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TOXICITY OF SOME INDIGENOUS PLANT EXTRACTS AGAINST *TRIBOLIUM CONFUSUM* DUVAL

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Abstract

The efficacy of seven different plant extracts viz. *Acorus calamus* rhizome, leaves of *Datura fastuosa*, *Datura stramonium* and seeds of *D. stramonium*, *Corchorus capsularis*, *Aphanamixis polystachea* and *Jatropha curcas* on *Tribolium confusum* adult was studied. Dose mortality experiments were conducted with three solvent (petroleum ether, acetone and methanol) extracts separately but *J. curcas* seed was tested with petroleum ether extract only. Among three solvents, petroleum ether extract exhibited piquant toxic effect against the beetle at all the intervals although *D. fastuosa* leaf produces no mortality at 24 hours of treatment. Acetone extract of *A. calamus* rhizome, *D. fastuosa* leaf, *D. stramonium* seed and *C. capsularis* seed produced mortality at all the intervals but *D. stramonium* leaf and A. *polystachea* seed did not show any toxic effect. Methanol extract of *C. capsularis* seed showed toxicity at all the duration.

Key words: Toxic effect, plant extracts, *Tribolium confusum*.

Introduction

The protection of stored grain and seeds against insect pests has been a major problem from the development of agriculture. Plant products have been successfully exploited as insecticides, insect repellents and insect antifeedants (Dethier *et al.* 1960, Schoonhoven 1982, Mordue (Luntz) 1998). The insecticidal and acaricidal properties of a number of plants have been discovered long ago, and some of the plants can compete with synthetic means of control (Hedin and Hollingworth 1997). Especially remarkable are tropical plants from which hundreds of secondary metabolites with insecticidal properties have been extracted (Hiiesaar *et al.* 2001). They are environmentally less harmful than synthetic pesticides and acting in many insects in different ways (Schmutterer 1990, Metspalu and Hiiesaar 1993, Berger 1994, Luik 1994, Kuusik *et al.* 1995). To minimize use of pesticides and to avoid pollution of the environment, natural antifeedant, deterrent and repellent substances have been searched for pest control during recent times (Lindgren *et al.* 1996, Klepzig and Schlyter 1999, Govindachari *et al.* 2000). This led to the present study.

Materials and Methods

Plant parts were collected from different areas of Bangladesh. All the parts were dried in shade and dried in an oven at 40^{O} C. After drying, plant parts were crushed in a grinder machine and extracted in soxhlet apparatus separately with petroleum ether, acetone and methanol. The solvents were evaporated in rotary

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vacuum evaporator at 40^{O} C under reduced pressure yielding the petroleum ether, acetone and methanol extracts and then collected in small reagent bottle, preserved at 4^{O} C in a refrigerator.

Mass culture of *T. confusum* was maintained in glass jars (15.40 ? 12.00 cm) on whole meal flour and brewers yeast (19:1) in an incubator at 30^{O} C. A sub culture was also maintained in an incubator at the same temperature for collection of *T. confusum.* For testing beetle mortality, six doses were used including control (only solvent). The experiments were carried out by adopting residual film technique.

The doses were prepared by mixing the requisite quantities of extracted materials with 10 ml acetone or methanol. Methanol was used in the case of methanol extract because this extract does not dissolve properly in acetone. For each dose containing 01 ml liquid was dropped on a Petri dish (9.5 cm diam.) and after drying15 days old 40 (20 ? and 20 ?) adults were released in each Petri dish. The doses were calculated by measuring the weight of extracted materials (mg) in 01 ml of the solvent divided by the surface area of the Petri dish and converted into mg/cm^{2}. Mortality was assessed after 24, 48 and 72 hours. The mortality was corrected using Abbott's formula (Abbott 1925) and LD_{50} values were determined by probit analysis (Busvine 1971). The experiments were replicated thrice and conducted at 30±0.5^{O} C.

