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ECOFRIENDLY MANAGEMENT OF LESSER GRAIN BORER *RHIZOPERTHA DOMINICA* F. (COLEOPTERA: BOSTRICHIDAE) USING PLANT PRODUCTS IN STORED WHEAT

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ABSTRACT

A laboratory experiment was conducted to study the ecofriendly management of lesser grain borer with plant products *viz.*, custard apple seed powder (*Annona squamosa* L.), neem seed kernel powder (*Azadiracta indica* A. Juss) and jamun seed powder (*Sygygium cumini* L.) with their two application rates (0.5 & 1.0%) in stored wheat in 2014. All plant products were found effective against lesser grain borer as compared to control. This might be due to antifeedant activity of plant products. The wheat grains treated wih neem seed kernel powder at their application rate of 1.0% was found superior with no grain damage, no weight loss, no population build up (adults) and 100% adult mortality was recorded. No adverse effect of plant products was observed on the germination of treated wheat grains upto 120 days of storage.

Key words: *Rhizopertha dominica*, wheat, custard apple seed, neem seed kernel, jamun seed powder, adult mortality, germination,

Major loss of food grains in storage is due to insect pests of which internal feeders like the lesser grain borer, *Rhizopertha dominica* F., are very important. Surveys conducted by the Food and Agriculture Organization had revealed that it is the major pest of wheat, rice and millets in India (Champ and Dyte, 1977). It has widespread occurrence and feeds on a variety of stored products like cereals, pulses, groundnut, other edible substances and grocery stores. 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.

To avert these problems, there is a need to develop management practices, which are more effective and ecofriendly. The use of plant products are considered ecologically safe and non-toxic to human beings and beneficial organisms. There are encouraging reports on the use of certain indigenous plant products as grain protectants (Sundria *et al.*, 2001; Bhargava and Meena, 2002). This study reports on the use of some plant products against lesser grain borer on wheat.

MATERIALS METHODS

The experiment was conducted under laboratory conditions with the *R. dominica* adults collected from storage (bulk and bag storage) at the RCA Farm, Udaipur, and mass cultured on wheat at 27±2^{0}C and 65±5% RH. The stock culture was reared in glass jars of 2 kg capacity on wheat.

Plant materials *viz*., custard apple seed powder (*Annona squamosa* L.), neem seed kernel powder (*Azadiracta indica* A. Juss) and jamun seed powder (*Sygygium cumini* L.) were collected and shade dried until they became crisp dry. The powder was obtained by grinding their dried seeds in a mechanical grinder and sieving through a mesh size of 50. These powders were evaluated by treating 100 g of wheat grains in each jar with two application rates of 0.5 and 1.0% of grain weight up to 120 days. Each treatment was replicated three times, and an untreated check was used. Ten pairs of lesser grain borer adults were released in each jar with their mouth covered with muslin cloth and secured by rim of lid. Each jar was examined at monthly intervals for computing % weight loss, % damage and progeny development.

The numbers of dead insects were counted up to

120 days by sieving the grains and counting the adults. For estimating the damage, the grains were thoroughly mixed and samples of 100 grains were drawn for five times from each, then damaged grains counted. The % weight loss was recorded by counting un-infested and infested grains, and with the following formula (Adams and Schulton, 1978).

$$\text{Per cent weight loss} = \frac{(\text{UND}) - (\text{DNU})}{\text{U}(\text{ND} + \text{NU})} \times 100$$

Where U = Weight of uninfested seeds (g); NU = Number of uninfested seeds; D = Weight of infested seeds (g); ND = Number of infested seeds

The effect of plant powders on germination was also studied through drawing samples and as per the International Rules of Seed Testing (Anonymous, 1976). The data were subjected to statistical analysis as Completely Randomized Design (CRD). The data in % were transformed into angular and number values were transformed to square root transformations before statistical analysis.

