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Efficacy of certain plant products on the incidence of *Sitophilus oryzae* Linnaeus (Coleoptera: Curculionidae) on the extent of damage of stored rice in Nagaland.

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ABSTRACT: *An experiment was carried out in the Department of Entomology, SASRD Medziphema campus, Nagaland University, during the month March to August, 2004 to evaluate the extent of damage of three rice varieties caused by rice weevil,* Sitophilus oryzae *after treated with four different plant products. Factorial Completely Randomized Design (FCRD) was adopted with three (3) rice varieties viz., IR-8, Nagaland Special and Lumanyi were used and plant products viz., Chinaberry fruit powder, Turmeric rhizome powder, Eucalyptus bark ash, Raja chilli fruit powder were used to control* Sitophilus oryzae. *The lowest percentages of damage was found in Eucalyptus bark ash with 0.44%, 1.11% and 4.89% whereas the highest damage was indicated in control with 1.89%, 7.33% and 14.00% respectively after 2,4 and 6 months of storage among the varieties, the lowest percentages of damage were observed in IR-8 with 0.46%, 3.20% and 8.80% whereas the highest damage was found in Lumanyi with 1.40%, 4.87% and 11.13% at 2, 4 and 6 months after storage respectively. Lastly the results indicated that the Eucalytus bark ash was most effective to protect the milled rice and there was no adverse effect on the treated rice making it palatable for human consumption.*

Keywords: *Sitophilus oryzae. Lumanyi; IR-8; Nagaland Special; Plant products; Eucalyptus bark ash;*

INTRODUCTION

Sitophilus oryzae is the most destructive pest of tropics and sub tropics (Mathur, 1985). More than 70 insect pests have been identified which attack stored grains and cereal products in store houses and the damage caused by these insect pests, worldwide is estimated to be 10-40% annually (Upadhyay and Ahmad, 2011). About 5-10% of food grains produced in India is lost to various agencies every year during storage, of which 3.5% are destroyed by stored grain insect pests (Girish *et al*., 1985). Storage of grains without loss is of national importance. It not only infests the grains in storage but also attack mature paddy in the field as well. This insect is called primary pest, or internal feeder because the adult attacks whole kernel and larva feeds and develops within the kernel (Morenomari *et al*., 2002). Plant products as grain protectants are least toxic and possess surface persistence for a long period, have least or no adverse effect on germinability of seed, cooking quality and milling, are less expensive, easily available and some products like natural pyrethrins have rapid killing action (Prakash *et al*., 1981c). Use of plant products (biopesticides) like neem leaves against insect pest is very imperative (Prakash *et al.* 1982a). Prakash and Rao (1985) indicated usage of plant products as protectants against insect pests when grains are preserved for human consumption.

MATERIALS AND METHODS

The experiment was carried out in the Department of Entomology, SASRD Medziphema campus during the month March to August, 2004. Three (3) rice varieties viz., IR-8, Nagaland Special and Lumanyi were used and plant products viz., Chinaberry fruit powder, Turmeric rhizome powder, Eucalyptus bark ash, Raja chilli fruit powder and control to evaluate their effect on *Sitophilus oryzae*. One kg of husked rice was mixed with 10 g of plant products thoroughly and stored in a gunny bag of 1 kg capacity. Five (5) pairs of *S. oryzae* were released in each bag and were tied with tin thread. The experiment was conducted in Factorial Completely Randomized Design (FCRD) and all the treatments were replicated three times. A total the

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forty five (45) treatments (bags) with proper labels were randomized and stacked on a wire mesh wooden rack in the laboratory at room temperature. The effects of plant products and rice varieties on weight loss caused by *S. oryzae* were recorded at 2, 4 and 6 months after storage (MAS).

The experiment was conducted in by Factorial Completely Randomized Design (FCRD) and was transformed to Square root transformation $\sqrt{x+0.5}$ before subjecting them to statistical analysis. All the treatments were replicated three times. 'F' test was used to determine the significance and non-significance of the variance due to different treatments at 0.05 level of significance. Further, comparison between the different treatments was carried out by Duncan's Multiple Range Test (DMRT) to find out the significant differences between mean values.

RESULTS

After 2 months of storage, the lowest percentage of damage (0.44%) were recorded in Turmeric rhizome powder and Eucalyptus bark ash which were at par with each other (Table 1). This was followed by Raja chilli fruit powder with 0.78% damage and the highest damage (1.89%) was recorded in untreated control treated. Among the varieties, the lowest percentages of damage were observed in IR-8 with 0.46% followed by Nagaland Special (0.73%). The variety Lumanyi was recorded to be highest per cent damage (1.40%). It is evident that the variety IR-8 was highly superior over other varieties.

