OnLine Journal of Biological Sciences 2 (1): 5-7, 2002


# Effects of Plant Extracts on the Development of Rice Hispa, *Dicladispa armigera* (Oliver)

M. M. Rahman, B. N. Islam and [1]M. N. Bari
Department of Entomology, Bangladesh Agricultural University, Mymensingh, Bangladesh
[1]Entomology Division, Bangladesh Rice Research Institute, Gazipur-1701, Bangladesh

**Abstract:** Methanolic and acetone extracts of seeds of Pithraj, *Amoora ruhituka* ( Wright & Arn.) were tested on rice hispa, *Dicladispa armigera* (OLV.) to know the effects of the extract in relation to the feeding behaviour, ovipositional behaviour and adult emergence of rice hispa. The food consumption on treated seedlings was very poor. The deterrent action of PSE & BSE were high and egg deposition ranges 0-13 in 48 hours and 0-8 in 72 hours of exposure to treated rice seedlings. In controls, egg deposition ranged from 0-28 in 48 hours and 0-18 in 72 hours respectively. Low emergence of rice hispa in all treated rice seedlings indicated the high degree of inhibition effect of the extracts on adult emergence. The adult emergence in control (MeOH and Water) were significantly higher than those on treated seedlings.

**Key words:** Acetone, deterrent, inhibition, methanolic, oviposition

## Introduction

Insect pests of rice cause serious damage and substantial reduction in rice yield. About 800 species of injurious rice insects are known in the world (Barr *et al.*, 1975). More than 100 species are persistent to rice and 20 species are considered to have major significance (Pathak, 1968). Insect pests are the important limiting factors of rice production in Bangladesh. There are more than 175 insects and several vertebrate pest species which cause damage to the rice plants (Anonymous, 1995). Among these rice hispa is one of the serious pest. It has long history of outbreaks in Bangladesh and in recent years it has been considered as one of the most important pests of rice in Bangladesh (Islam and Hasan, 1999). It causes considerable damage to Boro, Aus and transplanted Aman. Both grub and adults feed the green tissues of leaf. The damage is recognized by characteristic white parallel streaks along the long axis of the leaf resulting in complete bleaching of leaf. The attacked field looks completely sun-burnt and plants become stunted in growth. There are usually six generations of rice hispa in the year. The first generation is passed on the Boro paddy, the second to fifth generation on the Aus and deep water Aman and the sixth generation on the transplanted Aman crop. The insect is active on rice crop from February through August and in some areas up to October. The maximum is often observed during June to July. Catastrophic outbreaks were experienced in Bangladesh in several years during 1980 and mid 1990s (Islam, 1997).

The importance of rice hispa as pest of rice has been increasing day by day. Therefore the need for control of rice hispa cannot be over-emphasized. Effective control of this pest would reduce the loss in rice production. Pesticides are often recommended to be the most potent control methodology in pest control.

Recently search for naturally occurring feeding deterrents and antifeedants has been intensified to suppress the pests of field crops and storage. A number of researchers isolated and identified several chemical compounds from leaves and seeds of many tropical plants and screened out for insect feeding deterrents and growth inhibition. Neem oil or neem seed extracts retarded growth and development of some Hemipterous rice pest (Heyde *et al.*, 1984). Methanolic extracts of seeds of pithraj, *Amoora ruhituka* (Weight and Arn) and bullocks heart, *Annona reticulata* (Linn.) affected the orientation, feeding behaviour and growth response of green rice leaf hopper, *Nephotettix nigropictus* Stal. (Haque and Islam, 1989). The present work had therefore undertaken with a view to advancing the knowledge on insect feeding deterrent or antifeedants in plants contributed the use of natural products for the pest management.

## Materials and Methods

Methanolic and acetone extracts of seeds of pithraj , *Amoora ruhituka* ( Wright & Arn.) and Bullock's heart, *Annona reticulata* Linn. were prepared in the laboratory of the Department of Entomology Bangladesh Agricultural University, Mymensingh in October, 1999. These extracts were tested in the same month on rice hispa, *Dicladispa armigera* (Olv.) reared on rice cultiver cv. BR-3 in Bangladesh Rice Research Institute's glass house, Joydebpur, Gazipur. Observations were made on feeding, oviposition, egg hatching, grub period and adult emergence of rice hispa in treated and untreated rice seedlings. Statistical analysis were done by Duncan's multiple range test (DMRT) of Gomez and Gomez (1984).

