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Pesticidal effect of different botanicals and wood ash against Angoumois grain moth *Sitotroga cerealella Olivier.*

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Abstract

Pesticidal effects of different botanicals (like neem, *Azadirachta indica;* Biskataly, *Polygonum hydropiper* Linn. karanja, *Pongamia pinnata,* arjun (*Terminalia arjuna*) and tobacco, *Nicotina tabacum*) and wood ash were studied for the management of Angoumois grain moth, *Sitotroga cerealella* (Olivier) in stored rice grain at the Department of Entomology, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh. For the studies, de-infested rice variety BR-11 was collected from farm store house. The treatments of the studies were: Neem leaf powder @ 10gm / kg of rice grains were mixed with seeds (T_1); Biskatali leaf powder @ 10gm/kg of rice grains were mixed with seeds (T_2); Karanja leaf powder @ 10gm / kg of rice grains were mixed with seeds (T_3); Arjun leaf powder t @ 10gm / kg of rice grains were mixed with seeds (T_4); Tobacco leaf powder @ 10gm / kg of rice grains were mixed with seeds (T_5); Wood ash @ 10gm / kg of rice grains were mixed with seeds (T_6) and Control (T_7) and experiment was laid out in a Completely Randomized Design (CRD) with four replications. In all generation (1^{st}, 2^{nd} and 3^{rd} generation), the results showed that different botanicals and wood ash had pesticidal effect against angoumois grain moth. Among them tobacco leaf powder showed the highest toxic effect in case of the percent of mortality (100%), percent of adult emerged (0.00%) , adult longevity (0.00) and repellency effect (75%) which closely followed by neem leaf powder (T_1), whereas biskataly and karanja leaves powder showed lowest and the no repellency rate (0.00) was recorded in T_3 and T_6 treatment.

KeyWords: Botanicals; Wood ash; Angoumois grain moth (*Sitotroga cerealella*); Powder; Management

Introduction

There are many ways to improve the condition of a country. The production of crops is one of them. Rice is the most important cereal crop and staple food in Bangladesh. The demand for rice is constantly rising in Bangladesh with nearly 2.3 million people being added each year to her of about 120 million (Anon, 2001). Maintenance of reserve food grain stocks is necessary to ensure a continuous supply at stable prize. Losses due to insect infestation are the most serious problems in grain storage, particularly in the cases of developing countries like Bangladesh. The harvested crops or grain stored in storage. The stored grains suffer seriously from the attack of a number of insect pests. Now a-days, pest control by botanicals have been proposed as potential pest control measures in the world. But very few works have so far been done in Bangladesh on botanical use as pesticides.

Many preventive and effective control measures have been reported to minimize the loss of stored grains due to insect attack. At present, in many areas of the world locally available plants and plant materials have been widely used to protect stored product against damage by insect attack (Golob and Webley, 1980; Talukder and Howse, 1993).

Because of undesirable side effects of use the synthetic or chemical pesticides, this awareness has created a world wide interest in the development of alternative strategies, including the search for new types of insecticides and use of age-old traditional botanicals pest control agents (Heyda *et al*., 1983). In ancient times, Egyptian farmers used to mix the stored grains with fine kitchen ashes (Abdel-Gawaad and Khatab, 1985). During 1690, tobacco was used as contact insecticides and in 1773 nicotine fumigation was trying (Famulu, 1992). Indo-Pakistani farmers use biskatali for the control of stored grain pests, while various Nigerian tribes use roots, stems and leaves of plants (Abdel and Khatab, 1985; Ahmed and Grainge, 1986).

The main advantages of botanical are that these can be easily produced by farmers, less expensive, biodegradable, broad spectrum, safe to apply and unique in action. Most of the botanical insecticides are non-hazardous and non-toxic to human. The earlier studies by different authors (Islam, 1997; Talukder and Howse, 1993, 1994; Haque and Husain,

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1993). also established the successful actions of different plant parts and extracts against different major stored product insect pests of Bangladesh.

Few scientific research works have done to explore locally available plant materials for the management of harmful insect pests in storage like angoumois grain moth. Present studies were under taken to assess the effectiveness of some botanicals and wood ash for the management of angoumois grain moth, *Sitotroga cerealella* (Olivier).

