Kasetsart J. (Nat. Sci. Suppl.) Vol. 25, : 106-110 (1991)

Insecticidal Activity of Plant Crude-extracts on Diamondback Moth Larvae

Neungpanich Sinchaisri [1], Dumre Roongsook [1] and Narong Chungsamarnyart [2]

ABSTRACT

Fortynine ethanol crude extracts from 44 plant species were tested for the insecticidal activity on third instar diamondback moth larvae under laboratory conditions. Three plant extracts (20 mg/ml conc.) showed high insecticidal activity (100% mortality of larvae): *Annona muricata* seeds, *Annona squamosa* seeds and *Stemona collinsae* roots.

Keywords: insecticide, Plant crude-extracts, Diamondback moth larvae

INTRODUCTION

The diamondback moth larvae (*Plutella xylostella*) is one of the most important vegetable insects (Bonnamaison, 1965; Areekul, 1966; Talekar et al., 1985) and they can develop resistant strains (Miyata et al., 1986, 1988; Rushtapakornchai and Vattanatangum, 1986). Therefore, it is necessary to continue screening insecticidal plant extracts effective against the diamondback moth larvae to discover new insecticidal plants (Sinchaisri et al., 1990).

MATERIALS AND METHODS

Forty nine plant samples from 44 plant species were extracted with 95% ethanol. The crude-extracts were tested for insecticidal activity on diamondback moth larvae by the same method as previous works (Sinchaisri et al., 1988, 1990). The concentration of crude-extract was 20 mg/ml of dissolving solvent (containing 13 ml distilled water, 8 ml ethanol, 26 ml acetone, 4 ml ethyl acetate, 0.04 ml Linoh^R spreader and add up to 100 ml with 70% ethanol). The effective extract was tested again with 10 mg/ml and 5 mg/ml concentrations. The control treatment was a mixture of dissolving solvent and 70% ethanol. Abbott's formula (Abbott, 1925) was used to calculate the corrected mortality of larvae.

RESULTS

The extracts from the seeds of *Annona muricata* and *Annona squamosa*, and from the roots of *Stemona collinsae* exhibited 100% corrected mortality of larvae with 20 mg/ml concentration of ethanol extracts (Table 1). The larvae died with no eating lesions on the cabbage leaf coated with extract (20 mg/ml conc.) of *A. muricata* and *A. squamosa*, but the larvae ate the leaf coated with the lower concentration extract (5 and 10 mg/ml conc.) (Table 2). The larvae ate the leaf coated with the extract of *S. collinsae* even at a high concentration (20 mg/ml) (Table 1).

In addition, the crude-extract of *Schefflera leucantha* and *Cymbopogon nardus* showed a tendency for repellent action. The *Alpinia galanga* extract showed no insecticidal activity (Table 1), but showed phytotoxic lesions on the cabbage leaf after application.

DISCUSSION

The toxicity of *A. muricata* and *A. squamosa* to insects has been shown in many previous reports, especially *A. squamosa*. The extract of *A. muricata* seeds has shown insecticidal activity on the pea aphid (*Acyrthosiphum pisum*), the Chrysanthemum aphid

1 Department of Entomology, Faculty of Agriculture, Kasetsart University, Bangkok 10900, Thailand.
2 Environmental Science Unit, Central Laboratory and Greenhouse Complex, Research and Development Institute, and Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Kasetsart University, Kanphaengsaen Campus, Nakhon Pathom 73140, Thailand.

Table 1 Insecticidal screening of plant crude-extracts against the third instar diamondback moth larvae.*