**Preparation of extract:** Seeds of ripe fruits of pithraj, *Amoora ruhituka* ( wright & Arn.) Meliaceae and Bullock's heart, *Annona reticulata*(Linn) Annonaceae were collected. The air dried seeds were grind to a fine powder ( 50 mesh) in warning blendor. Extraction of the active principles was done following the procedures of Ascher (1981) and Feuerhake and Schmuterrer (1982). Extractions were done both in cold as well as in a soxhlet apparatus with distilled water, methanol and acetone. The solvents were removed from the extracts under reduced pressure (15 mm) . All organic solvents used for extraction were chemically pure (Merck) . Dried crude extracts were stored in a refrigerator until for tests. In addition to the usual extractions, spray formulations of extracts of pithraj (PSE) and Bullock's heart (BSE) were prepared to a concentration of 1.0% and 0.5% (w/v) extracts in 85% menthanol and pure acetone with aqueous solution of 0.1% nonidet.

**Insects rearing:** The rice hispa, *Dicladispa armigera* (Olivier ) were reared in the laboratory, from a stock culture of Bangladesh Rice Research Institute . The rice hispa was reared on susceptible young rice seedling (cv. BR-3 ) in pot culture.

**Food consumption by adult rice hispa:** Consumption of leaves ($mm^2$) was measured with section paper and recorded after 48 and 72 hours of exposure of rice hispa in the treated and untreated rice seedlings. The total amount of leaves consumed by the adults were analyzed statistically to determine the significant damage of leaves and the degree of deterrent effects of the individual extracts were also determined.

**Determination of ovipositional deterrent and adult emergence:** To determine the deterrent actions of the extracts on oviposition of beetles, 3-4 days old adult rice hispa, one pair (male + female) allowed to feed on treated and untreated rice plants and replicated in five. Rice plants of 45-55 days old grown in pot cultures having 4-5 leaves per hill were sprayed with 1.0% and 0.5% extracts of seeds of pithraj (PSE) and bullocks heart (BSE) by 100 ml atomizer, 48-72 hrs prior to the tests. Extracts were emulsified with 0.1 % nonidet and three controls $o_1$ (water control), $o_2$ (85% methanol control and $o_3$ (Acetone control ) accompanied each concentration.

**Growth and development:** Another experiment was also

conducted with methanolic (85%) and acetone extracts of seed of pithraj, *Amoora ruhituka* (Wrigtht & Arn ) and bullocks heart, *Annona reticulata* (Linn. ) following the method of Feuerhake and Schmutterer ( 1982 ). The extracts were evaluated as growth inhibitors of rice hispa, according to the procedures described above. The Soxhlet extracts were diluted to 1.0- 0.5 % with nonidet and sprayed on rice plants.

## Results and Discussion

**Effects of extracts on the feeding of rice hispa:** After release of 3-4 days old adults of rice hispa on both treated and untreated rice seedlings, they showed restlessness in search of food. However insects on untreated seedlings were found to feed normally. The food consumption's on treated seedlings were very poor (Table 1). The food consumption of adult rice hispa on rice seedlings treated with 1.0 and 0.5% BSE (MeoH &Acetone ) extracts were significantly lower and identical with those of PSE ( Acetone ) extracts but significantly different from those one PSE (MeOH) extracts. The food consumption's of adults on control (MeOH, Acetone & Water) were significantly higher than those of treated seedlings (Table 1). This findings agreed with those of Hellpap (1983) who reported that the methanolic extracts of neem seeds karnels incorporated into an artificial diet deterred feeding of all army worm *Spodoptera frugiperda* (smith). The methanolic extracts of the seed karnels of china berry (*Melia azedarch* Linn.) and *M. toosendam* Linn. exhibited feeding deterrent effects on 5th instar larvae of *Spodoptera litura* (Shin Foon Chiu and Zhang-Ye-Guang, 1984). Islam (1983) observed that hexane extracts of neen seed karnels and neem oil reduced feeding activity of brown plant hopper, green rice leaf hopper and rice hispa. Similar effects of oils of neem, chinaberry and custard apple were observed on brown plant hopper *N. lugens*, white backed plant hopper *S. furcifera* and green rice leaf hopper *N. virescens* (Saxena *et al.*, 1984). The seeds of pithraj and Bullock's heart probably contained some antifeedants similar to those of neem, chinaberry and custard apple.

**Oviposition by adult rice hispa:** Adult rice hispa fed on rice seedlings treated with 1.0 and 5% extracts of PSE (MeOH & Acetone) and BSE (MeOH and acetone) laid significantly lower no. of eggs than those fed on untreated rice seedling (Table 2).

