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Comparative Efficacy of Some Indigenous Plant Materials as Toxicity and Repellent Against Pulse Beetle, *Callosobruchus chinensis* L.

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Abstract: Three indigenous plant extracts, pithraj, *Aphanamixis polystachya*, Aroids, *Colocasia esculenta* and water hyacinth, *Eichhornia crassipes* were evaluated for toxicity and repellent effect on adult beetle, *Callosobruchus chinensis* L. Aroid was found to be more effective than other plant extracts. The order of toxicity was aroid > pithraj > water hyacinth. All the plant extracts were found to be effective as repellent effect on the beetle. Aroid extracts have strong repellent effects followed by pithraj and water hyacinth. The water extract was more effective than acetone extracts.

Key words: Plant extract, toxicity, repellent, *Callosobruchus chinensis*

Introduction

Insect pest cause heavy losses to stored grains, especially in humid and warm area of the world. At least 15 primary species of the insects are well adapted to stored grain (Wilbur *et al.*, 1977). Among these species pulse beetle *Callosobruchus chinensis* L. is one of the most devastating pests to almost all kinds of stored pulses in Bangladesh (Alam, 1971; Singh *et al.*, 1977, Bhuiyan and Peyara, 1978). Losses of serious dimensions due to damage and deterioration by insect pest in stored pulses occur every year. Gujar and Yadav (1978) reported 55- 60% loss in seed weight and 45.50-66.30% loss in protein content due to damage by the pulse beetle. They cause both quantitative and qualitative damage to stored pulses and as a result, the pulse seeds become unfit of human consumption and planting. Curative control measures are practiced to protect them. Among them, synthetic insecticides have been used since long time, but has serious drawbacks (Sharaby, 1988). These insecticides carry potential health hazards and affect non-target organisms and environment. Some residues of the insecticides remain in stored grain and also in environment (Kavadia *et al.*, 1984; Fishwick, 1988). Many workers have studied the effects of leaf powder as protectant of pulse against pulse beetle (Ivbijaro, 1983; Prakash and Rao, 1990; Rejesus *et al.*, 1989). Indigenous plant materials are cheaper and hazard-free in comparison with chemical insectides (Saxena *et al.*, 1992). This study has been carried out to evaluate the effectiveness of pithraj, aroids, water hyacinth as toxicants and repellents on pulse beetle.

Materials and Methods

Experiments were conducted in the Laboratory of Department of Entomology, Bangladesh Agricultural University, Mymensingh during the period of 1999-2000. The pulse beetle, *Callosobruchus chinensis* L. was used from the laboratory stock culture. The culture was maintained in glass jar (12 x 31 x 23 cm^3) on lentil seeds. All the test insects response assays were conducted in petri dishes (9 x 1.3cm^2) placed in growth chamber at 28 ± 2°C temperature and 73 ± 2% relative humidity.

Green and fresh leaves of pithraj, aroids and water hyacinth were washed thoroughly, air dried and ground with electrical grinder. Fifty grams of each ground leaves were taken in a 500 ml beaker separately. Then 250 ml of distilled water and acetone was added in each beaker. The mixture was stirred for 30 minutes in a magnetic stirrer. The mixture was filtered through fine cloth and condensed by evaporation in a water bath at 70-90°C temperature with the constant weight gained. After complete evaporation of solvent, the semi solid extracts were cooled and preserved in the refrigerator for later use. The 25, 50, 75 and 100 mg/ml stock solution of water and acetone extract of different plants were prepared from preserved semi solid solution by diluting in the water and acetone for insect bioassay. Control was maintained by using only solvent (acetone).

For direct toxicity tests were done by using dipping methods suggested by De-Pedro and De-Pedro (1994), 10 adult insects were taken in a filter paper and the filter paper was dipped in to the treatments for 4 to 6 seconds. The insects were then released into the petri dishes with normal food and replicated thrice. Insect mortality was observed at 24, 48 and 72 hours after treatments (HAT). The data for mortality were corrected by Abbott, (1925) formula, LC_{50} values were calculated using Probit analysis (Finney, 1971) with a log10 transformation of concentration of extracts.