Plant scientific name (and Thai name)	Plant parts	Corrected mortality (mean, %) at 72 h**
Acanthus ebracteatus Vahl. (Gnueak-pla-moo)	L	0.0
Aganosma marginota (Sai-ton)	L	0.0
Agave sp. (A-ga-ve)	L	0.8
Albizzia lebbecloides Benth. (Kaang, Phuek)	L	0.0
Alpinia officinarum Hance (Kha-taa-daeng)	D Rh	0.0
Annona muricata L. (Thu-rian-thet)	S	100.0
Annona squamosa L. (Noi-naa)	S	100.0
Azadirachta indica J.V.S. (Sa-daao-in-dia)	L & Br	0.0
Barleria cristata L. (Ang-gaap)	L & F	0.0
Caesalpinia pulcherrima L. Swartz. (Haang-nok-yoong-thai)	F	0.0
Calotropis procera R.Br. (Ruk-dook-khao)	L & St	0.0
Caryota mitis Lour. (Tao-rang-daeng)	L	0.0
Caryota mitis Lour. (Tao-rang-daeng)	Fr	0.0
Cassia alata L. (Chum-hed-thed)	L & St	0.0
Cassia fistula L. (Kuun)	F	0.0
Coccinia indica W & A (Tam-lueng)	L	0.0
Cymbopogon nardus Rendle. (Tra-khai-hom)	L & St	0.0
Erythrina orientalis (L.) Merr. (Thong-laang)	L	0.0
Garcinia mangostana L. (Mang-kud)	Ri	0.0
Harrisonia perforata Meer (Naam-see-phan)	L & St	0.0
Hibiscus esculentus L. (Kra-cheap-khao)	Fr	0.0
Holarrhena antidysenterica W. (Mok-yai)	L	0.0
Ipomoea pes-caprae Sweet (Phak-bong-ta-ley)	W P	0.0
Jatropha curcas L. (Sa-buu-dam)	St	0.0
Jatropha curcas (Sa-buu-dam)	L	0.0
Lagerstroemia floribunda Jack (Ta-baek)	F	0.0

Table 1 Insecticidal screening of plant crude-extracts against the third instar diamondback moth larvae.* (con't)

Plant scientific name (and Thai name)	Plant parts	Corrected mortality (mean, %) at 72 h**
Listsea glutinosa (Mei-mehn)	L	0.0
Malachra alceifolia	L	0.0
Melia azedarach L. (Lian)	B	0.0
Melia azedarach L. (Lian)	B R	0.0
Melia azedarach L. (Lian)	L	0.0
Melia azedarach L. (Lian)	F	0.0
Microtoena insauvis (Hance) (Kham-pong)	L & St	0.0
Morinda citrifolia L. (Yoa)	L	0.0
Niebuhria siamensis Kurz. (Jaeng)	L	0.0
Pedelanthus tithymaloides Poit. (Sa-yaek)	W P	0.0
Peltophorum pterocarpum B ex H (Non-three)	F	0.0
Plumeria rubra L. (Lan-tom-daeng)	F	0.0
Premna latifolia Roxb. (Muu-man)	L	0.0
Sansevieria sp. (Lin-mang-kon)	L	0.0
Scheffera leucantha Vig. (Ha-nu-maan-pra-sarn-guy)	L	0.0
Setcreasea purpurea Boon. (Hua-jai-see-muang)	L & Br	0.0
Stachytarpheta jamaicensis (Phan-gnuu-keaw)	W P	0.0
Stemona collinsae Craib (Non-taay-yaak)	R	100.0
Strychnos nus-vomica L. (Sa-laeng-chai)	L	0.0
Tabebuia pentaphylla Hemsl. (Chom-puu-phan-tip)	F	0.0
Tacoma stans Juss (Thong-urai)	Fr	0.0
Tinospora crispa (L.) M. ex H.& T (Boa-ra-phet)	St	0.0
Wedelia trilobata L. Hitchc. (Gra-dum-tong-luei)	W P	0.0

* All treatments were performed in a constant temperature of 25 ±2 °C and 18L : 6 D

** Mean (%) of corrected mortality of 3 replications at 72 h after treatment.

B, Stem bark; B R, Bark roots; Br, branches; F, Flower; Fr, Fruits; L, Leaves; R, Roots; Rh, Rhizome; Ri, rind; S, Seeds; St, Stems & branches; WP, Whole plant.