RESULTS AND DISCUSSION

The adult mortality ranged from 95.00 to 100.00, 90.33 to 100.00, 84.00 to 100.00 and 75.00 to 100.00% in the plant powders at 30, 60, 90 and 120 days after storage, respectively (Table 1). Neem seed kernel powder at 1.0% with 100% adult mortality was found the best and it was statistically at par with its 0.5% dose (99.63%) after 120 days; jamun seed powder at 0.5% (87.51%) was found the least effective. These findings are in agreement with those of Kalasagond (1998) who observed that custard seed powder at 1.4% caused 60% adult mortality of *R. dominica* at 180 days after storage with minimum seed weight loss of 1.43%. This result is also agreeing with Mahanti (2002) who reported that neem seed powder at the rate of 2 g/ kg of maize grain caused 100% mortality of *S. oryzae* at ten days after beetle release. Other earlier results that fall in line with present study includes: neem kernel extract formulation provides complete protection of wheat for up to 48 weeks (Rahim, 1998); neem (2.0 and 3.0%) proved the most effective in terms of adult mortality and reduced grain damage (number basis and weight basis) of *R. dominica* (Singh *et al.*, 1996); and all neem products caused significant dose-dependent mortality to the rice weevil (Nukenine *et al*, 2012).

The population build up (number of adults emerged) ranged from 0.00 to 23.33% in different plant powders (Table 1). No population build up was recorded in grains treated with neem seed kernel powder at 1.0% upto120 days of storage. It was followed by neem seed kernel powder at 0.5% with 1.42 adults. Maximum population build up was recorded in grains treated with jamun seed powder. These findings are in agreement with those of Arya and Tiwari (2013) who reported that neem leaf powder, cow dung powder and cow dung ash powder and cow urine at 2% were effective with minimum adult emergence, grain damage and weight loss with higher adult mortality, and grain germination. According to Savitri and Subba Rao (2012) neem concentration of 0.5, 0.75 and 1% significantly reduced the adult populations of the *Sitophilus oryzae*, the *Rhyzopertha dominica* and *Sitotroga cerealella*, respectively. However, a concentration of 2% has been recommended to protect paddy effectively and economically from these. Adult population was lowest in seeds treated with 5% neem kernel powder after 96 days (Patel *et al*., 1993). Neem seed powder (2.0 and 3.0%) resulted in lower fecundity and adult emergence; prolonged duration for completion of one generation and lower fecundity per female after completion of one generation of *R. dominica* (Singh *et al.*, 1996)

The grain damage varied from 0 to 11.40% in different plant powders, with all the powders found effective. Neem seed kernel powder at 1.0% was found the most effective followed by its 0.5% dose; and jamun seed powder was the least effective. These results draw support from Singh and Singh (2005) who reported on the significantly less grain damage with neem seed kernel powder at 10 g/kg grain with *R. dominica* in wheat. Similarly, Yevoor (2003) reported that custard apple seed powder at 0.2% was highly effective and gave 0% grain damage and weight loss up to 90 days after treatment. Neem (2.0 and 3.0%) proved the most effective in terms of reduced grain damage by *R. dominica* in the study by Singh *et al*. (1996)

The weight loss was observed to vary from 0 to 12.18% with the plant powders (Table 2). No weight loss was recorded with neem seed kernel powder at 1.0%, while jamun seed powder was found the least effective. These findings are in agreement with those of Singh and Singh (2005) on *R. dominica* in wheat.

The germination % in all the plant powders ranged from, 92.20 to 96.69% as compared to 92.55% in control; there was non-significant difference among the treatments initially and up to 30 days (Table 3).