For repellency test, substrates were prepared from 9cm diameter filter paper disks cut in half following of Talukder and Howse (1994) and 1ml of each category extract solution was applied to a half filter paper disk uniformly with a pipette. The treated half disks were then air dried to evaporate the solvent completely and attached with the untreated (control) half with cellotape and placed in a petri dishes. The insects were released at the centre of each filter paper disks and the cover was replaced on the petri dish. Insects present on each strip were counted at an hour intervals up to 5th hours. The average of count was converted to express percentage repellency. Data were analyzed using analysis of variance (ANOVA) after transforming them into arcsine percentage values. The repellency class was classified as class I-0.1 to 20. 1, class II-20.1 to 40.0, class III-40.1 to 60.0, class IV-60.1 to 80.0 and class V-80.1 to 100.0% repellency (McDonald *et al.*, 1970)

Results and Discussion

Mortality percentages of pulse beetle treated with different plant extracts were found statistically significant (Table 1). Among the four concentrations, the highest concentration (100mg/ml) of all plant extracts had maximum mortality and mortality decreased proportionally with the decreased of concentration. Data also revealed that aroid showed the highest insect mortality, followed by pithraj and water hyacinth (Table 1). The above findings more or less similar with the report of Talukder and Howse (1993,1994). They reported that seed extracts of Pithraj were

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Table 1: Mean mortality percentage of pulse beetle, *C. chinensis* treated with different plant extracts by dipping method (interaction of extract and concentration)

Name of the plant extracts	Dose (mg/ml)	Average mortality (%)
Pithraj	100	64.52ab (54.24)
	75	53.09c (56.95)
	50	29.38de (32.18)
	25	29.33e (28.30)
Aroid	100	70.62a (59.40)
	75	60.86b (51.85)
	50	49.63c (44.81)
	25	45.18c (42.16)
Water hyacinth	100	46.17c (42.62)
	75	34.94d (35.94)
	50	23.70e (28.10)
	25	15.68f (22.73)

The original insect mortality data were corrected by Abbott's (1925) formula before ANOVA. Within column values followed by same letter (s) did not differ significantly at $p < 0.01$ by DMRT. Arcsin values have been shown in parenthesis

Table 2: Relative toxicity of different plant extracts treated against pulse beetle, *Callosobruchus chinensis* L.

HAT	Plant materials	χ^2	LC_{50}	95 % fiducial limit Lower	Upper
24	Pithraj	0.27	9.93	2.39	41.11
	Aroid	0.83	7.76	4.89	12.27
	Water hyacinth	0.12	12.77	2.30	70.77
48	Pithraj	0.23	6.90	1.77	26.85
	Aroid	0.13	5.48	3.69	8.14
	Water hyacinth	0.42	10.00	23.87	114.63
72	Pithraj	0.00	3.19	2.16	4.73
	Aroid	0.90	2.59	1.64	4.09
	Water hyacinth	0.93	6.21	2.95	13.05

highly toxic to pulse beetle and red flour beetle. The probit statistics estimate of LC_{50} and 95 % fiducial limits at 24, 48 and 72 HAT for mortality of pulse beetles were recorded (Table 2). It was revealed that aroid extract had highest toxicity, followed pithraj and water hyacinth. From the results it was clear that aroid and pithraj plant extracts would be effective for controlling the pulse beetle. The repellent effects of all the three plant extracts on pulse beetle in different hours were statistically significant (Table 3, 4). Among the four concentrations, the highest concentration (100mg/ml) of all plant extracts had maximum repellency (73.33, 82.67 and 66.67% repellency for water extract and 68.00, 76.00 and 68.00 % repellency for acetone extract pithraj, aroids and water hyacinth, respectively) activity from class IV to class V. The result also indicated that repellency action increased proportionally to the concentrations and in all cases it was class II to class III. Considering all concentrations the order of repellency of three plant extracts were aroid > pithraj > water hyacinth. The results

