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RESEARCH ARTICLE

Efficacy of different botanicals against Rice Weevil, *Sitophilus oryzae* L. (Coleoptera: Curculionidae) in stored paddy seeds

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ABSTRACT

Experiments were conducted in private paddy seed processing units to study the efficacy of different botanicals against rice weevil, *Sitophilus oryzae* (L.) in stored paddy seeds. Rhizome powder of *Acorus calamus* (sweet flag), Rhizome powder of *Curcuma longa* (L.) (turmeric), leaf powder of *Azadirachta indica* (L.) (neem), leaf powder of *Vitex negundo* (L.) (notchi) and husk ash of *Oryza sativa* (paddy) were used as treatments for this experiment. The results showed that neem leaf powder and notchi leaf powder caused about 90 per cent mortality of weevils and the further multiplication of weevils was arrested. The storability was found to be better in rice husk ash treated seeds. The seeds treated with sweet flag rhizome powder and rice husk ash recorded more than 80% germination in 150 days after seed treatment. Whereas, sweet flag rhizome powder and turmeric rhizome powder treatment, only 50% mortality of the pest was observed.

Keywords: *Botanicals, Rice weevil, Neem powder, Notchi powder, Mortality of weevils, Storability of seeds.*

INTRODUCTION

Rice weevil, *Sitophilus oryzae* (Linn) is a major pest in stored cereal grains like paddy, sorghum, wheat, barley and maize (Raju, 1984). Though there are several insect pests attacking stored paddy, *S. oryzae* is more specific to cause economic loss. Of course, it is the most destructive insect pest of the stored cereal grains in the world (Champ and Dyte, 1976). This particular pest causes upto 18.30% of grain loss. The larvae of *S. oryzae* live and feed inside the grain and the adults feed either in the old larval burrows or on the grain. The weevils have the habit of destroying more than what they eat. It causes enormous losses up to 100 per cent (Singh *et al*., 1975).

Insect pests can be managed using synthetic insecticides, but in storage, indiscriminate use of these synthetic insecticides resulted in the development of resistance (Subramanyam and Hagstrum 1995; Arthur, 1996), residues, undesirable effects on non-target organisms, human and environmental hazards (White and Leesch, 1995). In view of negative effects of synthetic insecticides, substances of plant origin for the control of stored grain insects are quite promising as they are more biodegradable, less toxic to human beings and safe to environment (Guzzo et al., 2006). The use of plant products as seed protectants is a traditional method and is off great interest in the recent past. The plant materials possess insecticidal as well as repellent properties with little or no mammalian toxicity (Uma Reddy and Shoba Reddy, 1987). Recently lot of work is being carried out on indigenous practices for protecting field crop pests; such work on storage is very less and not in much practice. Hence this experiment was conducted to evaluate the efficacy of different botanicals against rice weevil.

MATERIAL AND METHODS

Experiments were conducted in private paddy seed processing unit to study the efficacy of different botanicals on the larval and adult mortality of S. oryzae. The experiment was laid out in a factorial randomized block design with six treatments and with four replications.

Botanicals used for treatments are Sweet flag rhizome powder (Acorus calamus(L), Turmeric powder (Curcuma longa (L.), Neem leaf powder (Azadirachta indica (L.), Nochi leaf powder (Vitex negundo (L.) and rice husk ash each @5 gms/kg of seed. An untrated control was maintained so as to compare the efficacy of botanicals.

Well processed paddy seeds were kept at -200C for 48h in deep freezer in moisture proof container to kill all existing insect pests if any. The seeds thus disinfested were used for further studies. To assess the larval mortality of S. oryzae, about hundred grams of freshly processed disinfested seeds were taken in zip lock polythene bags (20x15cm) and 20 numbers of uniform aged adults were released for

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egg laying. Adults were allowed for egg laying for 20 days after which the released adults were removed. Then seeds were treated with botanicals and inert dust as above mentioned quantity. The treated seeds were kept in polythene bags. Observation on adult emergence was taken from 8th day after treatment until fresh adult emergence stopped. The per cent larval mortality was calculated (Howe, 1971) based on the number of adults emerged. Analysis of collected data is done by completely randomized design (CRD) method.