The interaction effect of plant products and varieties were statistically analyzed as insignificant. However, the lowest damage percentage (0.00) was observed in IR-8 treated with Eucalyptus bark ash and the highest infestation (1.67%) in Lumanyi treated with Raja chilli fruit powder. Further studies revealed that, the lowest damage (1.33%) in the untreated control was observed in lR-8 and Nagaland Special, while the highest damage percentage (3.00%) was recorded in Lumanyi. lt is evident from the data given that Eucalyptus bark ash treated in IR-8 and Nagaland Special could effectively control infestation caused by *S. oryzae* as compared to other treatments.

After 4 months of storage, the extent of damage caused by *S. oryzae* revealed that the mean damage percentage of four plant products varied from 1.11% to 5.22% as against 7.33% in untreated control (Table 1). The lowest damage percentage was recorded in Eucalyptus bark ash (1.11%), followed by Turmeric rhizome powder (2.34%) in treated rice. The highest damage percentage (5.22%) was found in Raja chilli fruit powder, which was found at par with Chinaberry fruit powder (4.22%) lt is evident from the data recorded that rice treated with Eucalyptus bark ash was highly superior over other plant products. Among the varieties, the lowest damage percentage was obtained in IR-8 (3.20%), which was found at par with Nagaland special (4.07%) while the variety Lumanyi received highest damage percentage (4.87%) It is evident from the data that IR- 8 was observed to be a superior variety over other varieties.

The interaction effect of plant products and varieties were found highly significant. The mean damage percentage ranges from 0.33 to 5.67% in treated rice as against 6.33 to 9.00% in untreated control. The lowest damage percentage (0.33%) was found in Nagaland Special treated with Eucalyptus bark ash, which did not differ significantly with IR-8 and the highest (5.67%) in the same variety treated with Raja chilli fruit powder. Under investigation revealed that least percentage of damage (6.33%) in untreated rice was observed in IR-8, which at par with Nagaland special (6.67%). The highest damage (9.00%) was noted in Lumanyi, which was significantly higher than the other varieties. From the data, it is evident that Nagaland Special and IR-8 treated with Eucalyptus bark ash was most effective in reducing damage by the insect over other treatments.

After 6 months of storage, the critical examination on the extent of damage caused by *S. oryzae* revealed that rice treated with plant products varied from 4.89 to 11.11% against 14.00% in untreated control (Table 1). The least damage (4.89%) in treated rice was found in Eucalyptus bark ash, followed by Turmeric rhizome powder (7.89%) The highest damage (11.11%) was obtained in Raja chilli fruit powder being at par with Chinaberry fruit powder (10.67%). It was found that rice treated with Eucalyptus bark ash was repeatedly recorded as superior over other plant products even after six months of storage. Among the varieties, the least damage percentage was recorded in IR-8 (8.80%) followed by Nagaland Special (9.20%) and highest in Lumanyi (11.13%). All the varieties were statistically significant at 1.00% probability level. IR-8 was observed to be most superior in performance over other varieties.

The interaction effect of plant products and varieties revealed that there was no significance difference between the combine treatment of plant products and varieties. However, the mean damage percentages varied from 3.76 to 13.33% in rice treated with plant products as against 12.67 to 15.33% in

Table 1

Effect of plant products and rice varieties on the extent of damage caused by *S. oryzae* at 2, 4 and 6 months after storage during March to August, 2004