Table 1. Effect of plant powders on the adult mortality and population build up of lesser grain borer in wheat

Plant powders	Dose (%)	Mean adult mortality (%) of *R. dominica* at					Mean population build up (adult) of *R. dominica* at				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean	30 DAS	60 DAS	90 DAS	120 DAS	Mean
Custard apple seed powder	0.5	96.67 (81.39)	96.67 (81.39)	95.33 (77.55)	83.67 (66.27)	93.67* (78.30)	0.00 (0.71)	4.33 (2.20)	8.00 (2.91)	18.00 (4.30)	7.28** (2.53)
Custard apple seed powder	1.0	100.00 (90.00)	100.00 (90.00)	99.00 (85.63)	92.00 (73.63)	97.98 (85.33)	0.00 (0.71)	0.00 (0.71)	3.33 (1.95)	9.33 (3.13)	3.17 (1.63)
Neem seed kernel powder	0.5	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	97.00 (80.03)	99.63 (87.76)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	4.33 (2.20)	1.42 (1.15)
Neem seed kernel powder	1.0	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	100.00 (90.00)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)	0.00 (0.71)
Jamun seed powder	0.5	95.00 (77.08)	90.33 (72.02)	84.00 (66.42)	75.00 (60.02)	87.51 (70.95)	2.67 (1.77)	7.00 (2.73)	10.33 (3.29)	23.33 (4.88)	10.83 (3.17)
Jamun seed powder	1.0	100.00 (90.00)	96.33 (79.17)	90.33 (71.98)	79.33 (63.03)	92.30 (77.17)	1.00 (1.22)	5.00 (2.35)	9.33 (3.13)	16.00 (4.06)	7.83 (2.69)
Control	-	3.67 (10.88)	4.33 (11.98)	6.00 (14.18)	5.33 (13.32)	4.516 (11.85)	33.00 (5.79)	36.33 (6.07)	43.33 (6.62)	51.33 (7.20)	41.00 (6.02)
SEm±		0.52	0.99	1.16	1.11s	0.92	0.04	0.05	0.07	0.09	0.05
CD (p=0.05)		1.57	2.98	3.53	3.36	2.78	0.12	0.15	0.23	0.28	0.18

* Figures in parentheses angular retransformed values; **Figures in parentheses square root retransformed values; DAS- Days after storage.

Table 2. Effect of plant powders on the grain damage and weight loss by lesser grain borer

Plant powders	Dose (%)	Mean grain damage (%) by *R. dominica* at					Mean weight loss (%) in wheat at				
		30 DAS	60 DAS	90 DAS	120 DAS	Mean	30 DAS	60 DAS	90 DAS	120 DAS	Mean
Custard apple seed powder	0.5	0.00 (0.00)	3.07 (10.08)	6.53 (14.81)	9.20 (17.65)	4.70 (10.64)	0.50 (4.04)	2.67 (9.40)	5.45 (13.50)	8.31 (16.75)	4.23* (10.92)
Custard apple seed powder	1.0	0.00 (0.00)	2.07 (8.26)	5.40 (13.43)	7.67 (16.07)	3.79 (9.44)	0.00 (0.00)	1.50 (6.99)	3.83 (11.26)	6.69 (14.98)	3.01 (8.31)
Neem seed kernel powder	0.5	0.00 (0.00)	0.00 (0.00)	1.13 (6.11)	1.40 (6.78)	0.63 (3.22)	0.00 (0.00)	0.00 (0.00)	0.60 (4.44)	1.67 (7.42)	0.57 (2.97)
Neem seed kernel powder	1.0	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Jamun seed powder	0.5	3.80 (11.24)	4.73 (12.57)	9.27 (17.72)	11.40 (19.73)	7.30 (15.32)	3.83 (11.28)	4.75 (12.59)	8.20 (16.64)	12.18 (20.43)	7.24 (15.24)
Jamun seed powder	1.0	2.40 (8.91)	3.73 (11.14)	8.20 (16.64)	10.27 (18.69)	6.15 (13.85)	2.72 (9.49)	3.72 (11.12)	7.10 (15.45)	10.22 (18.64)	5.94 (13.68)
Control	-	13.33 (21.41)	17.87 (25.00)	26.40 (30.92)	37.73 (37.90)	23.83 (28.81)	7.56 (15.95)	10.56 (18.96)	16.53 (23.99)	21.49 (27.61)	14.04 (21.63)
SEm±		0.52	0.15	0.26	0.22	0.26	0.22	0.16	0.23	0.25	0.24
CD (p=0.05)		1.57	0.46	0.78	0.68	0.78	0.68	0.49	0.69	0.75	0.72

