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SCREENING OF EIGHTY JAMAICAN PLANTS FOR INSECTICIDAL ACTIVITY

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ABSTRACT

Acetone and ethanol extracts of the leaves of eighty plant species, belonging to seventy-three genera and forty-three families were bioassayed on adult Tribolium castaneum (Herst) by spraying a series of concentrations directly on the beetles under a Potter's tower. The highest concentration (20%) of the crude extracts of only four plants, Artocarpus incisa, Capsicum annuum, Cuscuta americana and Nicotiana tabacum inflicted 80 - 100% mortality in five days. About 47 to 67% mortality was recorded with the extracts of Annona reticulata, Bontia daphnoides, Eupatorium odoratum, Gliricidia sepium and Hibiscus rosa-sinensis, while the other seventy-one plants were relatively ineffective.

INTRODUCTION

For centuries, farmers around the world have used leaves, fruits and kernels of several plants for protecting food grains, clothes and other materials susceptible to insect activities. Leaves and kernels of Azadirachta indica have been used widely for millenia in India as insect repellent. Extract of plants have been employed in pest control at least since the sixteenth century (Crosby 1966).

With the advent of modern organic insecticides in the 1940's, interest in botanical insecticides declined almost totally. However, the development of resistance in insects to the organic insecticides and the environmental problems created by their residues compelled the entomologist and the agricultural chemist to look for safer insecticides (Atal et al. 1982). The discovery of paper factor (Slama and Williams, 1966) and the insect repelling properties of A.indica (Pradhan et al. 1962) created renewed interest in plant-based insecticides. The success of synthetic pyrethroids since their introduction in the 1970's has further developed the need for developing botanical insecticides.

Application of intermediate technology in the production and usage of pesticides in the developing world is of paramount importance if food production is to be increased without hard currency inputs. Plant extracts offer an excellent opportunity for the production of environmentally safer and economically affordable pesticides at the cottage industry level (Mansingh, 1988). Extensive research on the insecticidal activities of various plant extracts are currently being conducted at the East-West Centre, Honolulu, HI,

Agricultural University at Guangzhow, China, the Indian Agricultural Research Institute, New Delhi (Mansingh, personal comm. 1987) and in England. The present project was initiated to investigate the insecticidal properties of plants in Jamaica.

MATERIALS AND METHODS

The selection of plants for the present study was based upon the recommendation of Crystal (1964) and Beaver (1969). Folklores on anti-pest anti-helminthic and fish poisoning properties of local Jamaican plants were corroborated with published literature on the species and allied species of plants (Adams, 1972; Robertson,1982; Stover, 1958) and with the popularity and practice of folklore in the island.

Fresh green leaves were chopped in a blender and 10g samples were transferred individually to conical flasks containing 150 ml acetone or ethanol. The flasks were kept at room temperature (27 - 30 C) and shaken occasionally. After 120 hours each flask was shaken vigorously for a few minutes and the solvent filtered through a Whatman No.1 filter paper. The leaf residues were washed twice with 5 ml of water each and the washings pooled with the solvent. The pooled extract was then concentrated in a rotor evaporator by removing the solvent. The concentrate was transferred to a volumetric flask and brought up to 10 ml by adding water containing 0.1% Triton X-100.

Adult T. casteneum were collected from a laboratory colony, starved for about 12 hours and transferred to petri dishes in batches of thirty each. The petri dishes were sprayed individually with 1 ml of 5, 10 or 20% crude extract of different plant leaves, under a Potter's tower. Each concentration of an extract had three replicates. The controls were sprayed with water containing Triton X. After drying the droplets on petri dishes the insects were provided with food.

Mortality was recorded every 24 hours for five days and the cummulative data were graded into seven categories; grades 0, 1, 2, 3, 4, 5 and 6 were assigned to mortalities ranging from 0 to 10' 11 to 20, 21 to40, 41 to 50, 51 to 60, 61 to 7C and 71 to 100% respectively.

RESULTS AND DISCUSSION

Fairly low mortality was obtained by spraying 5 or 10% of crude extracts of only few plants. Data presented in Table 1 showed that 20% crude leaf extracts of 37 plants had none or little biological activity (grade 0), 35 had some activity (grades 1 and 2) whereas only eight species manifested promising toxic effects on the beetle; these in order of toxicity and mortality (in parenthesis) were N.tabacum = C.americana (100%) > C.annum (98.7%) > A. reticulata = H. rosa-sinensis (66.7%) > G. sepium (60%) > E. odoratum (50%).

It should be recognised that the present method of screening plants for biological activity by bioassaying crude leaf extracts, and using mortality of the insects as the sole criterion is not the most suitable one, but certainly the most practical one for the objectives of the present project. The

hormone-mimicking activities of bark extracts of coniferous trees (Slama and Williams, 1966) would never have been discovered if chronic effects of the extracts on vital physiological processes such as moulting and reproduction were not studied.