Materials and methods

The present study was conducted in the laboratory of the Department of Entomology, Sher-e- Bangladesh Agricultural University, Dhaka, Bangladesh during the period from April 2012 to September, 2013. For the experiment, de-infested rice variety BR-11, collected from farm's store house of Sher-e- Bangladesh Agricultural University was used. The leaves of neem (*Azadirachta indica*), biskatali (*Polygonum hydropiper* Linn), karanja (*Pongamia pinnata*), arjun used for the experiments were collected from trees from in and around the university campus. The tobacco leaves used were purchased from the local market. The wood ash was collected from farmer's house. The insect *S. cerealella* (Olivier) was reared from pure culture on rice of BR-11 to ensure the continuous supply of adults. The details of the experiments including the rearing of the test insect de-infestation of grains and different botanicals are furnished below:

Male and female moths were sorted under a simple microscope by their abdominal tergites and size of the body. One hundred pairs of *S. cerealella* (Olivier) were introduced into a plastic containers (26 cm height x 110 cm diameter) containing1 kg of de-infested rice grains. The mouth of the container was covered by fine mesh nylon nets and kept in the laboratory at the prevailing temperature and relative humidity. The insects were allowed to mate and to lay eggs for seven days and then the adults were separated. The rice grains with eggs were kept for 25 days to develop into adults and then the adult emergence was observed. One- day old adults were sorted from rice grains and were used for the study. Before artificial infestation of rice grains with moths, the rice grains of BR-11 variety was dried in the sun for de-infestation as suggested by (Nawab *et al*., 1980). Petri-dishes (1.0 cm height X 6 cm diameter) were used to set the experiment. 50g rice seeds were taken in each Petri-dish. Firstly, Leaves were washed in running water in the laboratory. Then the plant materials were kept in the shady open place for air-drying and then were dried in the oven at 60^{O}C to gain constant weight. Dusts were prepared by pulverizing the dried leaves with the help of a grinder. Then dusts were passed through a 25-mesh diameter sieve to obtain fine and uniform material. The dusts were preserved in airtight condition in polythene bags till its use for extract preparation as described by (Chitra *et al*., 1993).

Treatments

T_1: Neem leaf powder @ 10g / kg of rice grains were mixed with seeds on the upper layer

T_2: Biskatali leaf powder @ 10g/kg of rice grains were mixed with seeds on the upper layer

T_3: Karanja leaf powder @ 10g / kg of rice grains were mixed with seeds on the upper layer

T_4: Arjun leaf powder t @ 10g / kg of rice grains were mixed with seeds on the upper layer

T_5: Tobacco leaf powder @ 10g / kg of rice grains were mixed with seeds on the upper layer

T_6: Wood ash @ 10g / kg of rice grains were mixed with see ds

T_7: untreated control

After then leaf powder were mixed with rice grains on the upper layer of seeds in each Petri dish at the rate of 10 gm/kg. Afterwards 5 pairs of adult moth (male & female) were released in each Petri dish. There were 4 replications considering each petridish as a replication. Insect mortalities (toxicity effect) were recorded at 24, 48 and 72 hours after treatment (HAT). Orginal data were corrected by Abbott's formula (Abbott, 1987) as follows: P = (P´ - C/100 – C) x 100. Where, P = Percentage of corrected mortality; P´= % Observed mortality; C = % Control mortality. The experiment was laid out in Completely Randomized Design (CRD) with four replications. The significance of the difference among the treatment means were estimated by the least significant difference (LSD) test at 5% level of probability (Gomez and Gomez, 1984). The experiment was repeated for other two generations.

Results and discussion

The study results about pesticidal effect (toxicity effect) of neem (*Azadirachta indica*); Biskataly (*Polygonum hydropiper* Linn.); karanja (*Pongamia pinnata*); arjun and tobacco (*Nicotina tabacum*) botanicals and wood ash on Angoumois grain moth, *Sitotroga cerealella* (Olivier) in stored rice grain have been presented and discussed, and possible interpretations are given below under the following headings

Number of dead insects

Number of cumulative dead insects after 24, 48 and 72 hours showed statistically significant variation for commonly used botanicals and wood ash for the management of angoumois grain moth in stored rice grain (Table I.).