The deterrent actions of both methanol and Acetone of PSE and BSE were high and egg deposition ranged from 0-13 in 48 hours and 0-8 in 72 hours of exposure to treated rice seedlings. In the controls, egg deposition ranged from 0-28 in 48 hours and 0-18 in 72 hours respectively.

When 3-4 days old gravid rice hispa females were released on young rice plants treated with 1.0 & 0.5% PSE (MeOH & Acetone), BSE (MeOH & Acetone) extracts, they spent more time in searching for oviposition and feeding sites on young leaves. The egg deposition by adults on rice seedling treated with 1.0 & 0.5% BSE (MeOH & Acetone) extracts significantly lower and were identical with that of PSE (Acetone) but different from those on PSE ( MeOH) extracts in 48 hours. Considering 72 hours of exposure of rice hispa to treated seedlings PSE ( MeOH) and BSE (Acetone) extracts significantly reduced egg deposition and were identical to those on treated rice seedlings with PSE (Acetone) and BSE (MeOH) extracts. The egg deposition by adults on controls (MeOH, Acetone & water) was higher than those of treated seedlings (Table 2). Krishnaiah and Kaiode (1991) conducted an experiment on various insects with neem oil and they expressed that neem oil sprayed at 12% or greater acted as an ovipositional deterrent and 1% affected the growth of 1st instar nymphs of cicadellid, *Nephotettix virescens*.

**Hatching of grubs:** Adult rice hispa were released on both treated and untreated seedlings. No. of egg were hatched 0-11 in 48 hr and 0-7 in 72 hrs exposure. Rice seedling treated with 1.0 and 0.5% PSE (MeOH & Acetone), BSE (MeOH & Acetone) extracts significantly reduced the hatching of eggs laid in 48 hours from those of control (MeOH) (Table 3). There were no significant difference of hatching of eggs laid in 48 hrs and 72 hours among the treated and untreated seedlings.

**Duration of grub period:** It was observed that duration of grubs periods exposed for 48 hours of feeding was higher than that for 72 hours of feeding (Fig.1). In all cases of feeding, there was a slight variation in grub period among the concentration but in control, grub period remain more or less shorter than those in treated rice seedling. There was a slight variation on the grub duration fed on treated rice seedling between hours of exposures. Such difference in grub duration were statistically insignificant.

Table 1: Food consumption ($mm^2$) of rice leaves by rice hispa, *Dicladispa armigera* (Olv.) on treated and untreated rice plants

| Plant extract | Conc. (%) | No. of hispa /replication | Food consumption ($mm^2$/pair) | |
|---|---|---|---|---|
| | | | 48 hrs | 72 hrs |
| PSE (MeOH) | 1.0 | 2 | 86.20cd | 96.80c |
| | 0.5 | 2 | 108.4c | 110.0c |
| PSE (Acetone) | 1.0 | 2 | 15.40e | 17.60e |
| | 0.5 | 2 | 28.00e | 32.20e |
| BSE (MeOH) | 1.0 | 2 | 29.20e | 33.20e |
| | 0.5 | 2 | 36.80e | 45.40e |
| BSE (Acetone) | 1.0 | 2 | 15.60e | 14.80e |
| | 0.5 | 2 | 25.80e | 32.20e |
| MeOH | 0.0 | 2 | 252.4ab | 274.6a |
| Acetone | 0.0 | 2 | 209.4b | 256.6ab |
| Water | 0.0 | 2 | 255.0ab | 269.0a |

Within a column means followed by a common letter are not significantly different, at P = 0.05. PSE (Pithraj spray extract). BSE (Bullock heart spray extract)

Table 2: Effects of plant extracts on oviposition (egg-laying) by adult rice hispa, *Dicladispa armigera* (Olv.) on treated and untreated rice plants

| Plant extract | Conc. (%) | No. of hispa /replication | Mean no. of eggs deposited /pair of adults | |
|---|---|---|---|---|
| | | | 48 hrs | 72 hrs |
| PSE (MeOH) | 1.0 | 2 | 4.20ab | 4.00ab |
| | 0.5 | 2 | 1.80b | 1.40b |
| PSE (Acetone) | 1.0 | 2 | 2.20b | 4.80ab |
| | 0.5 | 2 | 3.20b | 4.80ab |
| BSE (MeOH) | 1.0 | 2 | 2.80b | 3.60b |
| | 0.5 | 2 | 2.40b | 3.40ab |
| BSE (Acetone) | 1.0 | 2 | 3.00b | 3.00b |
| | 0.5 | 2 | 3.60b | 4.40ab |
| MeOH | 0.0 | 2 | 13.60a | 9.20ab |
| Acetone | 0.0 | 2 | 11.00ab | 7.20ab |
| Water | 0.0 | 2 | 9.00ab | 10.20ab |