(*Macrosiphoniella sanborni*), the armyworm (*Pseudaletia unipuncta*), the southern armyworm (*spodoptera eridania*) and antifeedant activity on the yellow fever mosquito (*Aedes aegypti*) and the black carpet beetle (*Attagenus piceus*) (Grainge and Ahmed, 1988). However, its insecticidal activity has not yet been reported against the diamodback moth larvae. The present work found that the insecticidal activity of *A. muricata* extract was found in contact poisoning at 20 mg/ml concentration, since the larvae did not eat the extract-coated leaf. There might also be stomach poisoning action at lower concentrations (5 and 10 mg/ml conc.)

The extract of *A. squamosa* (20 mg/ml conc.) also showed high mortality of the larvae since there were no eating lesion on the leaf (Table 1). Therefore, the insecticidal activity of *A. squamosa* seeds might also be by contact poisoning. The contact poisoning action of *A. squamosa* seed extracts has previously been found for the yellow fever mosquito (*Aedes aegypti*), the black bean aphid (*Aphis fabae*), the chrysanthemum aphid (*Macrosiphoniella sanborni*), the potato aphid (*Macrosiphum solanifolii*), the brown planthopper (*Nilaparvata lugens*) and the larvae and adult tropical cattle ticks (Grainge and Ahmed, 1988; Chungsamarnyart et al., 1988, 1990). The extract of *A. squamosa* seeds also exhibited the stomach poisoning action on aphids, pumpkin beetles (*Aulacophola hilaris*), silkworms (*Bombyx mori*), cabbage aphids (*Brevicoryne brassicae*), sawflies (*Phymatocera aterrima*) and diamondback moth larvae (*Plutella xylostella*) (Grainge and Ahmed, 1988). The present work also found eating lesions at lower concentration (10 and 5 mg/ml conc.). This indicates that the low concentrations may work both by stomach and contact poisoning actions. Non identified insecticidal action of *A. squamosa* extracts has been found with regard to the Azuki bean beetle (*Callobruchus chinensis*), the red cotton stainer (*Dysdercus koenigii*), the false cabbage aphid (*Lipaphis erysimi*), the cotton leafworm (*Spodoptera litura*), and the drugstore beetle (*Stegobium paniceum*) (Grainge and Ahmed, 1988). The water distillation of seeds had a moderately high toxicity on the oriental fruit fly, but distillated seed oils or petroleum ether extract had very low toxicity (Areekul et al., 1987). The antifeedant activity of *A. squamosa* extracts has also been demonstrated with regard to the black carpet beetle (*Attagenus piceus*), the rice green leafhopper (*Nephotettix virescens*), the rice weevil (*Sitophilus oryzae*), the white-backed planthopper (*Sogatella furcifera*), and the webbing clothes moth (*Tineola bisselliella*) (Grainge and Ahmed, 1988). The cytotoxic substance from petroleum ether extract of the seeds has been named squamocin (Fujimoto et al., 1988). The ethanol extract from bark also contains the acetogenin which has shown a high degree of lethality to nauplii in the brine shrimp test (Li et al., 1990). However, the active insecticidal substance for the diamondback moth should be elucidated.

The larvae died after eating the leaves coated with *Stemona collinsae* extract, demonstrating that the extract of *S. collinsae* acts through stomach poisoning. The extract of *S. collinsae* roots has shown insecticidal activity on maggots (Grainge and Ahmed, 1988), and larvae and adults of tropical cattle ticks (*Booplilus microplus*) (Chungsamarnyart et al., 1988, 1990). The active insecticidal substances against diamondback moth larvae has already been identified as stemofoline and dehydrostemofoline (Jiwajinda, 1991).

Table 2 Insecticidal activities of highly effective plant crude-extracts against the third instar dismondback moth larvae at various concentrations.*

Plant scientific name (and Thai name)	Plant parts	Corrected mortality (mean, %)** 5 mg/ml	10 mg/ml
Annona muricata L. (Thu-rian-thet)	S	43.0	60.0
Annona squamosa L. (Noi-naa)	S	46.7	70.0
Stemona collinsae Craib (Non-taay-yaak)	R	26.7	50.0

* All treatments were performed in a constant temperature of 25±2 °C and 18L : 6 D

** Mean (%) of corrected mortality of 3 replications at 72 h after treatment.

R, Roots; S, Seeds

ACKNOWLEDGEMENT

The authors are grateful to Dr. Sachihiko Mitsuoka, Long Term Expert of JICA, for his kind reviewing of the manuscript. The authors wish to thank Mr. Yingyong Paisooksantivatana and Mr. Pongsak Poltree, Botany section, Botany & Weed Science Division, Department of Agriculture, Ministry of Agriculture and Co-operatives for their help in plant identification.

