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Eco-friendly management on weight losses of three rice varieties caused by rice weevil, *Sitophilus oryzae* Linnaeus (Coleoptera: Curculionidae) after treated with different plant products

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ABSTRACT: *A study was conducted in the Department of Entomology, SASRD Medziphema campus, Nagaland University, during the month March to August, 2004 to evaluate the weight losses 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. After 2, 4 and 6 months of storage, the best result was recorded in Eucalyptus bark ash with 0.13%, 0.42% and 2.25%; whereas the highest weight loss was found in control with 0.97%, 3.01% and 7.69% at 2, 4 and 6 months after storage respectively. Among the varieties, the lowest percentages of weight loss were observed in IR-8 with 0.26%, 1.26% and 4.53% whereas the highest damage was found in Lumanyi with 1.61%, 2.21% and 5.23% at 2, 4 and 6 months after storage respectively. Among the plant products the most effective was Eucalyptus bark ash are as follows Chinaberry fruit powder 5.16, Turmeric rhizome powder 3.74, Raja chilli fruit powder 5.37, Untreated control 7.69. Thus from the results, it was found that Eucalyptus bark ash give the best result on the mill rice, thus making it palatable for human consumption.*

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

INTRODUCTION

Storage of milled rice without loss is of national importance. *Sitophilus oryzae* is the most destructive pest of tropics and sub tropics (Mathur, 1985). It not only infests the grains in storage but also attack mature paddy in the field as well. It is largely responsible for damage and frequently harbouring in stores, mills and warehouses (Koura and Et- Halfway, 1967). This insect is called primary pest, or internal feeder because the adult attacks whole kernel and larva feeds and develops within the kernel (Moreno-mari *et al*., 2002). Heavy damage may be caused to the rice particularly during the monsoon season (Atwal and Dhaliwal, 2002). Use of plant products (bio-pesticides) like neem leaves against insect pest is very imperative (Prakash *et al.* 1982a). Prakash and Rao 1984 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 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

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caused by *S. oryzae* were recorded at 2, 4 and 6 months after storage (MAS).

WEIGHT LOSS (%)

At 2, 4 and 6 months of storage about 100 healthy seeds from each treatment were weighed with the help of electric weighing balance. The loss in weight was done using the formula recommended by Indian Grain Storage Institute, Hapur (Majumder, 1978).

$$\text{Weight loss percentage } (\%) = \frac{W - 100}{S} \times Wi$$

Where, *W*= Percentage by number of damaged grains

S= Weight of 100 healthy kernels (Grams)

Wi= Weight of damaged kernels (Grams)

The data percentages relating to the extent of damage and weight loss were transformed to Square root transformation $\sqrt{x+0.5}$ before subjecting them to statistical analysis. The transformed values were subjected to one way analysis of variance (ANOVA) by Factorial Completely Randomized Design (FCRD). '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 critical examination on weight loss caused by *S. oryzae* revealed that the mean weight loss percentages varied from 0.l3 to 0.91% as against 0.97% in untreated control (Table 1). The lowest weight loss was recorded in rice treated with Eucalyptus bark ash (0.13%) followed by Turmeric rhizome powder (0.23%) and Chinaberry fruit powder (0.34%) while the maximum weight loss (0.40%) occurred in Raja chilli fruit powder. The most effective plant product was recorded in case of Eucalyptus bark ash which was found highly superior over untreated control. Among the varieties, the lowest loss in weight was recorded in IR-8 (0.26%), followed by Nagaland special (0.37%) and highest in Lumanyi (0.6l%). From the data recorded, it is found that IR-8 was observed to be highly significant than other rice varieties.

The interaction of the plant products and varieties on weight loss of rice was not significant. However, the lowest weight loss (0.00%) in treated rice was recorded in IR-8 treated with EBA and highest (0.88%) in Lumanyi treated with Raja chilli fruit powder. On the other hand, in untreated control, IR-8 (0.81%) was recorded as the least weight loss percentage followed by Nagaland special (0.84%) and highest in Lumanyi (1.27%) It is evident from the table that Eucalyptus bark ash treated in IR-8 revealed the least percentage of weight loss than other combined treatments.