Table 3: Repellency rate of different plant water extracts on pulse beetle *C. chinensis* using treated filter paper

Name of plant extracts	Dose (mg/ml)	Average repellency rate (%) at 1 HAT	2 HAT	3 HAT	4 HAT	5 HAT	Mean repellency rate (%)	Repellency class
Pithraj	100	66.67ab	73.33ab	80.00ab	73.33ab	73.33ab	73.33ab	IV
	75	53.33a-c	53.33b-e	60.00a-d	53.33a-d	53.33b-d	54.67ce	III
	50	33.33bc	33.33b	40.00c-e	33.33cd	40.00cd	36.00f-h	II
	25	26.67c	26.67e	33.33c-e	26.67dd	33.33d	29.33gh	II
Aroid	100	80.00a	80.00a	86.67a	80.00a	86.67a	82.67a	V
	75	60.00a-c	60.00a-d	60.00a-d	60.00a-c	66.67a-c	61.33b-d	IV
	50	40.00bc	46.67b-c	33.33c-e	46.67b-d	46.67b-d	42.67e-g	III
	25	26.67c	33.33e	26.67de	33.33d	33.33d	30.67f-h	II
Water hyacinth	100	60.00a-c	66.67a-c	66.67a-c	73.33ab	66.67a-c	66.67bc	IV
	75	40.00bc	46.67c-e	46.67b-e	53.33b-d	46.67b-d	46.67d-f	III
	50	33.33bc	33.33de	33.33c-e	33.33cd	33.33d	33.33f-h	II
	25	26.67c	26.67e	20.00e	26.67d	26.67d	25.33h	II

HAT = Hours after treatment, within column values followed by same letter (s) did not differ significantly at $p < 0.01$ by DMRT

Table 4: Repellency rate of different plant acetone on pulse beetle *C. chinensis* using treated filter paper

Name of plant extracts	Dose (mg/ml)	Average repellency rate (%) at 1HAT	2 HAT	3 HAT	4 HAT	5 HAT	Mean repellency rate (%)	Repellency class
Pithraj	100	60.00ab	66.67ab	66.67ab	73.33ab	73.33a	68.00a	IV
	75	46.67ab	46.67bc	46.67a-c	53.33b-d	53.33ab	49.33bc	III
	50	33.33b	33.33b	33.33bc	40.00cd	46.67ab	37.33cd	II
	25	26.67b	26.67b	26.67c	33.33b	33.33b	29.33d	II
Aroid	100	73.33ab	80.00a	73.33a	80.00a	73.33a	76.00a	IV
	75	53.33ab	53.33a-c	46.67a-c	53.33b-d	53.33ab	52.00b	III
	50	33.33b	33.33a-c	33.33c	46.67b-d	40.00b	37.33cd	II
	25	26.67b	26.67c	26.67c	33.33d	26.67b	28.00d	II
Water hyacinth	100	60.00ab	66.67ab	73.33a	66.67a-c	73.33a	68.00a	IV
	75	46.67ab	46.67bc	53.33a-c	46.67cd	53.33ab	49.33bc	III
	50	33.33b	33.33c	33.33c	33.33d	40.00b	34.67d	II
	25	26.67b	26.67c	26.67c	26.67d	26.67b	26.67d	II

HAT = Hours after treatment, Within column values followed by same letter (s) did not differ significantly at $p < 0.01$ by DMRT

also indicate that the repellency action of water extract is better than acetone extracts. Islam (1984) reported that pithraj had repellent effects on angomoir moths (*Sitotroga cerealella*), rice green leaf hopper (*Nephotettix nigropictus* stal.) brown leaf hopper (*Nilaparvata lugens* stal). Talukder and Howse (1993) reported strong repellent effects of pithraj on *Tribolium castaneum*. These findings are in agreement with their results.