Table I. Effect of botanicals and wood ash against angoumois grain moth, *S. cerealella* in stored rice grain after different duration of treatments

*Treatment	No. of dead insects after different duration of treatments		
	24 hours	48 hours	72 Hours
T_1	4.50 b	7.25 b	9.00 ab
T_2	3.00 c	6.00 c	7.50 c
T_3	3.25 c	6.00 c	8.25 bc
T_4	3.25 c	5.75 c	7.50 c
T_5	6.50 a	9.25 a	10.00 a
T_6	2.75 c	5.00 c	7.75 bc
T_7	0.00 d	0.00 d	0.00 d
$LSD_{(0.05)}$	1.084	1.067	1.217
Level of Significance	0.01	0.01	0.01
CV(%)	21.95	12.81	11.46

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 level of probability and numeric data represents the mean value of 4 replications

*T1: Neem leaves dust @ 10 g/kg of rice grains
T_2 : Biskatali leaves dust @ 10 g/kg of rice grains
T_3 : Karanja leaves dust @ 10 g/kg of rice grains
T_4 : Arjun leaves dust @ 10 g/kg of rice grains
T_5 : Tobacco leaves dust @ 10 g/kg of rice grains
T_6 : Wood ash @ 10 g/kg of rice grains
T_7 : Control

After 24 hours of treatment application the highest number of dead insects (6.50) was recorded in T_5 treatment (Tobacco leaf dust @ 10 g/kg of rice grains) which was closely followed by (4.50) T_1 treatment (Neem leaf dust @ 10 g/kg of rice grains). On the other hand, no dead insects were found in T_7 (untreated control) treatment which was closely followed by T_3 (Karanja leaf dust @ 10 g/kg of rice grains), T_4 (Arjun leaf dust @ 10 g/kg of rice grains), T_2 (Biskatali leaf dust @ 10 g/kg of rice grains) and T_6 (Wood ash @ 10 g/kg of rice grains) treatments (3.25, 3.00 and 2.75) respectively and statistically they were identical (Table 15). After 48 hours cumulative the highest numbers of dead insects were observed in T_5 (9.25) treatment which was closely followed byT_1, (7.25) whereas there were no dead insects in T_7 treatment. T_2, T_3, T_4 and T_6 treatments were statistically similar in respect of dead insects (Table 1). After 72 hours of treatment the cumulative highest number of dead insects were found in T_5 (10.00) treatment which was statistically identical with T_1 (9.00) and closely followed by T_3 (8.25) and T_6 (7.75) while there were no dead insects in T_7 treatment. T_2 and T_4 treatments were statistically identical in respect of dead insects.

(Facknath and Sunita, 2006). Reported that neem (*Azadirachta indica* A. Juss.) has been demonstrated to reduce insect populations infesting stored products through its toxic and growth- disrupting and other effects on the pests. These results were different from the findings observed by some others researchers (Akter, 2009; Rahman *et al.,* 1999; Akter, 2009) It was also reported that neem oil was most toxic and effective ranking next to Malathion for control of angoumois grain moth, *S. cerealella.*

Percent of Mortality of the angoumois grain moth, S. cerealella (Olivier)

Insect mortality showed statistically significant variation for commonly used botanicals and wood ash used as experimental treatments for the management of angoumois grain moth in stored rice grain. The highest mortality (100.00%) was observed in T_5 treatment which was statistically identical (90.00%) with T_1 treatment and closely followed by T_3 (82.50) and T_6 (77.50%) treatments respectively while there were no mortality was recorded in T_7 control treatment. The lowest mortality (75.00%) was observed in T_2 and T_4 treatments respectively (Fig. 1).

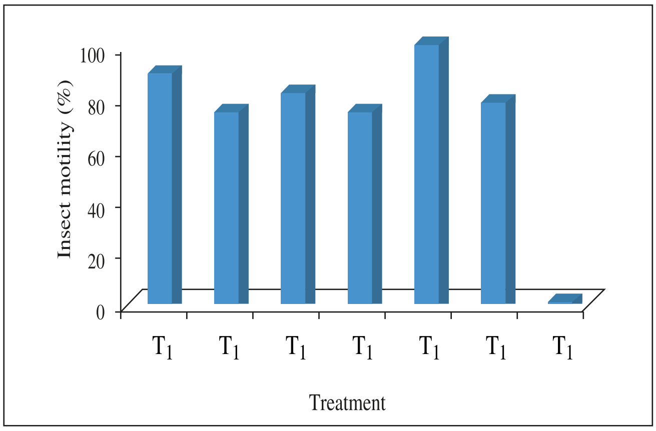

Fig. 1. Effect of commonly used botanicals and wood ash for controlling of S. cerealella in percentage of insect mortality

Germination of seeds

Germination of treated seeds showed statistically significant differences for the application of experimental treatments for the management of angoumois grain moth in stored rice grain (Figure 2). The highest germination was found in T_5 (97.50%) treatment which was closely followed by T_3, T_1, T_6, T_4 and T_2 (92.50%, 91.50%, 91.00% and 90.50%) respectively and they were statistically identical, whereas the lowest germination was recorded in T_7 (74.25%) untreated control treatment.

