states in India are U.P., M.P., Punjab, Haryana, Bihar, Gujarat, Maharashtra and Rajasthan.

In India, post harvest losses caused by rodents, insects, micro-organism, moisture and the unscientific storage accounts for about 10 per cent of the total grains. Global survey carried out by FAO indicated about 5 per cent loss of cereals during storage annually. However, the reduction due to post harvest losses has been, very high and reckon to the tune of 30 per cent. It has been

estimated that storage pests destroyed over 96 million metric tonnes of cereal grains and if this could be saved, it would have been sufficient for 375 million people for one entire year. A survey conducted by Mukherjee *et al.* (1998) revealed that the annual loss of grains due to insects was estimated to be 5.90 million tonnes, reflecting the intensity of insect pest problem in stores.

With the above views or theme, the following objectives were set to conduct the research work:

1. Screening of wheat varieties for resistance against *Rhyzopertha dominica* (Fab.)
2. Evaluation of plant leaves, seed-extracts and oils as grain protectants and packaging material impregnation against *Rhyzopertha dominica* (Fab.)

Materials and Methods

The study entitled as 'Screening of wheat varieties and eco-friendly management of *Rhyzopertha dominica* (Fab.) on wheat' was conducted in the laboratory of

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Department of Entomology, College of Agriculture, Bikaner- during January to June 2010 at 29 ± 1.5 °C temperature and 70 ± 5 per cent relative humidity.

The plan of work envisaged to carry out research is discussed herewith under following headings:

Management of *Rhyzopertha dominica* (Fab.)

To manage lesser grain borer, *R. dominica* on wheat some safer methods were evaluated, viz., screening of varieties, plant products (plant leaves, seed extract, oil etc.) packaging materials and varieties.

Maintenance of insect culture

The pure culture of test insect, *Rhyzopertha dominica* (Fab.) was procured and 20 pairs of 0-12 hour's old adult insect were released for oviposition in the plastic container containing 200 g wheat grains. Further, the newly emerged adults were transferred in a plastic container containing conditioned grains in order to maintain a stock culture for continuous fresh supply of large number of insects required for the experimentation. The culture was maintained at 29 ± 1.5 °C temperature and 70 ± 5 per cent relative humidity. For handling the infested grains and insects, a forcep and hair brush was used.

Release of insects in different varieties

A sample of 100 g of each variety was taken in plastic container, each replicated thrice as well as a required quantity (1 & 2 gm of Margosa, Eucalyptus, Dharek, Holy Basil, Marigold and Kanher) was mixed with 100 gm of sterilized and conditioned grain of leaves powder mixed lot was drawn for experimentation for other objective. One pairs of newly emerged beetles of equal sex (0-12 hours old) were released in each plastic container having the seeds of different varieties. The container was covered with muslin cloth.

Method of recording observation

The observations were recorded on adult emergence (F_1) grain damage by one generation and weight loss. The emergence (F_1) was recorded at every alternate day. The grain damage was recorded by visual counting. The weight loss was recorded by excluding the frass from the grains. The per cent grain damage are weight loss was calculated by using formula given below:

Number of damaged grain =

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

Percent weight loss =

$$\frac{\text{Initial weight of grain} - \text{Final weight of grain}}{\text{Initial weight of grain}} \times 100$$

Test for germinability

The germination test of the treated grains samples were carried out to know the adverse effect of plant products on seed viability. For this purpose, 100 grains were placed in the Petri dish between wet blotting papers. Three replications of each treated grain were maintained. The sprouted seeds were then counted after five days.

Evaluation of plant oils and seed extract by impregnating the packaging material

Treatment of packaging material

The gunny bags of 12×18 cm was used for the study and impregnated with three concentrations 5.0, 7.5 and 10.0 percent of plant oils and seed extract and kept for drying under shade. The solution of extract was made in water while the solution of oils made in acetone. 500 gm wheat grain (sterilized and conditioned) was filled in bags treated with each treatment, replicated thrice. The bags were kept with *R. dominica* infested stock to have natural infestation.

Method of recording observation

Periodical inspection (at monthly interval) of the grain in the bags was done to record the natural infestation. The number of adults emerged and damaged grains were recorded by visual count. The adults were discarded month after taking observation. The grain weight was recorded by excluding frass.

Statistical analysis

The per cent data on grain damage, weight loss and germination was transferred into angular values and number of insects emerged into log $X+1$ values for analysis of variance.