Furthermore extracts of different plant tissue may vary in their biological activity. For instance, extracts of Neem (A.indica) leaves inflicted only 23% mortality (Table 1), but kernel extracts have high insect and toxic properties (Ahmed, et al 1986; Atal, et al 1982; Attri, 1980). Likewise the flower beetle may not be the ideal test insect for bioassaying the activity of plant extracts. It is encouraging to note that the insecticidal activity of the extracts of C. americana, C. annuum and A. incisa is comparable to that of N. tabacum. Tobacco decoction has been used for centuries in controlling aphids and other bugs (Frear, 1943). Nicotine sulphate is also toxic to many insects (Little,1957). The three Jamaican plants certainly offer great promise.

Investigations on the extracts of the most promising plants are being extended to include different plant tissues, other methods of extraction and purification of the extracts, a wide range of test insects and acarids, wider physiological criteria for assessment of chronic and acute effects and chemical identification of active ingredients.

REFERENCES

Adams, C. D. 1972. Flowering plants of Jamaica. Robert Maclehose & Co. Ltd., The University Press, Glasgow. 848 pp.

Ahmad, S. and M. Grainge. 1986. Potential of the Neem Tree (Azadirachta indica) for Pest Control and Rural Development. Economic Botany, 40 (2), p. 201.

TABLE 1. Insecticidal activity of leaf extracts of 60 Jamaican plants on adult Tribolium castaneum (Herst).

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Abrus precatorius L. John Crow Bean (Papilionaceae)	Acetone	6.7	0
Acidoton urens Sw. Mountain Cowitch (Euphorbiaceae)	Acetone	30.0	2
Aloe vera L./(A.barbadensis Mill.) Sinkle Bible (Liliaceae)	Acetone	10.0	0
Anacardium occidentale L. Cashew (Anacardiaceae)	Ethanol	6.7	0
Andropogon citratus DC. Lemon Grass (Gramineae)	Acetone	0.0	0
Andrographis paniculata (Burm.f.)Wall Rice Bitters (Acanthaceae)	Acetone	13.3	0
Annona reticulata L. Custard Apple (Annonaceae)	Ethanol	66.7	5
Annona muricata L. Sour Sop (Annonaceae)	Acetone	16.7	1
Antigonon leptopus Hook &. Arn Corallita (Polygonaceae)	Acetone	13.3	1
Artocarpus incisus (Thunb)L.f. Breadfruit (Moraceae)	Acetone	80.0	6

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Asclepias curassavica L. Red Head (Asclepiadaceae)	Acetone	6.7	0
Azadirachta indica A.Juss. Neem (Meliaceae)	Ethanol	23.3	2
Blighia sapida Konig Ackee (Sapindaceae)	Ethanol	20.0	1
Brosimum alicastrum Sw Breadnut (Moraceae)	Acetone	3.3	0
Cannabis sativa L. Indian Hemp/Ganja (Cannabinaceae)	Acetone	0.0	1
Capsicum annuum L. Scotch Bonnet Pepper (Solanaceae)	Ethanol	98.7	6
Capsicum baccatum L. Bird Pepper (Solanaceae)	Ethanol	10.0	0
Cassia alata L. King of the Forest (Caesalpinaceae)	Acetone	3.3	0
Cassia occidentales L. Piss a Bed (Caesalpinaceae)	Ethanol	20.0	1
Catharanthus roseus (L.)G.Don. Periwinkle (Apocynaceae)	Acetone	23.3	2
Cayaponia racemosa (Mill.)Cogn. Wild Cerasee (Cucurbitaceae)	Acetone	0.0	0

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Cecropia peltata L. Trumpet Tree (Moraceae)	Ethanol	6.7	0
Coffea liberica Bull. Liberian Coffee (Rubiaceae)	Ethanol	10.0	0
Cola acuminata Beauv. Kola Nut (Sterculiaceae)	Acetone	10.0	0
Crescentia cujete L. Calabash (Bignoniaceae)	Ethanol	0.0	0
Curcuma domestica Valeton Curry Plant (Zingiberaceae)	Acetone	0.0	0
Cuscuta americana L. Love Bush (Convolvulaceae)	Ethanol	0.0	0
Datura stramonium L. Thorn Apple (Solanaceae)	Ethanol	13.3	1
Dieffenbachia sequine (Jacq.)Schott. Dumb Cane (Araceae)	Acetone	6.7	0
Ervatamia divaricata L. Coffee Rose (Apocynaceae)	Acetone	16.7	1
Erythrina corallodendrum L. Birch (Papilionaceae)	Ethanol	20	1
Eupatorium odoratum L. Jack in the Bush (Compositae)	Acetone	0	0

