International Journal of Entomology Research
www.entomologyjournals.com
ISSN: 2455-4758
Received: 05-05-2022, Accepted: 21-05-2022, Published: 06-06-2022
Volume 7, Issue 6, 2022, Page No. 75-80

Efficacy of anti feedant and ovi position deterrent properties in neem, pudina, pungam, lantana against *Sitophilus oryzae* (Rice Weevil)

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Abstract
Stored products host a wide array of insect, the damage of which may amount up to 10-50% in a non-modern storage system. Sitophilus *oryzae* spp. Can be a major pest and is associated with many stored pulses. Experiments were conducted under laboratory conditions to study the oviposition deterrent and anti feedant activity of different plant extracts *viz*., Neem (Azadirachta *indica*), Pungam (Pongamia *glabra*),Pudina (Mentha *arvensis*) and Lantana (Lantana *camara*) on Rice weevil, Sitophilus *oryzae*. The results obtained from the experiments are summarized below. The 10% aqueous solution of different plant extracts, registered varied levels of mortality in Sitophilus *oryzae* in two different hosts studied *viz.*, Sorghum and green gram.
Neem showed strongest antifeedant activity on *S.oryzae* with mean food consumption of 0.13g. This was followed by Pudina with mean food consumption of 0.35g followed by Lantana with 0.48g and Pungam 0.56g.The oviposition deterrence percentage for *S.oryzae* was found to be the highest in Neem(75.50%) followed by Pudina, Lantana showed values of 63.50,62.50 per cent, respectively in Sorghum and green gram.

Keywords: ovi position, neem, pudina, pungam, lantana, *Sitophilus oryzae*

Introduction
Increasing problems associated with the use of synthetic chemicals for the control of stored products insects for the development of toxic agents against stored products pest. Recent years many plant secondary metabolites (alkaloids, mono terpenoids, or phenyl propanoids are toxic to stored products insects addition, essential oil extracted from aromatic plants have been widely investigated for pest control properties with some proving to be toxic repellent, anti feedent, ovicidal or ovipoistion inhibitors in insect pests(Tunc *et al* 2000, isman 2000,tripathi and kumar 2007)Sorghum is the fifth most important cereal in world cereal production after rice, wheat, maize and barley. It is the chief cereal grain consumed in Asia and Africa. It is rich in Thiamin, riboflavin, vitamin B6, biotin and niacin. The chief minerals present in sorghum grain are potassium and phosphorus, while calcium is low (CCCF, 2011). World sorghum production is about 60 million tons/ year. India is one among the major sorghum producing countries (FALL Ramatoulay *et al*., 2016). The most significant loss in the post-harvest operations occurs during storage of cereals is caused by improper and inadequate facilities, particularly at farm level (Adhikarinayake, 2005).
Though use of different plant extracts on *S.oryzae* is an holistic studies on the mode of action hence the present studies aims at investigating the insecticidal, ovipositional and antifeedant effect of different plant extracts on *S. oryzae* in a view to minimize the damage.

Materials and Methods
The experimental procedures adopted for studies on effects of different plant extracts on Rice weevil (*Sitophilus oryzae*) in various hosts *viz*., White sorghum and Split pulses (green gram). The investigations were carried out at the Department of Agricultural Entomology, Imayam Institute of Agricultural and Technology, Thuraiyur. The materials used and methods adopted in the study are presented in this chapter.

Crop and Variety Used for the Study
Freshly harvested sorghum seeds were obtained from farmers of Thuraiyur region. Seeds of the following crops like White sorghum and split pulses were used in the storage experiments.

Mass Culturing of *Sitophilus oryzae*
Mass culturing of Rice weevil (Sitophilus *oryzae*) was done at the Entomology laboratory, IIAT, Thuraiyur. The Rice weevil (Sitophilus *oryzae*) adults were collected from sorghum and paddy seed samples of the Department

of Seed Science and Technology and from Department of Plant Breeding and Genetics and utilized for mass culturing (Plate 1 and 2). These weevils were reared on sorghum grains following the method developed by Credland and Wright (1989). 500 g of sorghum seeds were placed in 600 ml plastic jars, into which approximately 50 pairs of freshly emerged rice weevils (*S.oryzae*) were introduced. The plastic jars were covered with muslin cloth and placed in dark to facilitate maximum oviposition maintained at a room temperature of 30 ± 5°C and 65 ± 5% RH throughout the period of study. After 25 to 30 days, adults that emerged from the culture were utilized for maintenance of sub cultures following the same procedure as described above. Sub culturing of this weevil was done at weekly intervals so as to get continuous supply of insects for experiments. Freshly emerged adults were used for conducting the experiments.