* Figures in parentheses angular retransformed values; DAS- Days after storage

Table 3. Effect of plant powders on the germination of wheat

Plant powders	Dose (%)	Mean germination (%) in grains at				
		0 DAS	30 DAS	60 DAS	90 DAS	120 DAS
Custard apple seed powder	0.5	92.67	91.33	87.67	88.67	83.00
		(74.32)	(72.95)	(69.53)	(70.50)	(65.67)
Custard apple seed powder	1.0	93.33	93.00	89.00	87.33	86.67
		(75.14)	(74.73)	(70.69)	(69.29)	(68.77)
Neem seed kernel powder	0.5	92.33	90.00	91.33	86.67	83.00
		(74.25)	(71.58)	(72.95)	(68.77)	(65.67)
Neem seed kernel powder	1.0	96.67	94.00	89.00	87.67	83.67
		(79.58)	(75.95)	(70.69)	(69.45)	(66.29)
Jamun seed powder	0.5	93.33	89.00	88.67	87.33	88.67
		(75.04)	(70.95)	(70.50)	(69.37)	(70.62)
Jamun seed powder	1.0	94.00	94.33	91.00	88.00	88.0
		(75.85)	(76.27)	(72.87)	(69.94)	(69.91)
Control	-	92.67	92.33	91.67	90.33	85.00
		(74.33)	(73.95)	(73.49)	(72.03)	(67.31)
SEm±	1.20	1.38	1.78	1.93	1.88	
CD (p=0.05)	N S	NS	NS	NS	NS	

The germination ranged from 87.67 to 91.67% after 60 days, and after 90 days from 86.67 to 90.33%. After 120 days it was 83.00 to 88.67 as compared to 85.00% in control. These results revealed that there was no adverse effect of the plant powders on germination up to 120 days of treatment. No adverse effect on grain viability of green gram by seed and leaf powders of custard apple had been reported (Saxena *et al.*, 1976; Yadav and Bhatnagar, 1987; Gundannavar and Deshpande, 2006; Lakshmi and Venugopal, 2007) and on pigeon pea (Sharma *et al.*, 2010). Kumawat (2009) reported that mixing of neem seed kernel, neem leaf, and custard apple seed powder with wheat grains had no adverse effect on germination up to 270 days.

REFERENCES

Adams, J.M. and Schulten, G.G.M. 1978. Loss caused by insects, mites and microorganisms In: Post-harvest grain loss assessment methods (Eds. K. L. Harries and C. J. Lindblad), *American Association of Cereal Chemists*, p. 83-94.

Anonymous. 1976. International rules for seed testing. *Seed Science and Technology,* **4**: 1.

Arya, M. and Tiwari, R. 2013. Efficacy of plant and animal origin bio-products against lesser grain borer, *Rhyzopertha dominica* (Fab.) in stored wheat. *International Journal of Recent Scientific Research,* **4:** 649-653.

Bhargava, M.C. and Meena, B.L. 2002. Efficacy of some vegetable oils against pulse beetle, *Callosobruchus chinensis* (Linn.) on cowpea, *Vigna unguiculata* (L.). *Indian Journal of Plant Protection*, **30**: 46-50.

Champ, B.R. and Dyte, C.E. 1977. Global survey of pesticide susceptibility of stored grain pests. *FAO, Plant Protection Science,* No. 5, FAO, Rome.

Fishwick, F.B. 1988. Pesticide residues in grain arising from post harvest treatments. *Aspects of Applied Biology,* **17**: 37-46.

Gundannavar, K.P. and Deshpande, V.K. 2006. Effect of indigenous products on seed quality and incidence of pulse beetle, *Callasobruchus chinensis*, in different varieties of soybean. *Karnataka Journal of Agricultural Sciences*, **19**: 393-395.