Results and Discussion

The results on the effect of varieties, plant leaves, seed extract, and plant oils of *R. dominica* have been presented herewith.

Screening of wheat varieties for resistance against *R. dominica*

The varieties screened for resistance against *R. dominica* were Raj- 3077 PBW 343, HD 2122, Raj-1482, Raj- 911, Raj-3777, Raj-3765 and HD-2329. The observations on grain mass, grain size, progeny beetles emerged, grain damage and weight loss was recorded (table 1). The grain mass per 100 grains was in the range of 2.61-3.71 g. The grain size worked out by water displacement method was in the range of 2.00 -2.90 ml

per 100 grains. McGaughey *et al.* (1990) carried out studies on the reproductive rates of *R. dominica* on various wheat varieties. They pointed out that kernel size and density were not suitable criteria for distinguishing between the classes and did not correlated well with reproduction of the species.

Adult emergence (F_1)

The F_1 adults emerged was in the range of 7.00-26.00. The minimum adults were emerged from variety Raj-3765 (7.00) followed by Raj-1482 (14.00) and both differed significantly. However, HD-2329 (17.33) and HD-2122 (18.33) were statistically at par to each other. The maximum number of adults emerged from PBW-343 (26.00) followed by Raj-3777 (25.67), Raj-3077 (23.33) and Raj-911 (21.67). All these varieties were statistically at par to each other. The descending order of adult emergence was recorded as PBW-343, Raj-3777, Raj-3077, Raj-911, HD-2122, HD-2329, Raj-1482 and Raj-3765. Abhai *et al.* (1996) reported variety Raj-911 as least preferred in their study.

Grain damage

The grain damage was minimum in variety Raj-3765 (33.66%) followed by Raj-911 (51.66%) and significantly superior over other varieties. The maximum grains infestation was observed in PBW-343 (69.00%) and significantly inferior over rest of the varieties however, Raj-3077 (65.33%), Raj-3777 (63.00%) and HD-2122 (61.33%) were statistically at par to each other. The varieties according to descending order of infestation were: PBW-343, Raj-3077, Raj-3777, HD-2122, Raj-1482, HD-2329, Raj-911 and Raj-3765. Yadav (1998) observed low level of grain damage on variety HD-2329 however; Kumawat (2005) observed minimum grain damage on variety Raj-3765.

Weight loss

The minimum weight loss in grain was recorded in variety Raj-3765 (11.00%) and found significantly superior over rest of the varieties however, Raj-911 (16.67%) and HD-2329 (18.00%) were statistically at par. Maximum weight loss was observed in PBW-343 (32.00%), followed by Raj-3077 (30.00%), Raj-3777 (24.67%) and HD-2122 (21.33%) however, all these differed significantly to each other. The descending order of weight loss observed in varieties were more or less same in that of grain damage. Singh *et al.* (2003) reported the maximum weight loss in variety Raj-3077. Similarly, Mania *et al.* (2005) reported that grain damage and weight loss were also highest in Raj-3077 with a mean of 35.59 and 3.81 per cent.

Efficacy of plant product

Plant leaves dry and chopped

The efficacy of leaf dry chopped of neem, eucalyptus, dharek, holy basil marigold and Kanher were evaluated each in two doses level (1.0 and 2.0 g /100 grain) (table 2).

Adult emergence (F_1)

The adults emerged (F_1) from the adult released after 60 days of grain treatment were maximum in the Kanher leaf 1.0 per cent (9.00), followed by marigold leaf 1.0 per cent (8.66) and eucalyptus leaf 1.0 per cent (8.00), however all these were statistically at par. Minimum adult emergence was recorded from the neem 2.0 per cent (1.33), followed by dharek 2.0 per cent (2.33) however, both were differed significantly to each other. Pereira and Wohgemuth (1982) reported the neem effectively protected stored maize from *R. dominica* infestation. The ground leaves and seed acted by disrupting larval development or by reducing adult fecundity. Jilani and Malik (1973) reported low effectiveness of dharek (*Melia azadirachta*) as compared to neem which confirm the present findings. These findings are supported with the results of Samyal and Sharma (2006) 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*.