After 4 months of storage, the weight loss caused by *S. oryzae* revealed that the rice treated with plant products had lower weight loss over untreated control (Table 1). The weight loss percentage of treated rice varied from 0.42 to 1.99% as against 3.01% in untreated control. The least weight loss was recorded in Eucalyptus bark ash (0.42%) followed by Turmeric rhizome powder (1.12%). The highest weight loss (1.99%) was recorded in Raja chilli fruit powder though it did not differ significantly from Chinaberry fruit powder (l.59%) ice treated with Eucalyptus bark ash was found to be highly superior over other plant products. Among the varieties, the lowest weight loss was recorded in IR-8 (1.26%), which was significantly less than Nagaland Special (1.42%) while the highest percentage in weight loss was obtained in Lumanyi (2.21%). From the data recorded, it is evident that IR-8 was found to be highly superior over other varieties.

The interaction of weight loss of plant products and varieties varied from 0.17 to 2.71% in treated grains as against 2.76 to 3.91% in untreated control. However, there was no significant difference in combine effect of plant products and rice varieties. The lowest weight loss (0.17%) in treated rice was observed in Nagaland special treated with Eucalyptus bark ash (0.17%) and highest weight loss in Lumanyi (2.71%) treated with Raja chilli fruit powder. On the other hand, in untreated control the least weight loss (2.36%) was recorded in Nagaland special followed by IR-8 (2.76%) and highest weight loss was found in Lumanyi (3.91%). From the data, it is evident that Nagaland Special and IR-8 treated with Eucalyptus bark ash was most effective over other treatments.

After 6 months of storage, the critical examination on weight loss caused by *S. oryzae* revealed that the mean weight loss percentages in all the treatments were lower than the untreated control (Table 1). Weight loss percentage with treated varied from 2.25 to 5.37 percent as against 7.69 percent in untreated control. The lowest weight loss percentage (2.25%) was found in rice treated with Eucalyptus bark ash, which was significantly less than Turmeric rhizome powder (3.74%) The highest loss percentage was recorded in Raja chilli fruit powder (5.37%), which was at par with Chinaberry fruit powder (5.l6%). lt is observed from the data that Eucalyptus was recorded

the best and most effective plant product when compared to other plant products. Among the varieties, the lowest weight loss was found in IR-8 (4.53%) though it was at par with Nagaland special (4.78%) The highest weight loss was recorded' in Lumanyi (5.23%) It is evident from the data recorded that IR-8 was most superior over other varieties.

The interaction effect of plant products and rice varieties was not significant throughout the storage period. However, the least weight loss was found in IR-8 treated with Eucalyptus bark ash (2.14%) and highest loss was seen in Lumanyi (6.11%) treated with Raja chilli fruit powder. The highest weight loss in untreated control was obtained in Lumanyi (8.11%), followed by Nagaland special (7.84%) and lowest data was recorded in IR-8 (7.l2%). It is evident from the data that EBA treated in IR-8 was the most effective treatment than other plant products in all the varieties even after six months of storage.

DISCUSSION

It was observed from the Table 1 that 2 months after storage in rice treated with plant products where all of them were equally effective in lowering the weight loss due to *S. oryzae*. The minimum percent weight loss was found in rice treated with Eucalyptus back ash (0.13%), which does not differ significantly with other plant products as against untreated control (0.97%). It is evident from the data recorded that all the plant products could effectively control *S. oryzae* in the early period of storage. It is also found from the same table that IR-8 recorded least weight (0.26) followed by Nagaland special (0.37%) and highest in Lumanyi (0.61%) but there exist no significance difference among different rice varieties. Nigam *et al*., (1987) has also detected loss in grain weight in various rice varieties by *S. oryzae* one month after storage. Thus, it is evident that variety IR-8 treated with Eucalyptus back ash received least weight loss at 2 months after storage.

Percentage of loss in weight in rice treated with four plant products was found to be significantly different from untreated control at 4 months after storage (Table 1). The minimum weight loss percentage was found in rice treated with Eucalyptus back ash (0.42%), which was found at par with Turmeric rhizome powder (l.12%) and Chinaberry fruit powder (1.59%) while maximum percent weight loss was recorded in Raja chilli fruit powder (1.99%) as against 3.01% in untreated control. It is also evident from the table that minimum percentage of loss was recorded in IR-8 (1.26%), which highly differ from Lumanyi (2.21%). Nagaland special exhibited l.42%, which was at par with IR-8. Bhuiyah *et al*., (l988) reported that *S. oryzae* caused 11 - 16% weight loss of unhusked rice after four months of storage, which is similar to the present finding. From the data recorded, it is evident that IR-8 revealed to be less preferred than other two rice varieties against infestation by the insects. It can also be concluded that Eucalyptus back ash treated with IR-8 revealed better protection in reducing weight loss due to attack by *S. oryzae*.