Kalasagond, P.R. 1998. Management of beetle pests in stored wheat by non-insecticidal approaches. *M. Sc. (Agri.) Thesis*, *University of Agricultural Science*, Dharwad.

Kumawat, K.C. 2009. Efficacy of plant powders against lesser grain borer, *Rhyzopertha dominica* (Fabricius) in stored wheat, *Triticum aestivum* Linnaeus. *Journal of Insect Science,* **22**: 448-452.

Laxmi, L.G. and Venugopal, M.S. 2007. Effectiveness of powdered plant products as grain protectants against the pulse beetle, *Callosobruchus maculates* (F.). *Journal of Entomological Research*, **31**: 75-78

Mahanti, V. 2002. Ecology and management of stored grain pests of maize. *Ph. D. Thesis*, Acharya N. G. Ranga Agricultural University, Hyderabad.

Nukenine, E.N., Tofel, H.K. and Adler, C. 2012. Bioactivity of NeemAzal and neem products from Cameroon against *Sitophilus zeamais* on maize. *Mitteilungen der Deutschen*

Gesellschaft fuer Allgemeine und Angewandte Entomologie, **18**: 477-485.

Patel, K.P., Valand, V.M. and Patel, S.N. 1993. Powder of neem-seed kernel for control of lesser grain borer (*Rhizopertha dominica*) in wheat (*Triticum aestivum*). *Indian Journal of Agricultural Sciences*, **63**: 754-755.

Rahim, M. 1998. Biological activity of azadirachtin-enriched neem kernel extracts against *Rhyzopertha dominica* (F.) (Coleoptera: Bostrichidae) in stored wheat. *Journal of Stored Products Research*, **34**: 123-128.

Savitri, P. and Subba Rao, C. 1976. Studies on the admixture of neem seed kernel powder with paddy in the control of important storage pests of paddy. *Andhra Agricultural Journal*. **23**: 137-143.

Saxena, B.P., Koul, O. and Tikku, K. 1976. Non-toxic grain protectants against the stored grain insects. *Bulletin of Grain Technology*, **14**: 190.

Sharma, K.C., Jain, N.K., Mishra, B.K. and Kumar, S. 2010. Bio - efficacy of plant products of custard apple (*Annona squamosa* (L.) against pulse beetle, *Callosobruchus maculatus* L. *Indian Journal of Applied Entomology*, **24**: 54-57.

Singh, Hoshiar, Mrig, K.K. and Mahla, J.C. 1996. Effect of different plant products on the fecundity and emergence of lesser grain borer, *Rhyzopertha dominica* (F.) in wheat grains. *Annals of Biology* (Ludhiana), **12**: 96-98.

Singh, Hoshiar, Mrig, K.K. and Mahla, J.C. 1996. Efficacy and persistence of plant products against lesser grain borer, *Rhyzopertha dominica* (F.) in wheat grain. *Annals of Biology* (Ludhiana), **12**: 99-103.

Singh, R.K. and Singh, A.K. 2005. Efficacy of different indigenous plant products as grain protectant against *Rhizopertha dominica* Fab. on wheat. *Indian Journal of Entomology*, **67**: 196-198.

Sundria, M., Kumar, J. and Kumar, A. 2001. Efficacy of different botanicals against *Callosobruchus chinensis* (Linn.) in stored green gram. *Indian Journal of Applied Entomology*, **16**: 1-5.

WMO. 1995. Scientific assessment of ozone depletion: *World Meteorological Organization Global Ozone Research and Monitoring Project. Report No. 37, WMO*, Geneva, Switzerland.

Yadav, S.R.S. and Bhatnagar, K.N. 1987. A preliminary study on the protection of stored cowpea grains against pulse beetle by indigenous plant products. *Pesticides*, **21**: 25-28.

Yevoor. 2003. Biology and management of rice weevil, *Sitophilus oryzae* (Linn.) in maize grains. *M. Sc. (Agri.) Thesis, University of Agricultural Science*, Dharwad.

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