LITERATURE CITED

Abbott, W.S. 1925. A method of computing the effectiveness of an insecticide. J. Econ. Entomol. 18:265-267.

Areekul, S. 1966. The diamondback moth, a serious problem of growing cruciferous vegetables in Thailand. Kasitkorn 39(3):257-262. (In Thai).

Areekul, S., P. Sinchaisri and S. Tigvatananon. 1987. Effect of Thai plant extracts on the oriental fruit fly. I. Toxicity test. Kasetsart J. (Nat. Sci.) 21, 395-407.

Bonnmaison, L. 1965. Insect pests and their control. Ann. Rev. Entomol. 10:233-256.

Chungsamarnyart, N., S. Jiwajinda, W. Jansawan, U. Kaewsuwan and P. Buranasilpin. 1988. Effective plant crude-extract on the tick (*Boophilus microplus*). I. Larvicidal action. Kasetsart J. (Nat.Sci.) 22, suppl., 37-41.

Chungsamarnyart, N., S. Jiwajinda, W. Jansawan. 1990. Effects of plant crude-extracts on the cattle ticks (*Boophilus microplus*). Insecticidal action I. Kasetsart J. (Nat.Sci.) 24, suppl., 28-31.

Fujimoto, Y., T. Eguchi, K. Kanimura, N. Ikekawa, M. Sahai and Y.K. Gupta. 1988. Squamocin, A new cytotoxic Bis-tetrahydrofuran containing acetonin from *Annona squamosa*. Chem. Pharm. Bull. 36 (12), 4802-4806.

Grainge M. and S. Ahmed. 1988. Handbook of plants with pest-control properties. John Wiley and Sons. New York Chiches. Brisb. Torant. Singap

Jiwajinda, S. 1991. Bioactive compounds from tropical plants. MS thesis, Kyoto University. pp. 7-17.

Li X.-H., Y.-H. Hui, J.K. Rupprecht, Y.-H Liu, K.V. Wood, D.L. Smith, C.-J. Chang, and J.L. McLaughlin. 1990. Bullatacin, bullatacinone, and squamone, A new bioactive acetonin, from the bark of *Annona squamosa*. J. Nat. Prod. 53, 81-86.

Miyata, T., N. Sinchaisri, B. Sayampol., W. Rushtapakornchai, and A. Vattanatangum. 1988. Insecticide resistance patterns. Report meeting of the joint research project "Insect toxicological studies on resistanc to insecticides and integrated control of the diamondback moth", March 19-21, 1988, at Rama Garden Hotel, Bangkok, Thailand., pp. 10-19.

Miyata, T., T. Saito, and V. Noppun. 1986. Studies on the machanism of diamondback moth resistance to insecticides. *In* Diamondback moth management. Ed. by N.S. Talekar and T.D. Griggs, AVDRC, Taiwan, pp. 347-358.

Rushtapakornchai, W., and A. Vattanatangum. 1986. Present status of insecticide control of diamondback moth in Thailand. In Diamondback moth management (Ed. by N.S. Talekar and T.D. Griggs), AVDRC, Taiwan, pp. 307-312.

Sinchaisri, N., D. Roongsook, and S. Areekul. 1988. Botanical repellent against the diamondback moth, *Plutella xylostella* L. Kasetsart J. (Nat. Sci. Suppl.) 22, 71-74.

Sinchaisri, N., D. Roongsook, and N. Chungsamarnyart. 1990. Efficacies of plant crude-extracts on the diamondback moth larvae. Kasetsart J. (Nat. Sci.) 24, suppl., 49-53.

Talekar, N.S., H.C. Yang, S.T. Lee, B.S. Chen, and L.Y. Sun. 1985. Annotated bibliography of diamondback moth. Tropical Vegetable Information Service, AVRDC, Taiwan. 469 p.