After six months of storage, percentage in weight loss in treated rice with plant products significantly differs over untreated control. This implies that all the plant products were effective in minimizing loss in weight by *S. oryzae*. The maximum percent weight loss was obtained in Raja chilli fruit powder (5.37%), which was found at par with Chinaberry fruit powder (5.16%) Minimum loss was recorded in rice treated with Eucalyptus back ash (2.25%), which was significantly lower than other plant products. It is apparent that Eucalyptus back ash was recorded as the best and most effective grain protectant that can reduce weight loss even after six months of storage. The present investigation in conformity with the findings of Sharma (1995) who also observed cob ash in maize was effective over a period of nine months against *Rhizopertha dominica* Fab. It is also suggested that any dry powdery substance might serve as a good protective medium for storage of seeds (Apuuli and Villet, 1996). Kandalkand *et al.,* (2003) reported total loss of grain in gunny bag was noticed to the extent of 5.30 to 9.00%, which is also in accordance with present findings. Similar trends of efficacy were also obtained in other plant products, which too revealed better performance when compared to untreated control. It was reported by Prakash *et al*., (1993) that Turmeric rhizome powder could significantly reduce adult population of *S. oryzae* and weight loss of grains. Though Raja chilli fruit powder was also less effective than Eucalyptus back ash and Turmeric rhizome powder, but it was found to differ significantly from untreated control. Similar to this findings it was observed that black gram seed treated with 3% dried fruit powder of *Capsicum annum* L., against *Callosobruchus chinensis*, successfully lower fecundity and weight loss of grain (Misra, 2000). The trend to the present investigation were also reported by Procopio *et al*., (2003) that fruit powder of *C. frutescens* L, could reduce reproduction rate of *Acanthoslides obtestus*. It is revealed from the data recorded that IR-8 treated in Eucalyptus back ash could effectively

Table 1

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

Plant products	*Weight loss (%)*											
	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	0.16[b] (0.79)	0.34[b] (0.09)	0.53[c] (1.01)	0.34 (0.09)	1.28[b] (1.33)	1.64[b] (1.45)	1.85[c] (1.50)	1.59 (1.43)	4.79[c] (2.28)	5.45[b] (2.43)	5.45[c] (2.43)	5.16 (2.36)
Turmeric rhizome powder	0.16[b] (0.79)	0.34[b] (0.09)	0.18[d] (0.80)	0.23 (0.83)	0.49[c] (0.99)	1.07[c] (1.24)	1.80[c] (1.48)	1.12 (1.24)	3.46[d] (1.98)	3.56[d] (2.01)	4.21[d] (2.15)	3.74 (2.05)
Eucalyptus bark ash	0.00[b] (0.70)	0.17[b] (0.80)	0.21[d] (0.83)	0.13 (0.78)	0.33[c] (0.89)	0.17[d] (0.80)	0.76[d] (1.08)	0.42 (0.92)	2.15[e] (1.55)	2.14[e] (1.59)	2.47[e] (1.56)	2.25 (1.62)
Raja chilli fruit powder	0.16[b] (0.79)	0.17[b] (0.80)	0.88[b] (1.15)	0.40 (0.91)	1.14[b] (1.35)	1.84[b] (1.51)	2.71[b] (1.78)	1.99 (1.55)	5.11[b] (2.30)	4.89[c] (2.31)	6.11[b] (2.56)	5.37 (2.39)
Untreated control	0.81[a] (1.12)	0.84[a] (1.14)	1.27[a] (1.32)	0.97 (1.19)	2.76[a] (1.79)	2.36[a] (1.69)	3.91[a] (2.08)	3.01 (1.85)	12.67[a] (3.62)	14.00[a] (3.78)	15.33[a] (3.97)	7.69 (2.84)
Mean	0.26 (0.84)	0.37 (0.91)	0.61 (1.02)			1.26 (1.27)	1.42 (1.34)	2.21 (1.58)		4.53 (2.17)	4.78 (2.24)	5.23 (2.35)
	SEm±		**$CD_{(p=0.05)}$**		**SEm±**		**$CD_{(p=0.05)}$**		**SEm±**		**$CD_{(p=0.05)}$**	
Plant products	0.06		0.13		0.07		0.17		0.08		0.22	
Variety	0.08		NS		0.09		0.23		0.10		0.16	
P x V	0.13		NS		0.16		NS		0.18		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