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Euphorbia pulcherrima Willd. Poinsettia (Euphorbiaceae)	Ethanol	16.7	1
Fagara elephantiasis (Macf.)Krug.& Urb. Yellow Sanders (Rutaceae)	Ethanol	36.7	2
Ficus perforata L. Wild Fig (Moraceae)	Ethanol	23.3	2
Guaiacum officinale L. Lignum vitae (Zygophyllaceae)	Acetone	6.7	0
Gliricidia sepium (Jacq.)Kunth. St.Vincent, Growing Stakes (Papilionaceae)	Ethanol	60	4
Haematoxylum campechianum L. Logwood (Caesalpinaceae)	Ethanol	0	0
Hibiscus rosa-sinensis L. Shoe Black (Malvaceae)	Ethanol	66.7	5
Hyptis verticillata Jacq. John Charles (Labiateae)	Acetone	0	0
Ipomoea fistulosa Mart. Morning Glory (Convolvulaceae)	Ethanol	16.7	1
Justicia pectoralis Jacq. Fresh Cut (Acanthaceae)	Acetone	6.7	0
Lantana camara L. White Sage (Verbenaceae)	Acetone	3.3	0

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Lantana urticifolia Mill. Black Sage (Verbenaceae)	Acetone	3.3	0
Lastreopsis effusa Fine Fara (Polypodiaceae)	Ethanol	23.3	2
Leucaena leucocephala(Lam.DeWit Leucaena (Mimosaceae)	Acetone	6.7	0
Mangifera indica L. Mango (Anacardiaceae)	Ethanol	20	1
Momordica charantia L. Wild Cerasee (Cucurbitaceae)	Acetone	16.7	1
Nerium oleander L. Oleander (Apocynaceae)	Acetone	13.3	1
Nicotiana tabacum L. Tobacco (Solanaceae)	Ethanol	100	6
Ocimum micranthum Willd. Wild Barsely (Labiatae)	Acetone	6.7	0
Oreopanax capitatus(Jacq.)Decne. Woman Wood (Araliaceae)	Ethanol	20	1
Persea americana Mill. Avocado (Lauraceae)	Ethanol	26.7	2
Petiveria alliacea L. Guinea Hen Weed (Phytolaccaceae)	Ethanol	36.7	2

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Pimenta dioicia (L)Merr. Pimento (Myrtaceae)	Acetone	23.3	2
Piper amalago L. Black Jointer (Piperaceae)	Acetone	0	0
Picrasma excelsa(Sw.)Planch. Bitterwood (Simaroubaceae)	Acetone	3.3	0
Piscidia piscipula (L.)Sarg. Dogwood (Papilionaceae)	Ethanol	40	0
Ricinus communis L. Castor Oil (Euphorbiaceae)	Acetone	13.3	1
Rytidophyllum tomentosum (L.)Mart. Search Mi Heart (Gesneriaceae)	Acetone	6.7	0
Salvia serotina L. Chicken Weed (Labiatae)	Acetone	3.3	0
Sansevieria spp. Tiger Cat (Liliaceae)	Acetone	3.3	0
Sida spp. Broomweed (Malvaceae)	Ethanol	30.0	2
Spathodia campanulata Beauv. African Tulip Tree (Bignoniaceae)	Acetone	0.0	0
Simarouba glauca DC Bitter Damsel (Simaroubaceae)	Acetone	3.3	0

Species, Family and Common Name	Solvent	Percent Mortality	Grade
Tecoma stans (L.)Kunth. Jamaica Lilac (Bignoniaceae)	Ethanol	13.3	1
Thespesia populnea (L) Solander Seaside Mahoe (Malvaceae)	Ethanol	26.7	2
Tragia volubilis L. Twining Cowitch (Euphorbiaceae)	Acetone	13.3	1
Urena lobata L. Bar Mallow (Malvaceae)	Acetone	20.0	1
Urechites lutea (L.)Britton Night Sage (Apocynaceae)	Acetone	13.3	1
Vernonia acuminata Less. Bitter Bush (Compositae)	Ethanol	26.7	2
Verbenesa hasta Vervine (Verbenaceae)	Acetone	6.7	0
Vetiveria zizanioides (L.)Nash Khus Khus (Gramineae)	Ethanol	3.3	0
Wedelia gracilis L. Consumption Weed (Compositae)	Ethanol	3.3	0
Zingiber officinale Roscoe Ginger (Zingiberaceae)	Acetone	6.7	0

Grades 0, 1, 2, 3, 4, 5, and 6 represents 0 to 10, 11 to 20, 21 to 40, 41 to 50, 51 to 60, 61 to 70, and 71 to 100% mortality respectively.