Collection and Aqueous Extraction of Plants

Locally available four plants *viz*., Neem (Azadirachta *indica*), Pudina (Mentha *arvensis)*, Pungam (Pungamia *glabra)*and Lantana(Lantana *camera)* were collected from farm of IIAT, Thuraiyur. Leaves of above mentioned plants were shade dried for one week and ground into fine powder. Plant powders were sieved through 0.25mm pore size mesh sieve to obtain uniform fine dust particles (Jembere *et al*., 2005). The resulting powders were kept separately in plastic containers with tight cap and stored at room temperature in dark prior to use. Ten gram of each powder was soaked in 100 ml of distilled water and left for 24 hrs. Thereafter, the extracts were decanted and filtered using muslin cloth and the resultant solutions was used for laboratory study.

Experimental Methods

Design

The experiment was laid out in Complete Randomized Block Design (CRBD) with Five treatments and four replications.

Treatment Details

T_1 - 10 % Aqueous Extract of Azadiracta *indica*
T_2 - 10 % Aqueous Extract of Pongamia *glabra*
T_3 - 10 % Aqueous Extract of Mentha *arvensis*
T_4 - 10 % Aqueous Extract of Lantana *camera*

Ovipositional Deterrent Effect of Plant Extracts

Twenty five grams of seeds *viz*., White sorghum and split pulses of green gram were taken in plastic containers and mixed with plant extracts at concentration of 10%. Five pairs of newly emerged adults of rice weevil, S.oryzae were released to each plastic containers and covered firmly and were kept in laboratory at ambient conditions. Four replications were maintained for each treatment. The number of laid eggs was recorded after 48 h and oviposition deterrence was calculated with the following formula (Pascual-Villalobos and Robledo, 1998).

$$\text{Oviposition deterrence} = 100 \text{ X } (1 - NE_t/NE_c)$$

Where NE_t is the number of eggs in treatment NE_c is the number of eggs in control.

Acid Fuschin Technique

This technique is used to stain the eggs laid in the seeds. Acid fuschin stain for prepared by adding 3.5 g Acid Fuchsin to 750 ml distilled water and 250 ml glacial acetic acid. Solution is stirred well. Add the solution to the infested seeds and leave it for 1minute to stain.Wash the stained seeds with water to remove the excess stain. Weevil infested seeds are stained with Cherry red colour and those with mechanical injury are stained light pink colour. Then the seeds are dissected and examined under microscope for observation of eggs.

Antifeedant Effect of Plant Extract

After 24 hrs of treatment, grains were taken from the treated seeds of each treatment. Total weight loss in each replication was measured by using weighing balance. After data collection grains were kept in plastic container of the respective treatments. The extent of damage caused by rice weevil on white sorghum and split pulses of green gram was determined on the basis of the weight loss from the total weight was calculated. The data was recorded for each replications. Effect on infestation was calculated by computing infested/unhealthy grain after 48 and 72 hrs.

Statistical Analysis

The data were subjected to statistical analysis.The data on percent values were transformed into arcsine values and analysis of variance was done with AGRESS & AGDATA packages. Means were compared by using LSD (Least Significant Deviation Test).

Results

The results of the experiments were conducted to study the effect of different plant extracts (*viz.*,Neem, Pudina, Lantana, Pungam) on rice weevil, *oryzae* infesting sorghum and split pulses are presented in this chapter.

Fig 1

Anti –Feedant Activity of Plant Extracts on *Sitophilus Oryzae* in Sorghum

The data of antifeedant activity of different plant extracts on Rice weevil in Sorghum are furnished in Table 1. Among all the treatments Neem exhibited strongest antifeedant activity on *S.oryzae* with mean food consumption of 0.16g. This was followed by Pudina with mean food consumption of 0.26g, followed by Lantana with 0.31g which is on par with Pungam and lowest antifeedant activity was observed in control with 0.42g.

Anti–Feedant Activity of Plant Extracts on *Sitophilus Oryzae* in Green Gram

The data of antifeedant activity of different plant extracts on Rice weevil in green gram are also furnished in Table 2. Among all the treatments Neem exhibited strongest antifeedant activity on *S.oryzae* with mean food consumption of 0.1g. This was followed by Pudina with mean food consumption of 0.44g, followed by Lantana with 0.65g, followed by Pungam with 0.77g and lowest antifeedant activity was observed in control with 0.94g.

