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EFFICACY OF NATURAL PRODUCTS AGAINST LESSER GRAIN BORER *RHYZOPERTHA DOMINICA* (F.) IN STORED PADDY

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ABSTRACT

Twelve phyto products and two forms of cow dung were evaluated during 2021- 22 in the Entomology Research Laboratory, M S Swaminathan School of Agriculture, Centurion University of Technology and Management, Gajapati District of Odisha for their efficacy against *Rhyzopertha dominica* (F) in stored paddy. The experiment was laid out in a completely randomized design with each treatment replicated thrice. Individual treatments comprised 20 g disinfested paddy seeds treated with test products @ 5g/ kg seed separately and an untreated check and inoculated with 20 adults /treatment. All the treatments were effective in suppressing the *R. dominica,* with maximum adult mortality (92.1%) being in black pepper powder followed by custard apple seed powder (88.4%) at 28 days after release. The least population buildup (2 adults), grain damage (3.3%), and weight loss (2.7%) were observed with black pepper powder treated paddy at 120 days after storage.

Key words: Natural products, *Rhyzopertha dominica*, stored paddy, adult mortality, weight loss, grain damage, population buildup, cow dung products, antifeedant

Paddy is one of the most widely cultivated cereal with high worldwide recognition. More than 60% of the world's population depends on rice as a staple food, and it provides the body with essential nutrients such as carbohydrates, fiber, protein, minerals, and vitamins (Babendreier et al., 2020). Number of insect pests, such as *Sitotroga cerealella* (Olivier), *Rhyzopertha dominica* (F.), *Sitophilus* spp., and *Tribolium castaneum* (Herbst), attack paddy during storage (Guenha et al., 2014). Insect assault on stored grains is linked to mycotoxin contamination and in addition, it causes direct quantity and quality losses because it disperses fungal inoculum and fosters favourable circumstances for the growth and multiplication of fungi during storage (Milani, 2013). Synthetic insecticides work well in mitigating insects and are crucial for lowering losses of grain in storage. However, the high cost, insect resistance, residues in food, and environmental pollution limit their use (Silva et al., 2019). Synthetic pesticides are also only effective for a short time after application, which makes them unsuitable for smallholder farmers in developing nations where open storage facilities are common and can lead to re-infestation of insect pests. These limitations overlay the way to develop an effective alternative pest control method. Among various methods, focus has been on plants and animal products. Various phytoproducts like *Annona squamosa*, and *A. indica* have proven to be toxic for various warehouse pests (Morya et al., 2010). Annonaceae family plants were reported to contain a complex mixture of acetogenins comprising at least 30 compounds and might favour insects' repellence. Black pepper has insecticidal properties due to phytochemicals such as piperine, caryophyllene, and limonene (Chieng et al., 2008). Indian countryside leaves of *Ocimum sanctum* (L.), *Vitex negundo* (L.), have been utilized to safeguard stored paddy that has been stored. They had the strongest fumigation, repellent, antifeedant, and ovicidal activities and were therefore demonstrated by locally available botanicals (Moses et al., 2020). Boomathi et al. (2006) reported that cow dung and urine were found effective in managing insect pest. So, plant and animal products are inexpensive and ecologically

safe, alternatives to synthetic insecticides and fumigants which forms the rationale for taking up the evaluation of a few phyto products and cow dung products against *Rhyzopertha dominica* (F.), a major pest of stored paddy.

MATERIALS AND METHODS

Twelve phyto products and two forms of cow dung were evaluated during 2021- 22 in the Entomology Research Laboratory of MSSSoA, Centurion University of Technology and Management, Gajapati District of Odisha for their efficacy against the *Rhyzopertha dominica* (F) in stored paddy. *Rhyzopertha dominica* was mass multiplied and maintained in the Entomology Laboratory on variety, RNR-15048, at 27± 2°C and 65± 5% RH. The freshly emerged adult beetles were collected carefully from the culture and were used. The test products were collected from the locality, cleaned, and shade-dried until they became crisp enough to grind into fine powder. The uninfected healthy paddy seeds were treated separately with each product taking 5 g/ kg of the seeds. Ten pairs of freshly emerged lesser grain borer adults were released into each jar (size of 250 g) containing 20 g treated paddy grains and their mouths covered with muslin cloth were secured with thread. The observations on adult mortality were recorded at 14, and 28 days after release (DAR) and expressed in terms of corrected mortality (%) as per Abbott, 1925. Observations were recorded on progeny build up (Jyothi et al., 2014) and grain damage (%) (Padmasri et al., 2017) at 120 DAR. The paddy grains were weighed to estimate the weight loss (%) (Adams and Schulten, 1978) at 120 DAR. The data, thus collected were computed and analyzed statistically for the one-way ANOVA using the SPSS.16.0 computer program.