Grain damage

The grain damage due to one progeny of *R. dominica* after 60 days of grain treatment was recorded to find out the efficacy of plant leaves dry chopped. After 60 days of treatment, the minimum grain damage was recorded in neem leaf 2.0 per cent (1.00%), followed by dharek leaf 2.0 per cent (6.67%) and 1.0 per cent (13.00%). However, all these treatments differed significantly to each other Maximum grain damage was recorded in the grain treated with marigold leaf 1.0 per cent (28.67%) and was significantly inferior over rest of the treatments. Grain damage in Kanher leaf 1.0 per cent (26.33%) and holy basil leaf 1.0 per cent (26.00%) were statistically at par but differed significantly from other treatments. Singh and Kumar (1997) observed less damage of grains and high mortality of beetles in grains treated with dharek kernel powder with a dose of 5 g/100 g of grain however, Amin *et al.* (2000) indicated that neem leaves had repellency as well as direct toxicity of wheat grain by reducing both the F_1 progeny emergence and grain infestation.

Weight loss

The weight loss was recorded due to F_1 generation

Table 1 : Screening of different varieties of wheat against *R. dominica*.

Treatments	Grain mass (g/100 grains)	Grains size (ml/100 grains)	Adult emergence F1	Percent grains damage	Percent weight loss
Raj.3077	3.06	2.3	23.33 (2.37)**	65.33 (53.93)*	30.00 (33.121)*
Raj.3777	2.76	2.1	25.67 (2.41)	63.00 (52.54)	24.67 (29.75)
Raj.1482	2.61	2.0	.14.00 (2.15)	59.66 (50.55)	19.00 (25.84)
Raj. 911	2.90	2.2	21.67 (2.34)	51.66 (45.94)	16.67 (24.06)
PBW 343	3.36	2.5	26.00 (2.41)	69.00 (56.17)	32.00 (34.45)
HD2329	2.83	2.2	17.33 (2.24)	58.66 (49.97)	18.00 (25.1)
HD2122	2.65	2.0	18.33 (2.26)	61.33 (51.55)	21.33 (27.51)
Raj. 3765	3.71	2.9	7.00 (1.84)	33.66 (35.45)	11.00 (19.37)
S. Em. ±			0.02	0.06	0.38
CD (p=0.05)			0.60	1.81	1.14

* Figures in the parentheses are angular transformed values,

** Figures in the parentheses log x+1 values.

of *R. dominica* after 60 days of treatment as revealed in table 4.2. The minimum weight loss was recorded in neem leaf 2.0 per cent (1.33%), followed by dharek leaf 2.0 per cent (1.66%) and both were statistically at par to each other. The maximum grain weight loss was recorded in treated grain with marigold leaf 1.0 per cent (9.00%), followed by Kanher 1.0 per cent (8.66%), holy basil 1.0 per cent (7.66%) however, these treatment were statistically at par to each other. Other treatments moderate to exhibit the weight loss in grain. Singh and Kumar (1997) found that the neem seed kernel and leaves were effective against *R. dominica* infestation however, Sharma (1999) reported that neem seed kernel 4 per cent and leaf powder at 5 per cent protected maize for five months against *R. dominica*, similarly Kumawat (2005) reported that neem leaves 5 per cent level observed no weight loss.

Effect of plant leaves on the germination of wheat

The effect of plant leaves on the germination of wheat did not found adverse; as the data was in the range of 83.33-86.33 which were statistically at par to each other (table 3).

Evaluation of plant oils and seed extracts by impregnating the packaging material

Adult emergence

The neem seed kernel extract, karanj seed extract, neem oil, castor oil and mustard oil each at three doses level (5.0, 7.5 and 10.0%) were evaluated by impregnating the gunny bags with these products. The adult emergence of *R. dominica* was observed in the gunny bags at monthly interval. Upto 60 days no adult emergence was recorded in the treated bags. At 90 days of treatment, the adult emergence was noticed zero in the bags treated

with neem oil 10.0 per cent and mustard oil 10.0 per cent. Maximum adults emerged from bags treated with karanj-seed extract 5.0 per cent (8.33), followed by castor oil 5.0 per cent (6.33) however, both were statistically at par but differed significantly from other treatments. Minimum adults emerged from bags treated with NSKE 10.0 per cent (1.33) followed by NSKE 7.5 per cent (2.33) and both differed significantly to each other. The other treatments moderate with respect to adult emergence. The present findings are in agreement with those of Shukla *et al.* (1992) reported that mustard oil was very effective against *R. dominica* caused 56.67% mortality. Verma *et al.* (1983) found that the oils and cakes of neem, castor and mustard reduced the fecundity, hatching and adult emergence. However, Bhargava and Meena (2002) reported significant reduction in adult emergence with different plant oil treatments.