Plant products	*Damage (%)*											
	2 months after storage				*4 months after storage*				*6 months after storage*			
	IR-8	*Nagaland Special*	*Lumanyi*	*Mean*	*IR-8*	*Nagaland Special*	*Lumanyi*	*Mean*	*IR-8*	*Nagaland Special*	*Lumanyi*	*Mean*
Chinaberry fruit powder	0.33[b] (0.87)	1.00[b] (1.22)	1.00[c] (1.22)	0.78 (1.10)	3.33[c] (1.95)	5.00[c] (2.33)	4.33[c] (2.19)	4.22 (2.16)	9.33[c] (3.13)	10.67[b] (3.34)	12.00[c] (3.53)	10.67 (3.33)
Turmeric rhizome powder	0.33[b] (0.87)	0.67[c] (1.05)	0.33[d] (0.87)	0.44 (0.93)	0.67[e] (1.05)	2.67[d] (1.76)	3.67[d] (2.19)	2.34 (1.67)	7.33[d] (2.79)	7.67[d] (2.85)	8.67[d] (3.02)	7.89 (2.89)
Eucalyptus bark ash	0.00[c] (0.70)	0.33[d] (0.87)	1.00[c] (1.67)	0.44 (1.08)	1.00[d] (1.22)	0.33[e] (0.87)	2.00[e] (1.56)	1.11 (1.22)	3.67[e] (2.03)	4.67[e] (2.25)	6.33[e] (2.53)	4.89 (2.27)
Raja chilli fruit powder	0.33[b] (0.87)	0.33[d] (0.87)	1.67[b] (1.44)	0.78 (1.06)	4.67[b] (2.26)	5.76[b] (2.47)	5.33[b] (2.40)	5.22 (2.38)	11.00[b] (3.39)	9.00[c] (3.09)	13.33[b] (3.71)	11.11 (3.39)
Untreated control	1.33[a] (1.34)	1.33[a] (1.34)	3.00[a] (1.86)	1.89 (1.51)	6.33[a] (2.60)	6.67[a] (2.66)	9.00[a] (3.12)	7.33 (2.79)	12.67[a] (3.62)	14.00[a] (3.78)	15.33[a] (3.97)	14.00 (3.79)
Mean	0.46 (0.93)	0.73 (1.07)	1.40 (1.41)		3.20 (1.81)	4.07 (2.02)	4.87 (2.29)		8.80 (2.99)	9.20 (3.06)	11.13 (3.35)	
	SEm±		**$CD_{(p=0.05)}$**		**SEm±**		**$CD_{(p=0.05)}$**		**SEm±**		**$CD_{(p=0.05)}$**	
Plant products	0.07		0.22		0.04		0.17		0.06		0.17	
Variety	0.09		0.28		0.06		0.22		0.08		0.21	
P x V	0.16		NS		0.10		0.39		0.13		NS	

Note: Figures in the table are mean values and those in parenthesis are square root transformed values
Same small letter(s) in a column after mean values indicates non-significant different from each other at 5% level of significance
NS = Non significant at 5% level of significance