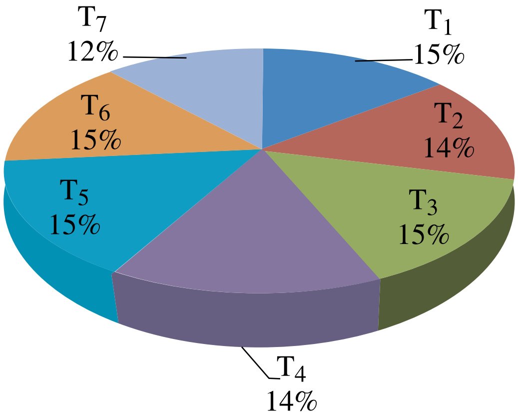

Fig. 2. Effect of commonly used botanicals and wood ash for controlling of S. cerealella on germination (%) of seeds

*T_1: Neem leaves dust @ 10 g/kg of rice grains
T_2 : Biskatali leaves dust @ 10 g/kg of rice grains
T_3 : Karanja leaves dust @ 10 g/kg of rice grains
T_4 : Arjun leaves dust @ 10 g/kg of rice grains
T_5 : Tobacco leaves dust @ 10 g/kg of rice grains
T_6 : Wood ash @ 10 g/kg of rice grains
T_7 : Control

Adult emergence

Adults emerged for 1st, 2nd and 3rd generations varied significantly for the application of experimental treatments for the management of angoumois grain moth in stored rice grain. At 1st generation no adults emerged in T_5 treatment which was followed by T_6 (7.75) while the highest number of adults were recorded in T_7 (81.75) treatment which was followed by T_4 (21.50) treatment (Table II). At 2nd generation there were no emerged adults was recorded in T_5 treatment which was followed by T_6 (14.75) treatment while the highest adult was recorded in T_7 (122.00) which was followed by T_4 (31.75) treatment. At 3rd generation no adults emerged in T_5 treatment which was followed by T_1 (21.00) while the highest adult was obtained in T_7 (203.00) treatment which was followed by T_4 (67.50) treatment. In case of total adult emergence for 1st, 2nd and 3rd generation no adults emerged in T_5 treatment which was followed by T_1 (46.75) treatment while the highest adult was recorded in T_7 (406.75) which was followed by T_4 (120.75) treatment.

Table II. Effect of commonly used botanicals and wood ash for adults emerged of S. cerealella at 1st, 2nd, 3rd generation and total adult emerged

*Treatment	Percent Adult emerged at				
	1st generation	2nd generation	3rd generation	Total	Longevity
T1	8.50 d	17.25 d	21.00 d	46.75 d	6.25 d
T2	18.00 c	22.25 c	31.25 c	71.50 c	6.75 c
T3	17.50 c	21.50 c	32.50 c	71.50 c	7.00 c
T4	21.50 b	31.75 b	67.50 b	120.75 b	8.25 b
T5	0.00 e	0.00 e	0.00 e	0.00 e	0.00 e
T6	7.75 d	14.75 d	22.50 d	45.00 d	8.00 b
T7	81.75 a	122.00 a	203.00 a	406.75 a	10.00 a
LSD(0.05)	1.996	2.933	4.686	8.794	0.477
Level of Significance	0.01	0.01	0.01	0.01	0.01
CV(%)	6.07	6.02	5.84	5.44	4.86

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 levels of probability and numeric data represent the mean value of 4 replications.

*T_1: Neem leaves dust @ 10 g/kg of rice grains
T_2 : Biskatali leaves dust @ 10 g/kg of rice grains
T_3 : Karanja leaves dust @ 10 g/kg of rice grains
T_4 : Arjun leaves dust @ 10 g/kg of rice grains
T_5 : Tobacco leaves dust @ 10 g/kg of rice grains
T_6 : Wood ash @ 10 g/kg of rice grains
T_7 : Control

Adult longevity

Adult longevity showed statistically significant differences after the application of experimental treatments for the management of angoumois grain moth in stored rice grain. The highest longevity was recorded in T_7 (10.00) treatment which was closely followed by T_4 (8.25) while no longevity was attained in T_5 treatment which was followed by T_1 (6.25) treatment (Table II.).