Within a column means followed by a common letter are not significantly different, at P = 0.05 (DMR test)

**Adult emergence:** PSE (MeOH & Acetone) and BSE (MeOH & Acetone) extracts of seeds of pithraj, *Amoora ruhituka* (wright & Arn) and Bullock's heart, *Annona reticulata* (Linn.) were potent inhibitors of adult emergence of rice hispa. Relatively low emergence of rice hispa in all treated rice seedling indicated the high degree of inhibition effect of the extracts on adult emergence (Table 4). In most cases, grubs that hatches from eggs on treated leaves dropped to the ground and failed to reach the adult stage. Most probably, the tunnel feeding of the newly hatches grubs was disturbed by deterrent action of extracts and often the grubs were found to the leaves of feeding tunnels and dropped to the ground, which severely affected adult emergence. The adult emergence in control (MeOH and water) was significantly higher than those on treated seedlings. Similar results were also reported by Islam (1983).

Table 3: Effects of plant extracts on the hatching of grubs of rice hispa, *Dicladispa armigera* (Olv.) on treated and untreated rice plants

| Plant extract | Conc. (%) | No. of hispa /replication | No. of grub | |
|---|---|---|---|---|
| | | | 48 hrs | 72 hrs |
| PSE (MeOH) | 1.0 | 2 | 4.20ab | 4.00ab |
| | 0.5 | 2 | 1.80b | 1.40b |
| PSE (Acetone) | 1.0 | 2 | 2.20b | 4.80ab |
| | 0.5 | 2 | 3.20b | 4.80ab |
| BSE (MeOH) | 1.0 | 2 | 2.80b | 3.36b |
| | 0.5 | 2 | 2.40b | 3.40ab |
| BSE (Acetone) | 1.0 | 2 | 3.00b | 3.00b |
| | 0.5 | 2 | 3.60b | 4.40ab |
| MeOH | 0.0 | 2 | 13.60a | 9.20ab |
| Acetone | 0.0 | 2 | 11.00ab | 7.20ab |
| Water | 0.0 | 2 | 9.00ab | 10.20ab |

With in a column means followed by a common letter are not significantly different, at P = 0.05 (DMR-Test)

Table 4: Effects of plant extracts on the adult emergence of rice hispa, *Dicladispa armigera* (Olv.)on treated and untreated rice plants

| Plant extract | Conc. (%) | No. of hispa /replication | Adult Emergence | |
|---|---|---|---|---|
| | | | 48 hrs | 72 hrs |
| PSE (MeOH) | 1.0 | 2 | 3.40d | 2.60d |
| | 0.5 | 2 | 0.80d | 2.00 |
| PSE (Acetone) | 1.0 | 2 | 2.40d | 2.60d |
| | 0.5 | 2 | 2.60d | 3.20d |
| BSE (MeOH) | 1.0 | 2 | 2.00d | 2.60d |
| | 0.5 | 2 | 3.20d | 1.80d |
| BSE (Acetone) | 1.0 | 2 | 2.20d | 2.40d |
| | 0.5 | 2 | 2.00d | 4.00d |
| MeOH | 0.0 | 2 | 9.40abc | 13.40abc |
| Acetone | 0.0 | 2 | 5.00bcd | 4.40cd |
| Water | 0.0 | 2 | 10.00ab | 10.40ab |

Within a column means followed by a common letter are not significantly different, at P = 0.05 (DMR-Test)

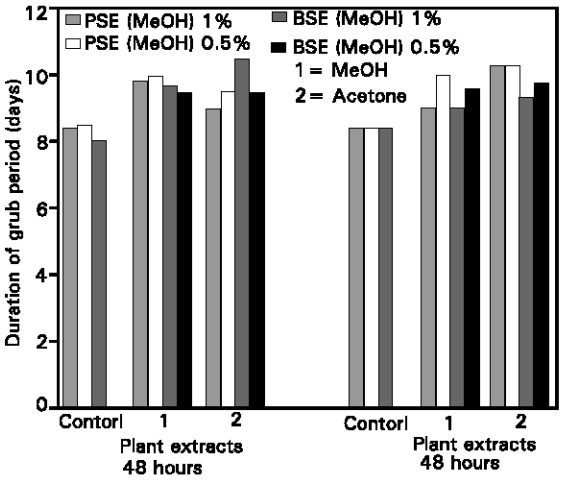


Fig. 1: Mean grub period (in days) of rice hispa feed on treated and untreated rice seedling for 48 and 72 hours.