Grain damage

No damaged grains were observed upto 60 days of bag treatment, but at 90 days the grains revealed infestation. The grain damage observed in neem seed kernel extract 10.0 per cent, neem oil 10.0 per cent, castor oil 10.0 per cent and mustard oil 10.0 per cent was nil. Minimum grain damage was recorded in the treatment of mustard oil 7.5 per cent (1.66%) and found significantly superior over rest of the treatments. The grain damage neem seed kernel extract 7.5 per cent (2.66%), followed by castor oil 7.5 per cent (2.66%) and mustard oil 5.0 per cent (3.66%) were statistically at par to each other. Maximum grain damage was found in the treatment of karanj seed extract 5.0 per cent (11.33%), followed by karanj seed extract 7.5 per cent (8.00%). However, both differed significantly with each other.

Table 2 : Effect of plant leaves dry chopped on the *R. dominica* in wheat after 60 days.

Treatments	Dose g/100g	Adult emergence F ₁	Per cent grain damage	Per cent weight loss
Neem	1	5.33 (1.73)**	15.33 (23.07)*	5.33 (13.34)*
	2	1.33 (1.12)	1.00 (5-74)	1.33 (6.62)
Eucalyptus	1	8.00 (1.90)	24.00 (29.33)	7.00 (15.34)
	2	5.33 (1.73)	19.33 (26.10)	4.00 (11.54)
Dharek	1	4.00 (1-60)	13.00 (21.13)	3.66 (10.95)
	2	2.33 (1.37)	6.67 (14.95)	1.66 (7.30)
Holy basil	1	6.66 (1.82)	26.00 (30.66)	7.66 (16.05)
	2	5.00 (1.70)	16.00 (23.58)	4.66 (12.42)
Marigold	1	8.66 (1.94)	28.67 (32.40)	9.00 (17.46)
	2	6.33 (1.80)	23.00 (28.66)	5.66 (13.72)
Kanher	1	9.00 (1.95)	26.33 (30.86)	8.66 (17.10)
	2	6.66 (1.82)	20.00 (26.57)	6.00 (14.18)
Control		29.00 (2.46)	68.67 (55.96)	32.00 (34.45)
S.Em. ±		0.04	0.52	0.58
CD (p=0.05)		0.12	1.51	1.70

*Figures in the parentheses are angular transform values.

** Figures in the parentheses log x+1 values.

Other treatments stood in the middle to exhibit the in grain damage. Patel *et al.* (1993) tested the efficacy of powdered neera seed kernel 5 per cent and found most effective at this dose. Maximum grain damage occurred in the treatment of karanj seed extract 5.0 per cent (11.33%) followed by karanj seed extract 7.5 per cent (8.00%) and castor oil 5.0 per cent (7.66%). Yadav *et al.* (2008) reported that neem, castor, karanj, lemongrass and eucalyptus oils at 1.0 ml/100 g seeds were effective in reducing the grain damage by *S. oryzae* in wheat.

Table 3 : Effect of plant leaves on the germination of wheat after 90 days of treatment.

Treatments	Dose (g/100g)	Germination (%)
Neem	1	83.67 (66.16)*
	2	84.33 (66.68)
Eucalyptus	1	83.67 (66.16)
	2	83.67 (66.16)
Dharek	1	84.00 (66.43)
	2	85.33 (67.48)
Holy basal	1	86.33 (68.32)
	2	85.33 (67.48)
Marigold	1	86.00 (68.04)
	2	83.33 (65.91)
Kanher	1	84.33 (66.68)
	2	85.33 (67.48)
Control		89.00 (70.64)
S. Em. ±		0.35
CD (p=0.05)		1.03

* Figures in the parentheses are angular transform values.

Weight loss

No weight loss in grain was observed upto 60 days of impregnation. However, weight loss was observed at 90 days of treatment. The weight loss observed in neem seed kernel extract 10.0 per cent and mustard oil 10.0 per cent was nil. Minimum weight loss was observed in the treatment of neem oil 10.0 per cent (1.00%), followed by mustard oil 7.5 per cent (1.33%) and neem seed kernel extract 7.5 per cent (2.00%). All these treatments were statistically at par to each other. The maximum weight loss was found in the treatment of karanj seed extract 5.0 per cent (6.33%) which was significantly inferior over rest of the treatments. The weight loss in castor oil 5.0 per cent (4.33%) and neem oil 5.0 per cent (3.66%) were

statistically at par to each other. Kumawat (2005) reported that neem seed kernel extract 10.0 per cent provided complete protection of the weight loss therefore, the present results are in agreement with him.