Repellency effect

Repellency effect for experimental treatments showed statistically significant variation (Table 3.). In case of repellency effect after 1 hour of treatment application the highest repellency rate was found from T_5 (75.00%) which was followed by T_1 and T_2 (45.00 and 30.00) treatments respectively whereas the lowest repellency rate was recorded in T_6 (15.00) which was statistically identical with T_3 and T_4 (20.00 and 25.00) treatments respectively (Table

III). After 2 hours of treatment application the highest repellency effect was observed from T_5 (65.00%) which was followed by T_1 (40.00) treatment, while the lowest repellency rate was observed in T_6 (0.00) which was statistically identical with T_3 (5.00) treatment. After 3 hours of application the highest repellency rate was obtained from T_5 (50.00%) which was followed by T_1 (35.00) again the no repellency rate was recorded in T_6 (0.00). After 4 hours of treatment application the highest repellency rate was observed from T_5 (40.00%) which was followed by T_1 (20.00) while the no repellency rate (0.00) was recorded in T_3 and T_6. After 5 hours of treatment application the highest repellency rate was found from T_5 (30.00%) which was followed by T_4 (10.00) whereas the no repellency rate (0.00) was recorded in T_3 and T_6 treatment.

Table III. Repellency effect of commonly used botanicals and wood ash on angoumois grain moth in stored rice grain at different hours after treatment

*Treatment	Percent of repelled after application of treatment				
	1 hour	2 hour	3 hour	4 hour	5 hour
T1	45.00 b	40.00 b	35.00 b	20.00 b	5.00 b
T2	30.00 bc	20.00 c	15.00 c	10.00 c	5.00 b
T3	20.00 c	5.00 d	0.00 d	0.00 d	0.00 b
T4	25.00 c	25.00 c	20.00 c	15.00 bc	10.00 b
T5	75.00 a	65.00 a	50.00 a	40.00 a	30.00 a
T6	15.00 c	0.00 d	0.00 d	0.00 d	0.00 b
LSD(0.05)	18.80	10.42	11.46	8.845	13.48
Level of Significance	0.01	0.01	0.01	0.0	0.01
CV(%)	15.63	26.76	18.01	11.43	10.00

In a column means having similar letter(s) are statistically identical and those having dissimilar letter(s) differ significantly as per 0.05 levels of probability and numeric data represent the mean value of 4 replications.

*T_1: Neem leaves dust @ 10 g/kg of rice grains
T_2 : Biskatali leaves dust @ 10 g/kg of rice grains
T_3 : Karanja leaves dust @ 10 g/kg of rice grains
T_4 : Arjun leaves dust @ 10 g/kg of rice grains
T_5 : Tobacco leaves dust @ 10 g/kg of rice grains
T_6 : Wood ash @ 10 g/kg of rice grains
T_7 : Control

Considering the results of the experiments the efficacy of different botanicals and wood ash for the management of angoumois grain moth, *Sitotroga cerealella* (Olivier) in stored rice grain as controlling components were in order as: Tobacco leaves powder > wood ash > neem leaves powder > Biskatali leaves powder > Karanja leaves powder > Arjun leaves powder.

The effectiveness of botanicals and wood ash obtained in the present investigation is in agreement with the results obtained by Hill, 1990; Chatterjee, 1984; Facknath and Sunita, 2006; Hill, 1990. Reported that wood ash and is useful as a physical barrier in the grain, but it can also possess various chemical properties according to its botanical source. Chatterjee (1984) revealed that the ashes and sand which were widely used acted as hygroscopic substances and reduced the moisture content of the commodities to some extent with which they were mixed and indirectly affected insect multiplication. Facknath and Sunita (2006) reported that neem (*Azadirachta indica* A. Juss.) has been demonstrated to reduce insect populations infesting stored products through its toxic and growth-disrupting and other effects on the pests. These results were different from the findings observed by some others researchers (Akter, 2009; Rahman *et al.,* 1999; Akter, 2009). Also reported that neem oil was most toxic and effective ranking next to Malathion for control of angoumois grain moth, *S. cerealella*. (Rahman *et al.,* 1999). Evaluated the extracts and powder of Urmoi, Neem and Turmeric for their repellency, feeding deterrence, direct toxicity and residual effects against the storage grain pests.

Conclusion

Considering the percent of mortality, percent of corrected mortality, adult emerged, adult longevity and repellency effect it was found that the treatment with tobacco leaf powder @ 10g / kg of rice grains mixed with seeds on the upper layer (T_5) was the most effective in comparison to all other treatments in this experiment against angoumois grain moth, *S. cerealella* Olivier in stored rice grains. In the present study, the results obtained are very encouraging and there is a great potential for the use of botanicals as a toxic agent in storage pest, *Sitotroga cerealella* Olivier management systems in our country.

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