Figure 1: Layout of the experiment in laboratory condition

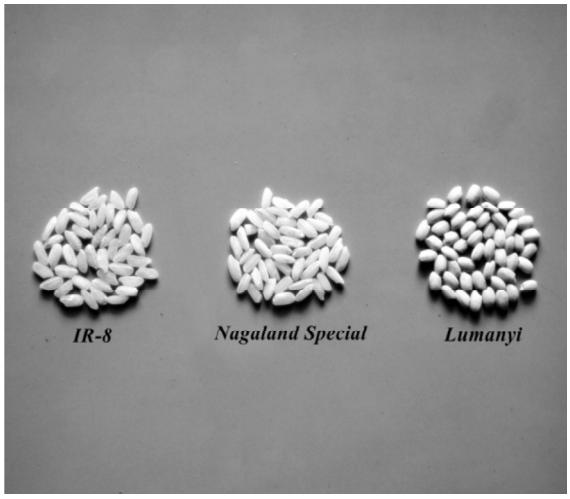

Figure 2: Three rice varieties used during the study

Figure 3: Infestation caused by *S. oryzae* on Nagaland Special

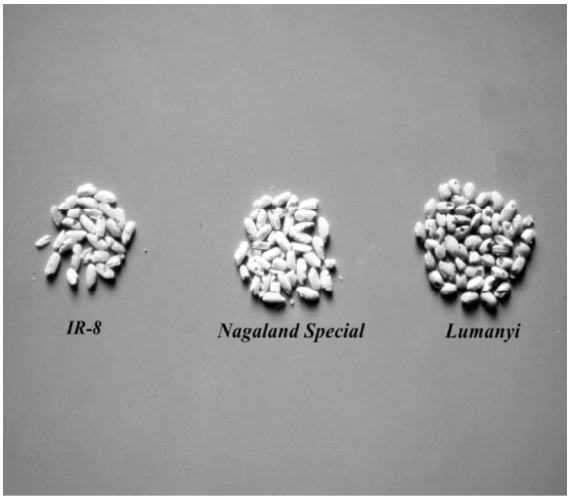

Figure 4: Infestation caused by *S. oryzae* on three rice varieties

Figure 5: Different stages of *S. oryzae* observed during the investigation

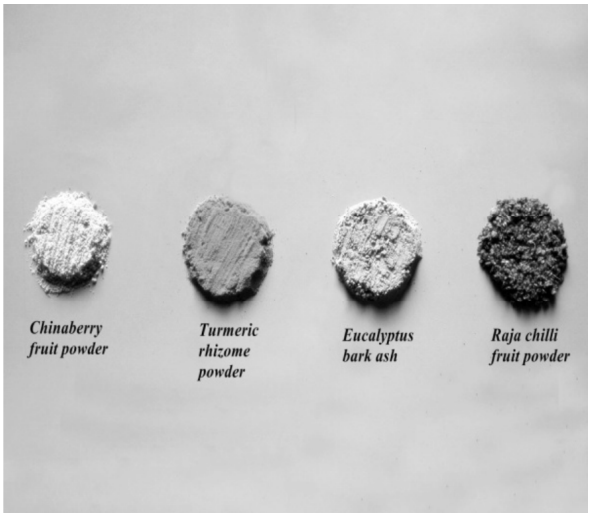

Figure 6: Different plant products used during the study

control from causing weight loss by *S. Oryzae* even after six months of storage.

It is also recorded from the Table that percentage of weight loss in different rice varieties due to *S. oryzae* at 6 months after storage was found to be significant. The least percentage of loss in weight occurred in variety IR-8 (4.53%) followed by Nagaland special (4.78%) and highest in Lumanyi (5.23%). Jayakurnar and Jayaraj (1995) have also reported loss of grain weight 90 days after storage. Verma and Uttam (1990) reported that the grains of IR-8 was least susceptible while basmati was most susceptible to *Sitotroga cerealella*. Pareek *et al*., (1977) observed difference in weight loss in various varieties of maize, which is somewhat in accordance with the present findings. Nagaland special and Lumanyi were found to suffer greater weight loss because these varieties are scenty and sticky in nature as compared to IR-8. Prakash *et al*., (1982a) also pointed out that scenty varieties of rice were attractive to *S. oryzae*. From the above data, it can be concluded that IR-8 was less preferred by *S. oryzae* while Lumanyi was highly susceptible to infestation by *S. oryzae*. Nagaland special exhibited 4.78%, which was found that it did not differ significantly from IR-8 variety. It was revealed from the present investigation that Eucalyptus back ash treated in IR-8 was observed to the most effective treatment in reducing weight loss of rice even after six months of storage.

CONCLUSION

Eucalyptus bark ash was found to be very effective in protecting milled rice and also caused no adverse effect on the treated rice, thus making it palatable for human consumption. Other plant products like turmeric powder , chinaberry fruit powder and Raja chilli 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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