Per cent larval mortality = 100 - Percent larval survival

$$\text{Per cent larval survival} = \frac{\text{No. of adults emerged in treatment}}{\text{Total no. of adults emerged in control}} \times 100$$

To find out the effect of botanicals on adult mortality of *S. oryzae,* about hundred grams of freshly processed disinfested seeds were treated with botanicals and taken in zip lock polythene bags (20x15cm). Twenty numbers of uniform aged adults were released. Percent mortality of adults was recorded on 4th, 8th and 12th day after treatment. The per cent adult mortality was calculated (Howe, 1971) based on the number of adults dead.

$$\text{Per cent adult mortality} = \frac{\text{No. of adults dead}}{\text{Total no. of adults released}} \times 100$$

The storability of paddy seeds was also tested using the botanicals by taking about hundred grams of freshly processed disinfested seeds were treated with botanicals and taken in zip lock polythene bags (20x15cm). Twenty numbers of uniform aged *S. oryzae* adults were released. Number of live and dead adults emerged was counted on 60, 90, 120 and 150 days after treatment to find out the population build-up of the pest. After counting, dead insects were removed while the live insects were released back to the same seed pack. During next observation, the number of already released live insects was deducted.

Similarly per cent damage to seeds was recorded (number of seeds with bore holes) from randomly selected 100 seeds on 60, 90, 120 and 150 days after treatment.

Germination of botanicals treated paddy seeds in prescribed quantity was assessed by following Roll towel method as recommended by ISTA (1999). Observation on germination was recorded up to five months from 60th DAT after treatment in one month interval. (60, 90, 120 1nd 150 DAT.) Germination percentage was calculated by counting number of seeds germinated among randomly selected 100 treated paddy seeds.

RESULTS AND DISCUSSION

The results pertaining to the efficacy of different botanicals as seed treatment materials on rice weevil, *Sitophilus oryzae are* presented below. The mean per cent larval mortality of *S. oryzae* on 8th day after treatment with botanicals was maximum of 90.3 in neem leaf powder, 5 gms treated seeds and was on par with nochi leaf powder (83.0%.) 5 gms per kg of seed and turmeric rhizome powder (79.3%) 5 gms per kg of seed (Table 1) .

Table 1. Effect of botanicals as seed treatment material on larval mortality of *S. oryzae*

Treatment	Dose used gm/kg of seed 8th day onwards	Per cent larval mortality*
Sweet flag rhizome powder	5	77.0 (61.4)b
Turmeric rhizome powder	5	79.3 (63.0)ab
Neem leaf powder	5	90.3 (71.8)a
Nochi leaf powder	5	83.0 (65.8)ab
Rice husk ash	5	34.0 (34.6)c
Control (without any treatment)	-	0.0 (0.0)d
Mean		60.6 (49.4)
CD @ 5%		8.9

*Larval mortality worked out based on reduction in adult emergence in treatment compared to untreated control. Figures in parenthesis are arcsine (sin-1 √p) transformed value In a column, figures followed by a common lower case letter are not significantly different at p=0.05.