Result and Discussion

The contact toxicity, LD_{50} values, regression equations and fiducial limits for each of the test materials were determined (Tables 1-3). Petroleum ether extract of *A. calamus* rhizome exhibited lowest LD_{50} values (Table 1) at all the intervals. The efficacy of the extracts followed in order: *A. calamus* rhizome > *D. stramonium* seed > *C. capsularis* seed > *A. polystachea* seed > *J. curcas* seed > *D. stramonium* leaf after 24 hours of treatment. After 48 hours of treatment the order of efficacy were: *A. calamus* rhizome > *D. stramonium* seed > *C. capsularis* seed > *A. polystachea* seed > *D. fastuosa* leaf > *D. stramonium* leaf > *J. curcas* seed and after 72 hours efficacy were: *A. calamus* rhizome > *D. stramonium* seed > *C. capsularis* seed > *A. polystachea* seed > *D. fastuosa* leaf > *J. curcas* seed.

The acetone extract of *A. calamus* rhizome was the most effective at all the intervals (Table 2). The order of efficacy after 24 and 48 hours were: *A. calamus* rhizome > *C. capsularis* seed > *D. stramonium* seed > *D. fastuosa* leaf. The efficacy after 72 hours were: *A. calamus* rhizome > *C. capsularis* seed > *D. fastuosa* leaf > *D. stramonium* seed.

The present results indicated that the methanol extract of *C. capsularis* seed was effective at all the intervals (Table 3). The petroleum ether extract of all plants tested are more efficient in controlling *T. confusum* than those of other extract tested. In insect pest management antifeedants are of paramount importance since they are pest specific and retard feeding activities of pests. However, these are dependent upon the chemicals present in the plant parts.

Result of the present study is in agreement with the result of Liu and Ho (1999), who reported that essential oil of *Evodia rutaecarpa* was toxic to *T. castaneum* and *Sitophilus zeamais* adults when applied tropically. Deshmukh and Borle (1975) also reported the toxic effect of petroleum ether extract of *Datura alba* (*Datura.*

fastuosa) seed on *Dactynotus carthami*. Khalequzzaman and Islam (1992) reported that methanolic extract of *Datura metel* (*D. alba, D. fastuosa*) leaf was more toxic than other extracts on *T. castaneum*. The results are in conformity with the results of Talukder and Howse (1993) who reported the repellent action of different solvent extracts of *Aphanamixis polystachea* seed on *T. castaneum*. In another experiment, they found that ethanol extract of *A. polystachea* seed was more toxic to *T. castaneum* than petroleum ether and acetone extracts. Khanam *et al.* (1990) reported that seed coat extracts of *A. polystachea* had a deleterious effect on the growth and development of *T. confusum*. The toxic and sterilizing effects of *A. calamus* rhizome oil to certain stored grain insects have been reported (Saxena and Mathur 1976, Koul *et al.* 1977, and Paul *et al.* 1965). The result supported the findings of Pandey *et al.* (1977) who noted the mortality of mustard saw fly *Athalia proxima* Klug. when treated with ether extract of *A. calamus* rhizome. The present findings suggested a piquant toxic nature of the plant parts on *T. confusum* that can be utilized in storehouses against this pest. Further work on the identification of active ingredient of petroleum ether extract, which is more effective than other extracts and their bioassay, is utmost needed.

Table 1. Toxicity of petroleum ether extracts of seven indigenous plants on *T. confusum*.

Duration	Plant parts	Regression Equation	LD_{50} (mg/cm^2)	Fiducial Limits (mg/cm^2)
24 hours	*A. calamus* rhizome	Y= 3.238 + 3.813X	0.0068	0.004 - 0.010
	D. fastuosa leaf	NE	NE	NE
	D. stramonium leaf	Y= 0.503 + 5.393X	0.681	0.523 - 0.886
	D. stramonium seed	Y= 0.602 + 2.624X	0.047	0.036 - 0.061
	C. capsularis seed	Y= 3.783 + 1.364X	0.077	0.062 - 0.096
	A. polystachea seed	Y= 0.572 + 3.285X	0.222	0.167 - 0.293
	J. curcas seed	Y= 1.890 + 1.728X	0.629	0.506 - 0.781
48 hours	*A. calamus* rhizome	Y= 4.014 + 1.414X	0.0049	0.003 - 0.007
	D. fastuosa leaf	Y= 3.633 + 2.899X	0.295	0.223 - 0.391
	D. stramonium leaf	Y= 2.851 + 3.492X	0.412	0.340 - 0.499
	D. stramonium seed	Y= 1.039 + 2.901X	0.023	0.020 - 0.025
	C. capsularis seed	Y= 4.084 + 1.328X	0.048	0.036 - 0.064
	A. polystachea seed	Y= 1.904 + 2.88X	0.118	0.105 - 0.133
	J. curcas seed	Y= 1.602 + 1.987X	0.517	0.436 - 0.607
72 hours	*A. calamus* rhizome	Y= 4.217 + 1.667X	0.003	0.001 - 0.005
	D. fastuosa leaf	Y= 0.354 + 3.209X	0.280	0.223 - 0.351
	D. stramonium leaf	Y= 3.238 + 3.813X	0.289	0.245 - 0.342
	D. stramonium seed	Y= 3.737 + 1.554X	0.0065	0.0045 - 0.0093
	C. capsularis seed	Y= 3.859 + 1.797X	0.043	0.034 - 0.054
	A. polystachea seed	Y= 1.666 + 3.42X	0.094	0.083 - 0.106
	J. curcas seed	Y= 1.504 + 2.230X	0.368	0.326 - 0.415