Table 1: Antifeedant activity of 10% aqueous plant extracts on *Sitophilus oryzae* in Sorghum and Green gram

Treatment	Antifeedant activity (10%)	
	Sorghum	Green gram
T1: Azadirachta *indica*	24.84	24.90
	$(4.97)^{b}$	$(4.95)^{b}$
T2: Mentha arvensis	24.74	24.56
	$(4.963)^{cd}$	$(4.93)^{bc}$
T3: Lantana *camara*	24.69	24.23
	$(4.95)^{d}$	$(4.90)^{c}$
T4: Pongamia *glabra*	24.63	24.35
	$(4.969)^{bc}$	$(4.92)^{bc}$
T5: Control	24.58	24.06
	$(4.984)^{a}$	$(4.99)^{a}$
CD (5%)	0.010	0.034

Values are mean of four replications

Figures in parentheses are arcsine transformed value**s**

Oviposition Deterrent Action of Plant Extracts on *Sitophilus oryzae* in Sorghum

The results of oviposition deterrent of Rice weevil, *S.oryzae* when treated with different plant extracts *viz*., Neem, Pudina, Lantana, Pungam are furnished in Table 2

Table 2: Ovi position Deterrent activity of 10% aqueous plant extracts on *Sitophilus oryzae* in Sorghum and Green gram

Treatment	Oviposition Deterrent Activity 10%		
	Sorghum	Green gram	
T1: *Azadirachta indica*	4.75	4.25	
	(12.49)^{c}	(11.51)^{c}	
T2: Mentha *arvensis*	7.25	6.00	
	(15.58)^{b}	(14.15)^{bc}	
T3: *Lantana camara*	9.25	8.25	
	(17.61)^{b}	(16.65)^{b}	
T4: Pongamia *glabra*	7.00	6.25	
	(15.28)^{b}	(14.37)^{bc}	
T5: Control	17.00	18.50	
	(24.32)^{a}	(25.33)^{a}	
CD (5%)	0.942	1.074	1.159

Values are mean of four replications
Figures in parentheses are arcsine transformed value

On 72HAT,the highest oviposition deterrent activity was observed in Neem with 73 per cent followed by Pudina with 59 per cent, Lantana with 58 per cent, pungam with 46 per cent, and oviposition deterrent.
activity was nil in control

Oviposition Deterrent Action of plant Extracts on *Sitophilus oryzae* in Green Gram

The results of oviposition deterrent of Rice weevil, *S.oryzae* when treated with different plant extracts *viz*., Neem, Pudina, and Lantana,Pungam are furnished in Table 2.
On 72HAT, the highest oviposition deterrent activity was observed in Neem with 78 per cent followed by Pungam with 68 per cent, Lantana with 67 per cent, Pungam with 56 per cent, and oviposition deterrent

Discussion

The results of the investigations on evaluation of antifeedant and oviposition deterrent activity of plant extracts against *Sitophilus oryzae* in laboratory conditions are discussed in this chapter.

Antifeedant Effect of Plant Extracts on *S. oryzae* Different Hosts

Any substance that reduces food consumption by an insect can be considered as an antifeedant or feeding deterrent (Isman, 2002).In sorghum, the mean food consumption was minimum (0.16g) in *Azadiracta indica* treated seeds (Fig.3). In green gram seeds, the mean food consumption was 0.10g (Fig.4).The results of the present study is in concordance with the findings of Shimul Das *et al.*, (2015) who recorded maximum antifeedant activity (66.67%) of *A. indica* leaf powder extract on *S.oryzae.* This indicated that the active principles present in the *A.indica* inhibit feeding behaviour or make the food unpalatable or the substances provides repellent effect on insects resulting in feeding deterrence.

Oviposition Deterrent Effect Plant Extracts on *C. chinensis*in Different Hosts

The results of the oviposition deterrent activity study showed that egg laying of *S.oryzae* was lowest in *A. indica* treated sorghum (73.00%) and green gram (78%) seeds (Fig.5&6). Current findings were supported by the results of Kalpana *et al*. (2013) who reported the oviposition deterrent effect of 1 and 5 per cent aqueous extracts might possess repellent and /or oviposition deterrent principles. Oviposition deterrent may be due to the changes induced in physiology and behaviour in the adult of S.oryzae as reflected by their egg laying capacity.