Plate 1: Eucalyptus

Plate 2: Chinaberry

Plate 3: Turmeric plant

Plate 4: Turmeric Rhizome

Plate 5: Raja chilli

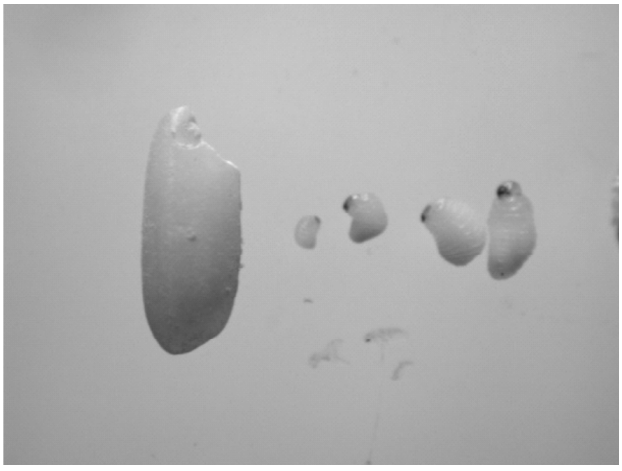

Plate 6: Different Nymphs Larva stages

Plate 7: Layout of the experiment in laboratory condition

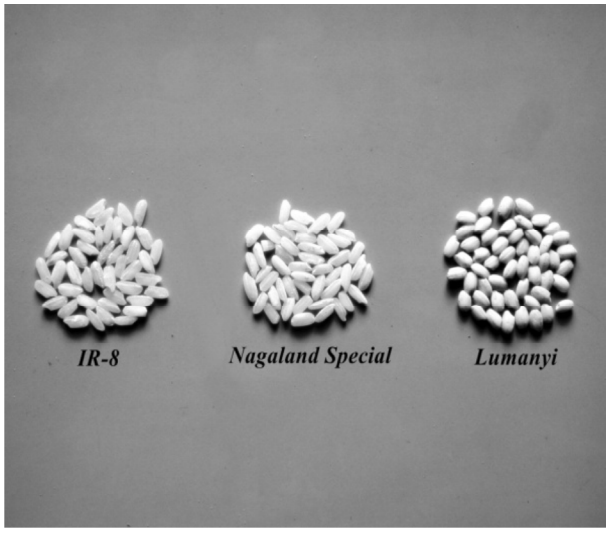

Plate 8: Three rice varieties used during the study

untreated control. The lowest damage (3.67%) was recorded in IR-8 treated with Eucalyptus bark ash and highest (l3.33%) in Lumanyi. On the other hand, the least damage percentage (l2.67%) in untreated rice was observed in IR-8 followed by Nagaland special (l4.00%). The highest damage percentage (15.33%) was noted in Lumanyi. It is evident from the data recorded that IR-8 treated with Eucalyptus bark ash yielded the most effective treatment after six months of storage.

DISCUSSION

At 2 months after storage it was observed that least damage (0.44%) was recorded in Turmeric rhizome powder and Eucalyptus bark ash which were at par with each other. Similar findings were also reported by Apuuli and Villet (1996) who recorded l.30% damage in cowpea by bruchid after one breeding cycle. Singh *et al*. (1991) has also reported that significant reduction in damage to barley (0.89 - 35.34%) by *S. oryzae* occurred 2 months after storage. It can be concluded that the extent of damage was lowest in the rice treated with Turmeric rhizome powder and Eucalyptus bark at 2 months after storage.

At 4 months after storage the minimum damage was recorded in rice treated with Eucalyptus back ash (1.11%) which was highly differ from other plant products. Apart from Eucalyptus back ash, Turmeric rhizome powder was also found to have better efficacy which was also supported by Chander *et al*., (2000) for its good repellency against *Tribolium castaneum* even after three months of storage. Further, during the investigation maximum damage was recorded in Lumanyi (4.87%) whereas the lowest damage was observed in IR-8 (3.20%) and was significantly different from each other

At 6 months after storage the highest level of damage by *S. oryzae* was recorded in Raja chilli fruit powder (11.11%) treated rice, which was at par with Chinaberry fruit powder (10.67%). The finding was in conformity with Sharma (1995) that cob ash was found effective in inhibiting emergence of *Rhizopertha dominica*, in stored maize. Turmeric rhizome powder was also recorded as a better grain protectant in suppressing extent of damage by the insect. This trend was in conformity with the findings of Chander *et al*., (1992) who reported the effectiveness of Turmeric rhizome powder as grain protectant for milled rice against infestation by *Tribolium castaneum.* Chinaberry fruit powder and Raja chilli fruit powder were less effective as compared to Eucalyptus back ash. This findings was in conformity with Onu and Aliyu (1995) who reported that peppers at 2.5-50 gm/250 gm of seeds were effective in reducing oviposition and damage to the seeds as indicated by the significantly lower number of emergence hole. It was also suggested that insecticidal activity of chilli may be due to the presence of 'Capsaicin` a pungent compound that irritate insects Pruthi (l993) and Rethinaraia and Narayanaswamy (1999).

It was also observed from the Table 1 that all the varieties of rice were recorded to have significant difference over each other at 6 months after storage. Maximum damage was noticed on Lumanyi (11.13%) and minimum damage in IR-8 (8.80%) which was found at par with Nagaland Special (9.20%) lt is

apparent that the variety Lumanyi was preferred most by the *S. oryzae* while reference to Nagaland Special was less and IR-8 was the least preferred milled rice. Bhatia *et al*., (1975) found the percentage of damage by *S. oryzae* to the grain varied from variety to variety, which was in accordance with the present findings. The trends on the varietal preference by *S. oryzae* were earlier recorded by Nigam *et al*., (1987), Mbata (l992) and Jayakumar and Jeyaraj (l995) in mill rice. Nagaland special and Lumanyi are found to be slightly scented and sticky in nature when cooked and also found to contain fats as compared to IR-8. According to Prakash *et al*., (l982a) scents of rice grain were considered to attract many stored pests and also reported that scented variety like 'Basmati` was found to be more susceptible to *Sitotroga cerealella* Oliv.

CONCLUSION

Eucalyptus bark ash was found to be very effective in protecting milled and also caused no adverse effect on the treated rice, thus making it palatable for human consumption. Other plant products like turmeric powder and chinaberry fruit powder were also found to be effective. Further, investigations on the use of indigenous plant products such as Eucalyptus bark, turmeric powder, chinaberry fruit powder and raja chilli fruit power etc. can be done by extracting their active ingredients for management against stored grain pests.

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