NE = Not Effective

Table 2. Toxicity of acetone extracts of six indigenous plants on *T. confusum*.

Duration	Plant parts	Regression Equation	LD_{50} (mg/cm^2)	Fiducial Limits (mg/cm^2)
24 hours	*A. calamus* rhizome	Y= 2.558 + 1.688X	0.027	0.023 - 0.032
	D. fastuosa leaf	Y= 1.325 + 3.861X	0.894	0.671 - 1.193
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	Y= -3.022 + 4.646X	0.532	0.44 - 0.644
	C. capsularis seed	Y= 1.28 + 2.378X	0.365	0.221 - 0.604
	A. polystachea seed	NE	NE	NE
48 hours	*A. calamus* rhizome	Y= 2.146 + 2.149X	0.021	0.018 - 0.024
	D. fastuosa leaf	Y= 1.568 + 4.348X	0.615	0.0451 - 0.838
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	Y= -1.168 + 3.873X	0.391	0.284 - 0.538
	C. capsularis seed	Y= 3.606 + 1.507X	0.084	0.048 - 0.144
	A. polystachea seed	NE	NE	NE
72 hours	*A. calamus* rhizome	Y= 3.264 + 1.69X	0.010	0.008 - 0.013
	D. fastuosa leaf	Y= 3.186 + 3.984X	0.285	0.263 - 0.308
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	Y= -1.168 + 3.873X	0.391	0.284 - 0.538
	C. capsularis seed	Y= 4.323 + 1.134X	0.039	0.016 - 0.093
	A. polystachea seed	NE	NE	NE

NE = Not Effective

Table 3. Toxicity of methanol extracts of six indigenous plants on *T. confusum*.

Duration	Plant parts	Regression Equation	LD_{50} (mg/cm^2)	Fiducial Limits (mg/cm^2)
24 hours	*A. calamus* rhizome	NE	NE	NE
	D. fastuosa leaf	NE	NE	NE
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	NE	NE	NE
	C. capsularis seed	Y= 2.601 + 1.264X	0.79	0.509 - 1.226
	A. polystachea seed	NE	NE	NE
48 hours	*A. calamus* rhizome	NE	NE	NE
	D. fastuosa leaf	NE	NE	NE
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	NE	NE	NE
	C. capsularis seed	Y= 2.311 + 1.925X	0.249	0.215 - 0.287
	A. polystachea seed	NE	NE	NE
72 hours	*A. calamus* rhizome	NE	NE	NE
	D. fastuosa leaf	NE	NE	NE
	D. stramonium leaf	NE	NE	NE
	D. stramonium seed	NE	NE	NE
	C. capsularis seed	Y= 1.775 + 2.796X	0.142	0.117 - 0.172
	A. polystachea seed	NE	NE	NE

NE = Not Effective

References

Abbott W S (1925) A method of computing the effectiveness of an insecticide. *J. econ. Ent.* **18:** 265-267.

Berger A (1994) Using natural pesticides: current and future perspectives. *Alnarp, Swedish University of Agricultural Sciences* 56 pp.

Busvine J R (1971) *A critical review of the techniques for testing insecticides.* Commonwealth Agricultural Bureau, London. 345 pp.

Deshmukh S D and Borle M N (1975) Studies on the insecticidal properties of indigenous plant products. *Indian. J. Ent.* **37(1):** 11-18.

Dethier V G, Barton Browne L and Smith C N (1960) The designation of chemicals in terms of the responses they elicit from insects. *J. econ. Ent.* **53:** 134–136.