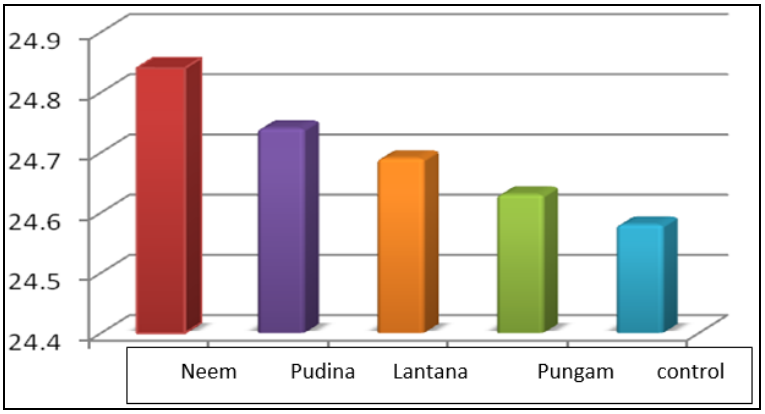

Fig 2: Antifeedant activity of 10 % aqueous plant extracts on *S.oryzae* in Sorghum

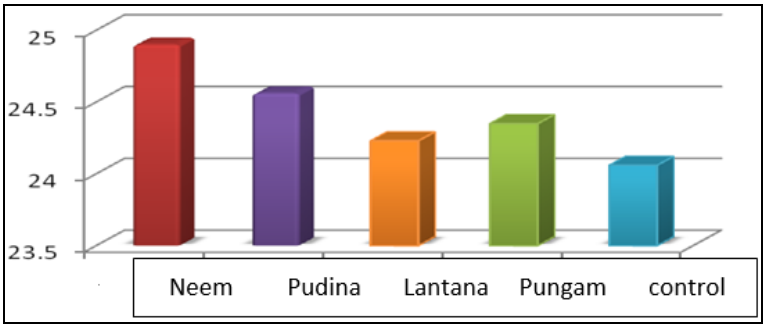

Fig 3. Antifeedant activity of 10 % aqueous plant extracts on *S.oryzae* in Green gram

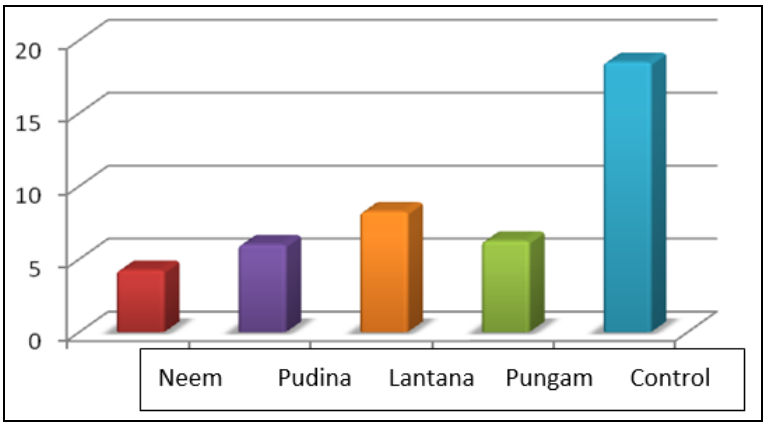

Fig 4: Oviposition activity of 10% aqueous plant extracts on *S.oryzae* in Sorghum

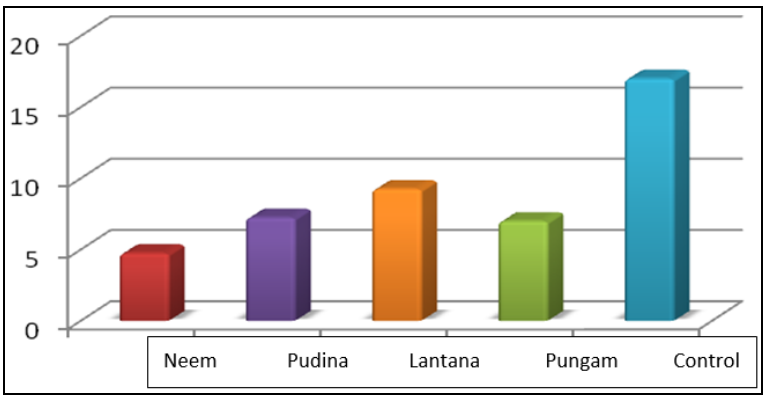

Fig 5: Oviposition deterrent activity of 10% aqueous plant extracts on S.oryzae in Green gram

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