**Conclusion:** Many natural plant products posses insect antifeedant activities. These compounds probably play a role as resistance factors in different plants against insect attack. These can be a novel approach in pest management program. It is relatively safer for environment. The result of present study revealed that PSE and BSE extracts contain the antifeedant actions of the insect *Dicladispa armigera*. Feeding activities and egg deposition of *Dicladispa armigera* were reduced in the presence of the deterrent activities of the extracts of PSE and BSE and were almost equally effective. Consequently they were affected in feeding and oviposition behaviour as well as adult emergence.

## References

Anonymous, 1995. Adhunik Dhaner Chash (in Bengali) Bangladesh Rice Research Institute, Gazipur, Bangladesh, pp: 52.

Ascher, K. R. S., 1981. Some physical (solubility) properties and biological (sterilant for Epilachna varivestis females) effects of a dried methanolic neem (*Azadirachta indica*) seed kernel extract. Proc. 1st Int. neem conf. (Rottack-Egern, 1980), pp: 63-74.

Barr, B. A., C. S. Koehler and R. F. Smith, 1975. Crop losses to insects, diseases, weeds and other pests. USAID. Pest management and related environment protection project. Uni. California, Berkeley, pp: 64.

Chiu, S. F., B. Huang and M. Y. Hu, 1985. South China Agricultural Univ., Guanghou (China). Insect Toxicology Lab. Intern. Rice Res. Newsl., 10: 25.

Feuerhake, K. and H. Schmutterer, 1982. Einfache verfahern zur Gewinnung and formulierung vou Neem samenxtrakten and deren wirkung anf verschiedence schadinsekten. Z. Pflkrankh. Pflscutz, 89: 737-747.

Gomez, K. A. and A. A. Gomez, 1984. Statistical procedures for Agricultural Research. Second Edition, John Willey & Sons, New York, 208-215.

Haque, M. A. and B. N. Islam, 1989. Effects of methanolic pithraj and bullock's heart seed extracts on green rice leaf hopper. Bang. J. Agril. Sci., 16: 209-211.

Hellpap, C., 1983. Effects of neem kernel extracts on the fall army worm, *Spodoptera fruquiperda* Smith. Abs. 2nd Int. Neem Conf. Rauisen Holzhausen castle. 25-28 May, 1983, pp: 26.

Heyde, J. V. D., R.C. Saxena and H. Schmutterer, 1984. Neem oil and neem extracts as potential insecticide for control of Hemipterous rice pests: Proc. 2nd. Int. Neem conf. Rauisch Holzhausen Castle. 25-28 May, 1983, pp: 377-390.

Islam, B. N., 1983. Use of some extracts form Meliaceae and Annonaceae for control of rice hispa *Dicladispa armigera* and pulse beetle, *Callosobruchus chinensis*. APPL. Entomol., 77: 602.

Islam, S., 1997. Field Ecology, Pest status and Management Rice hispa (*Dicladispa armigera*) in Bd. Ph.D. Thesis, School of Environment Resources and Development, Asian Institute of Technology, Bangkok Thailand, pp: 130.

Islam, Z. and M. Hasan, 1999. Pests of Rice in Bangladesh: Present management scenario and future chalenges. pp: 90-98. In: Proceedings of the First Agricultural Conference. CARE Bangladesh, Dhaka.

Krishnaiah, N. V. and M. B. Kaiode, 1991. Efficacy of neem oil against rice insect pests under green house and field condition. Ind. J. plant protection, 19: 1, 11-16.

Pathak, M. D., 1968. Ecology of common insect pests of rice. Ann. Rev. Entomol., 13: 257-294.

Saxena, R. C., P. B. Epino, T. U. Cheng-Wen and B. C. Puma, 1984. Neem, chinaberry (Chor neem) and custard apple: antifeedant and insecticidal effects of seed oils on leaf hopper and plant hopper pests of rice. Proc. 2nd Int. Neem Conf. Rauisch Holzahausen Castle. 25-28 May. 1983, pp: 403-412.

Shin-Foon, Chiu and Zhang-Ye-Guang, 1984. Effects of some plant materials of Meliaceae on fifth instar larvae of *Spodoptera litura* as feeding inhibitors. Neem Newsletter, 1: 23.