Govindachari T R, Suresh G, Gopalakrishnan G and Wesley S D (2000) Insect antifeedant and growth regulating activities of neem seed oil - the role of major tetranortriterpenoids. *J. Appl. Ent.* **124:** 287-291.

Hedin P A and Hollingworth R M (1997) New Application for Phytochemical Pest Control Agents, In: Hedin P A, Hollingworth R M and Masler E P (Ed.). *Phytochemicals for Pest Control, American Chemical Society*, Washington. pp. 1-13.

Hiiesaar K L, Metspalu A and Kuusik S (2001) An estimation of influences evoked by some natural insecticides on greenhouse pest insects and mites In: Metspalu L and Mitt S (Ed.). *Practice oriented results on the use of plant extracts and pheromones in pest control*. Proceedings of the international workshop, Estonia, Tartu, 24-25 January 2001. pp. 17-27.

Khalequzzaman M and Islam M N (1992) Pesticidal action of Dhutura, *Datura metel* Linn. leaf extracts on *Tribolium castaneum* (Herbst). *Bangladesh J. Zool.* **20 (2):** 223-229.

Khanam L A M, Khan A R and Talukder D (1990) Insecticidal properties of royna, *Aphanamixis polystachea* Wall (Parker) (Meliaceae) against *Tribolium confusum* Duval. *J. Asiatic Soc. Bangladesh, Sci.* **16(2):** 71-74.

Klepzig K D and Schlyter F (1999) Laboratory evaluation of plant-derived antifeedants against the pine weevil *Hylobius abietis* (Coleoptera: Curculionidae). *J.econ. Ent.* **92(3):** 644-650.

Koul O, Tikku K and Saxena B P (1977) Follicular regression in *Trogoderma granarium* due to sterilizing vapours of *Acorus calamus* L. oil. *Curr. Sci.* **46:** 724-725.

Kuusik A, Metspalu L and Hiiesaar K (1995) Insektitsiidide toimemehhanismide uurimine putukatel. Tartu, 292 lk.

Lindgren B S, Nordlander G and Birgersson G (1996) Feeding deterrence of verbenone to the pine weevil, *Hylobius abietis* (L.) (Col., Curculionidae). *J. Appl. Entomol.* **120 :** 397-403.

Liu Z L and Ho S H (1999) Bioactivity of the essential oil extracted from *Evodia rutaecarpa* Hook et Thomas against the grain storage insects, *Sitophilus zeamais* Motsch. and *Tribolium castaneum* (Herbst). *J. stored Prod. Res.* **35**: 317-328.

Luik A (1994) Soolikarohi kahjuritõrjeks. *Maakodu* **7:** 17–18.

Metspalu L and Hiiesaar K (1993) Taimemürgid tõrjuvad kahjurputukaid (In Estonian). *Põllumajandus* **6:** 7-8.

Mordue A J (1998) Azadirachtin - A review of its mode of action in insects. In: Kleeberg H (Ed.). *Practice Oriented Results on Use and Production of Neem-Ingredients and Pheromones* Germany pp. 1-4.

Pandey J P, Singh M and Tiwari G C (1977) Antifeedant, repellent and insecticidal properties of indigenous plant materials against mustard sawfly, *Athalia proxima* Klug. *Indian J. Ent.* **38 (2):** 110-113.

Paul C F, Agrawal P N and Ausat A (1965) Toxicity of solvent extract of *Acorus calamus* Linn. to some grain pests and termite. *Indian J. Ent.* **27(1):** 114-117.

Saxena B P and Mathur A (1976) Loss of fecundity in *Dysdercus koenigii* due to vapours of *Acorus. calamus* oil. *Experientia* **32:** 315-316.

Schmutterer H (1990) Properties and potential of natural pesticides from neem tree, *Azadirachta indica. Ann. Rev. Entomol*. **35:** 271-297.

Schoonhoven I M (1982) Biological aspects of Antifeedants. *Entomol. Exp. and Appl***. 31:** 57- 69.

Talukder F A and Howse P E (1993) Deterrent and insecticidal effects of extracts of pitraj, *Aphanamixis polystachea*(Meliaceae), against *Tribolium castaneum* in storage. *J. Chem. Ecol*. **19 (11):** 2463-2471.