References

Abbot, W.S., 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol., 8: 265-267.

Alam, M.Z., 1971. Pest of stored grain and other stored products and their control. Agril. Int. Serv. Pub. Dhaka, pp: 61

Bhuiyan, M.S.I. and S.A. Peyara, 1978. Studies on the biology of pulse beetle, *Callosobruchus chinensis* L. (Bruchidae: Coleoptera) on stored pulses. Bangladesh J. Agril. Sci., 5: 93-97.

De-Pedro, L.B. and R.C. Jr. De-Pedro, 1994. Alternative control strategies against stored product insect pests. Pest Management Council of Philippines, pp: 35.

Finney, D.J., 1971. Statistical method in biological assay (2nd edition), Griffin, London, pp: 668.

Fishwick, R.B., 1988. Pesticide residues in grain arising from post harvest treatments aspects. Appl. Biol., 17: 37-46.

Gujar, G.T. and T.D. Yadav, 1978. Feeding of *Callosobruchus maculatus* (Fab.) and *Callosobruchus chinensis* L. in green gram. Indian J. Entomol., 40: 108-112.

Islam, B.N., 1984. Pesticidal action of neem and certain indigenous plants and weeds of Bangladesh. In: Proc. 2nd Int. Neem Conf. Rauischholzhausen, pp: 263-290.

Ivbijaro, M.F., 1983. Toxicity of neem seed (*Azadirachta indica*) to *Sitophilus oryzae* in stored maize. Prot. Ecol., 5: 353-358.

Kavadia, V.S., E.L. Pareek and K.P. Sharma, 1984. Residues of malathion and carbaryl in stored sorghum. Bull. Grain. Technol., 22: 247-250.

McDonald, L.L., R.H. Guy and R.D. Speirs, 1970. Preliminary evaluation of new candidate materials as toxicant, repellents and attractants of stored product insects. Marketing Research Report No. 882. Agric. Res. Service, U. S. Deptt. Agric. Washington, pp: 8.

Prakash, A. and J. Rao, 1990. Leaves of begunia pulse grain protectant. Indian J. Entomol., 51: 192-195.

Rejesus, M.B., H.A. Maini, K. Ohsawa and I. Yamamoto, 1989. Insecticidal action of several plants to *Callosobruchus chinensis* L. In: Proc. 2nd Int. Sym. on Bruchids and Legumes (ISBL-2) held at Okayama, Japan, pp: 91-100.

Saxena, R.C., O.P. Dixit and V. Harshan, 1992. Insecticidal action of *Lanatana camara* against *Callosobruchus chinensis* (Coleoptera: Bruchidau). J. Stored Prod. Res., 28: 279-281.

Sharaby, A., 1988. Evaluation of some Myrtaceae plant leaves as protectants of rice against the infestation of *Sitophilus oryzae* L. and *Sitophilus granarius* L. Insect Sci. Appl., 9: 465-468.

Singh, S., S.C. Odac and Z. Singh, 1977. Studies on preference of pulse beetle, *Callosobruchus chinensis* L. for different host. Bull. Grain Technol., 15: 20-26.

Talukder, F.A. and P.E. Howse, 1993. Deterrent and insecticidal effect of extracts of pithraj, *Aphanamixis polystachya* (Meliaceae) against *Tribolium castaneum*. J. Chem. Ecol., 19: 2463-2471.

Talukder, F.A. and P.E. Howse, 1994. Laboratory evaluation of toxic and repellent properties of pithraj tree, *Aphanamixis polystachya* Wall and Parker against *Sitophilus oryzae* L. Int. J. Pest Management, 41: 274-279.

Wilbur, D.A., R.B. Mills and J.R. Pedersen, 1977. Grain and Cereal product insects and their control. Manual for operative Millers short course. GRSC Dept., KSU, KS., pp: 298.