Neem leaf powder showed 10.0 per cent adult mortality after 12th day which was on par with nochi leaf powder treated seeds. Similar variations in mortality were observed on 4th and 8th day of treatment. However the mean mortality was higher (32.5) on 12th day after treatment compared to 8th (24.8) and 4th (15.7) day after treatment. (Table.2). Among botanicals rice husk ash was found to be the best recorded only minimum number of alive adults (2.1) after 150 days of treatment, whereas in control it was highest ie 51.8 numbers. Sweet flag rhizome powder was found to be the second effective treatment which showed 4.5 numbers of live adults in average after 150 days (Table 3). Least per cent damage was recorded in seeds treated with rice husk ash (0.9%) and was found to be on par with

Table 2. Effect of botanicals as seed treatment material on adult mortality of S. oryzae

	Treatment	Dose used Gm/kg of seed	Adult mortality* (%)			
			4th day	8th day	12th day	Mean
	Sweet flag rhizome powder	5	15.0 (22.5) b	33.8 (35.4) b	52.5 (46.4) b	33.8 (34.8) b
	Turmeric rhizome powder	5	5.0 (11.1) c	16.3 (23.5) c	32.5 (34.7) c	17.9 (23.1) c
	Neem leaf powder	5	3.8 (7.8) c	10.0 (17.7) c	16.3 (23.5) d	10.0 (16.4) d
	Nochi leaf powder	5	3.8 (7.8) c	11.3 (19.5) c	20.0 (26.5) d	11.7 (17.9) d
	Rice husk ash	5	50.0 (45.0) a	63.8 (53.0) a	75.0 (60.6) a	62.9 (52.9) a
	Control (without any treatment)	-	2.5 (6.4) c	5.0 (12.9) d	7.5 (15.7) e	5.0 (11.7) e
Mean			13.3 (16.7) C	23.3 (27.0) B	34.0 (34.6) A	
CD @ 5%	Treatment (T)	**4.5**				
	Days (D)	**3.2**				
	T vs D	**7.8**				

*Adult mortality was calculated based on the number of adults dead. Figures in parenthesis are arcsine (sin-1 √p) transformed value In a column, figures followed by a common lower case letter are not significantly different at p=0.05. In a row, figures followed by a common upper case letter are not significantly different at p=0.05

Table 3. Effect of botanicals as seed treatment material on infestation of S. oryzae

	Treatment	Dose used Gm/kg of Seed	Number of adults				
			60 DAT	90 DAT	120 DAT	150 DAT	Mean
	Sweet flag rhizome powder	5	2.5 (1.7) a	3.0 (1.9)a	5.0 (2.3)b	7.5 (2.8)	4.5 (2.2) b
	Turmeric rhizome powder	5	5.5 (2.4) b	11.0 (3.4)b	16.5 (4.1)c	30.0 (5.5)	15.8 (3.9) c
	Neem leaf powder	5	10.8 (3.4) c	20.5 (4.6)c	26.8 (5.2)d	32.3 (5.7)	22.6 (4.7) d
	Notchi leaf powder	5	12.8 (3.6) c	28.8 (5.4)d	38.8 (6.3)e	44.3 (6.7)	31.1 (5.5) e
	Rice husk ash	5	3.0 (1.9) a	2.8 (1.8)a	1.5 (1.4)a	1.0 (1.2)	2.1 (1.6) a
	Control (without any treatment)	-	20.8 (4.6) d	36.3 (6.1)e	58.8 (7.7)f	91.5 (9.6)	51.8 (6.9) f
Mean			9.2 (2.9) A	17.0 (3.8) B	24.5 (4.5) C	34.4 (5.3) D	
	Treatment (T)	0.2					
CD @ 5%	Days (D)	0.2					
	T vs D	0.4					

Figures in parenthesis are square root (√x+0.5) transformed value

In a column, figures followed by a common lower case letter are not significantly different at p=0.05.