Effect of plant oils and seed extracts on the germination of wheat

The data on germination after 90 days of treatments ranged between 83.33 - 87.33, which were statistically at par to each other. Therefore, the oils and seed extract treatments were not found deleterious to seed viability. The present findings are in conformity with those of Verma *et al.* (1983), who observed no adverse effect on the seed viability on seeds treated with neem, castor and mustard oils.

Summary

The varieties screened for resistance revealed that no variety was immune to the infestation of *R. dominica*. The minimum adults emerged from variety Raj -3765 (7.00), followed by Raj-1482 (14.00), HM329 (17.33) and HD-2122 (18.33). The maximum number of adults emerged from PBW-343 (26.00), followed by Raj -37:77 (25.67), Raj -3077 (23.33) and Raj-911 (21.67).

The grain infestation was minimum in variety Raj - 3766 (33.66%) followed by Raj-911 (51.66%) and HD-2329 (58.66%). The maximum grain damage was observed in PBW-343 (69.00%), followed by Raj-3077 (66.33%), Raj-3777 (63.00%) and HD-2122 (61.33%).

The minimum weight loss in grain was recorded in variety Raj- 3765 (11.00%), followed by Raj-911 (16.67%) and HD-2329 (18.00%). Maximum weight loss was observed in PBW-343 (32.00%), followed by Raj-3077 (30.00%), Raj-3777 (24.67%) and HD-2122 (21.33%). The efficacy of leaves dry chopped of neem, eucalyptus, dharek, holy basil, marigold and Kanher were evaluated at doses level (1.0 and 2.0 g /100 g grain). The adults emerged (F_1) from the adult released after 60 days of grain treatment was maximum in the kenhar leaf 1.0 per cent (9.00), followed by marigold leaf 1.0 per cent (8.66) and eucalyptus leaf 1.0 per cent (8.00). Minimum adult emergence was recorded from the neem 2.0 per cent (1.33), followed by dharek 2.0 per cent (2.33).

The minimum grain damage due to one progeny of *R. dominica* after 60 days of grain was recorded in neem leaf 2.0 per cent (1.00%), followed by dharek leaf 2:0 per cent (6.66%) and 1.0 per cent (13.00%). Maximum grain damage was recorded in the grain treated with marigold leaf 1.0 per cent (28.66%), followed by kenhar leaf 1.0 per cent (26.33%) and holy basil leaf 1.0 per cent (26.00%).

After 60 days of treatment the minimum weight loss was recorded in neem leaf 2.0 per cent (1.33%), followed by dharek leaf 2.0 per cent (1.66%). The maximum grain weight loss was recorded in treated grain with marigold leaf 1.0 per Cent (9.00%), followed by kenhar 1.0 per cent (8.66%) and holy basil 1.0 per cent 7.66%).

The neem seed kernel extract, karanj seed extract, neem oil, castor oil and mustard oil each at three doses level (5.0, 7.5 and 10.0%) were evaluated by Impregnating the gunny bags with these products. Upto 60 days no adult emergency Was recorded in the treated bags. At the 90 days of treatment, the adult emergence was noticed zero in the bags treated with neem oil 10.0 per cent and mustard oil 10.0 per cent. Maximum adults were emerged from bags treated with karanj seep extract 5.0 per cent (8.33), followed by castor oil 5.0 per cent (6.33) and neem oil 5:0 per cent (5.33).

The grain damage observed in neem seed kernel extract 10.0 per cent, neem oil 10.0 per cent, castor oil 10.0 per cent and mustard oil 10.0 per cent was nil. Maximum grain damage was occurred in the treatment karanj seed extract 5.0 per cent (11.33%), followed by karanj seed extract 7.5 per cent (8.00%) and castor oil 5.0 per cent (7.66%).

The weight loss observed in neem seed kernel extract 10.0 per cent and mustard oil 10.0 per cent was nil. The test of seed extracts and oils materials on liability of the seed revealed no adverse effect upto 90 days of treatment.

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