RESULTS AND DISCUSSION

The results on the effect of phyto products and cow dung on adult mortality of *R. dominica* recorded at 14 and 28 DAR revealed that all the treatments were effective and resulted in 3.33 to 71.48 and 11.57 to 92.13% mortality at 14 and 28 DAR, respectively (Table 1). Maximum adult mortality was recorded in seeds treated with black pepper powder (71.48%) followed by custard apple seed powder (67.78%), neem seed kernel powder (64.07%) and neem leaf powder (60.37%) at 14 DAR which were statistically at par. The lowest mortality (3.33%) was recorded in cow dung powder. Similarly, at 28 days after treatment, black pepper powder was found to be superior with adult mortality of 92.13% followed by the custard apple seed powder (88.43%) which was statistically at par. At 28 DAR neem seed kernel powder resulted in 84.26% adult mortality, and cow dung powder was the least effective (11.57%). Ahmad et al. (2016) who assessed medicinal

Table 1. Efficacy of natural products on *R. dominica* in stored paddy

Treatments	Adult mortality (%)				Progeny buildup at 120 DAR		Grain damage (%) at 120 DAR		Weight loss (%) at 120 DAR	
	14 DAR		28 DAR							
Neem leaf powder	60.37	(51.06)*	80.56	(64.13)*	6.67	(2.68)**	9.33	(17.77)*	5.49	(2.44)*
Neem seed kernel powder	64.07	(53.24)	84.26	(67.02)	4.67	(2.27)	6.67	(14.93)	4.72	(2.27)
Lemon grass powder	49.63	(44.80	73.15	(58.87)	7.67	(2.86)	11.33	(19.66)	7.06	(2.71)
Mentha leaf powder (*M. piperata*)	35.56	(36.59)	53.70	(47.13)	10.00	(3.24)	14.00	(21.97)	9.39	(3.12)
Mentha leaf powder (*M. arvensis*)	39.26	(38.77)	69.44	(56.49)	7.67	(2.86)	12.67	(20.84)	7.73	(2.84)
Turmeric powder	28.15	(31.83)	45.83	(42.59)	10.67	(3.34)	15.33	(23.04)	10.12	(3.25)
Tulsi powder	35.19	(36.13)	61.57	(51.72)	9.33	(3.13)	12.67	(20.84)	8.70	(3.02)
Custard apple seed powder	67.78	(55.42)	88.43	(70.12)	3.33	(1.95)	6.67	(14.93)	3.06	(1.87)
Eucalyptus leaf powder	32.22	(34.58)	57.41	(49.31)	9.67	(3.19)	13.33	(21.4)	9.47	(3.15)
Black Pepper powder	71.48	(57.80)	92.13	(76.61)	2.00	(1.58)	3.33	(10.4)	2.66	(1.74)
Ginger powder	21.48	(27.61)	37.96	(37.82)	11.33	(3.44)	16.67	(24.09)	11.98	(3.52)
Horseshoe vitex	17.78	(24.72)	38.43	(38.28)	16.00	(4.06)	17.33	(24.6)	12.52	(3.6)
Cow dung ash	57.04	(49.05)	76.85	(61.25)	7.00	(2.73)	10.67	(19.05)	6.01	(2.54)
Cow dung powder	3.33	(6.14)	11.57	(19.88)	19.67	(4.49)	18.67	(25.59)	13.05	(3.67)
Untreated control					65.33	(8.11)	28.67	(32.37)	16.99	(4.19)
S.Em+	2.91		3.06		0.06		0.62		0.04	
C D (p=0.05)	8.42		8.87		0.17		1.80		0.10	
C V (%)	12.86		10.02		3.10		5.19		2.11	