In a row, figures followed by a common upper case letter are not significantly different at p=0.05

Table 4. Effect of botanicals as seed treatment material on per cent damage of S. oryzae

	Treatment	Dose used Gm/kg of Seed	Per cent Damage (%)				
			60 DAT	90 DAT	120 DAT	150 DAT	Mean
	Sweet flag rhizome powder	5	2.3 (8.5)b	1.5 (6.9)a	1.0 (4.9)a	0.8 (4.3)a	1.4 (6.1)a
	Turmeric rhizome powder	5	11.3 (19.5)d	15.3 (23.0)c	16.8 (24.1)c	21.8 (27.8)b	16.3 (23.6)c
	Neem leaf powder	5	5.5 (13.5)c	10.8 (19.1)b	12.0 (20.3)b	19.0 (25.8)b	11.8 (19.7)b
	Nochi leaf powder	5	14.5 (22.3)d	21.3 (27.4)d	25.3 (30.1)d	32.8 (34.9)c	23.4 (28.7)d
	Rice husk ash	5	1.0 (4.9)a	1.3 (5.4)a	0.5 (2.9)a	1.0 (5.7)a	0.9 (4.7)a
	Control (without any treatment)	-	19.3 (26.0)f	34.8 (36.1)d	43.5 (41.3)d	49.5 (44.7)d	36.8 (37.0)d
Mean			9.0 (15.8)C	14.1 (19.7)B	16.5 (20.6)B	20.8 (23.9)A	
	Treatment (T)	1.6					
CD @ 5%	Days (D)	1.3					
	T vs D	3.2					

sweet flag rhizome powder (1.4%), followed by neem leaf powder (11.8%), turmeric leaf powder (16.3%) followed by nochi leaf powder (23.4) treated seeds. In control about 49.5% of seed damage was recorded in 150 DAT itself. In rice husk treated seeds very minimum damage was found to be recorded since 60 DAT (Table 4).

CONCLUSION

In the present study, neem leaf powder and

notchi leaf powder showed good effect on larval mortality but less effective with respect to adult mortality. It was 10.0% on 12th day after treatment. However, in our studies, turmeric powder, neem leaf powder and notchi leaf powder produced low levels (less than 20%) of adult mortality.

Table 5. Effect of botanicals as seed treatment material on germination of treated paddy seeds

	Treatment	Dose used Gm/kg of seed	Per cent germination				
			60 DAT	90 DAT	120 DAT	150 DAT	Mean
	Sweet flag rhizome powder	5	85.0 (66.9)b	83.8 (67.2)b	83.5 (66.3)b	84.2 (66.1)b	84.1(66.6)b
	Turmeric rhizome powder	5	66.5 (56.4)c	54.5 (54.6)c	55.5 (47.6)d	61.4 (48.2)d	59.5 (51.7)e
	Neem leaf powder	5	81.8(71.6)a	61.3 (64.8)b	57.5 (51.5)c	72.6 (49.3)d	68.3 (59.3)d
	Nochi leaf powder	5	60.5(53.3)cd	49.8 (51.1)d	48.5 (44.9)d	55.8 (44.1)e	53.6 (48.3)f
	Rice husk ash	5	95.0 (71.2)a	93.3 (77.2)a	89.8 (75.0)a	91.9(71.4)a	92.5 (73.7)a
	Control (without any treatment)	-	81.8 (68.4)ab	80.5 (64.7)b	64.0 (63.8)b	78.1 (53.1)c	76.1 (62.5)c
Mean			78.4(64.6)A	70.5 (63.3)B	66.5 (58.2)C	74.0 (55.4)D	
	Treatment (T)	1.7					
CD @ 5%	Days (D)	1.4					
	T vs D	3.4					

In the current experimental study Rice husk ash treated seeds showed maximum of 92.5% mean germination on 150 DAT. In treated seeds, 84.1%, 68.3%, 59.5 and 53.6% seed germination was recorded with sweet flag rhizome powder, neem leaf powder, turmeric rhizome powder and notchi leaf powder respectively.

An experiment on effect of botanical seed treatments against *Sitophilus oryzae* in maize revealed that seeds treated with *Acorus calamus* rhizome powder @10g/kg seed had recorded the highest germination percentage (85.67), less pest infestation (0.18 per cent) and weight loss (0.02 per cent) at the end of nine months of storage. Similarly, in present study also, 84.1% (Table 5) germination was recorded in sweet flag rhizome powder treated seeds.

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