DAR- Days after release; *Figures in parentheses arc sin transformed values; **Figures in parentheses √(X+0.5) transformed values

plant extracts, reported the maximum mortality of *R. dominica* with *P. nigrum* after 120 hr of application. Similarly, the highest mortality of *S.oryzae* was recorded from leaf powders of *P. nigrum* (68.33%) and *P. longum* (75 %) at 7 days after treatment (Jacob et al., 2022). The pungency of the *P. nigrum* and *P. longum* owing to the presence of piperine has been reported to cause mortality (Reshmi et al., 2010). The powders and extracts could also act as food poison to adult insects as the testa of the treated grains were covered and hence mortality could be linked to the feeding habit (Ileke et al., 2020). According to Shukla et al. (2020) maximum larval repellence reported with *A. squamosa* extract. Ousman et al. (2007) observed that *P. nigrum* leaf oil was the most toxic to stored insect pests and concluded that it could be used as a substitute for insecticides by small farmers.

Mon et al. (2015) observed maximum adult mortality of *R. dominica* (97.50%) with black pepper seed powder (1.5 g/ 20 g of seed) at 9 days after treatment in paddy. Narayana Swamy et al. (2019) reported that 180 days after treatment the highest adult mortality was observed with custard apple seed powder @ 2% and cow dung ash powder @ 2% (85.00%). Prabhakaran (2023) observed that neem leaf powder 1% gave maximum adult mortality at 72 hr after treatment. Lal et al. (2017) observed no grain damage, no weight loss, no population buildup (adults), and 100% adult mortality with neem seed kernel powder (1.0%) in stored wheat grain up to 120 days. Lal et al. (2015) observed that cow dung ash @ 0.5% recorded adult mortality (72.8%), population build-up (16.75 adults), grain damage (5.7%), and weight loss (6.9%) in wheat. Population build-up ranged from 2.00 to 65.33 (adults) in various treatments at 120 DAR (Table 1); the least being with black pepper powder (2.00 adults) being at par with custard apple seed powder (3.33 adults). Ashouri and Shayesteh (2010) observed complete inhibition of the progeny after being exposed to black pepper seed powder (0.5%). Upadhyay and Jaiswal (2017) noted that progeny development of *Tribolium castaneum* and *Callosobruchus chinensis* (Chaubey, 2008) was suppressed with *P. nigrum* oil.

Grain damage per cent varied from 3.33 to 28.67% in various treatments at 120 DAR, the least being in black pepper powder (3.33%) followed by custard apple seed powder (6.67%) at par with neem seed kernel powder (6.67%); and maximum being in the untreated control (28.67%), followed by cow dung powder (18.67%) (Table 1). Narayana Swamy et al. (2019) reported maize grain treated with *A. squamosa* seed powder @ 2% and cow dung ash powder @ 2% recorded minimum seed damage and weight loss at 180 days after treatment. Kudachi and Balikai (2009) observed 88.33% adult mortality, minimum seed damage (4.00%), and weight loss (2.36%) at 180 days after treatment with *A. squamosa* @ 5%. Black pepper powder resulted in the least weight loss (2.66%) at par with custard apple seed powder (3.06%); maximum weight loss was observed with cow dung powder (13.05%) at 120 DAR (Table 1). Mon et al. (2015) observed the least weight loss with black pepper powder after four months after storage in rice; similarly, Islam et al. (2013) observed minimum weight loss by *Callosobruchus chinensis* in seeds treated with black pepper powder @1.00 g/ kg. Kalasagond (1998) observed 60.00% adult mortality of *R. dominica* and also least seed weight loss (1.43%) at 180 days after storage with custard seed powder @ 1.4%. This might be because custard apple seed powder has an antifeedant effect, as Luca (1979) documented. Cow dung ash @ 5.00 g showed 10. 40% adult mortality of *S. zeamais* after 48 hr (Oni, 2011). The ash has an impact, but it does it mechanically rather than chemically. Because the ash restricts adult movement, oviposition is hindered (Boeke et al., 2003).

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AUTHOR CONTRIBUTION STATEMENT

V R and C R S conceived and designed research. V R conducted experiments. S R analyzed data. V R wrote the manuscript. C R S, D G and S B reviewed and approved the final manuscript.

CONFLICT OF INTEREST

No conflict of interest.

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