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Efficacies of Plant Crude-extracts on the Diamondback Moth Larvae

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ABSTRACT

Forty three crude-extracts from 40 plant species were bioassayed *in vitro* on the insecticidal activity to the third instar diamondback moth larvae. The highly effective insecticidal activities (80-100% mortality of larvae at 40 mg/ml of crude-extract) were found in *Abrus precatarius* Linn., *Acorus calamus* Linn., and *Duranta repens* Linn. The moderate insecticidal activities (60-79% mortality of larvae) were observed in *Aglaia odorata* Lour. and *Bixa orellana* Linn. The low activity (40-59% mortality) was shown in *Cassia spectabilis* DC. and the very low activity (20-39% mortality) in *Andrographis paniculata* Wall ex Nees.

INTRODUCTION

The larvae of diamondback moth, *Plutella xylostella* L. is the important vegetable insect (Bonnmaison, 1965; Areekul, 1966;Talekar *et al.*, 1985). Control of the insect has become a serious problem since it can be resistant to many synthetic insecticides (Miyata *et al.*, 1986, 1988; Rushtapakornchai and Vattanatangum, 1986). Therefore, the study of effective natural products from plants is necessary to substitute those synthetic insecticides since they might have low toxicity to mammals and rapid degradation of toxicity. The present study is to find the plant crude-extracts which can be used as insecticides for controlling the diamondback moth.

MATERIALS AND METHODS

Forty three ethanol crude-extracts were bioassayed on the insecticidal activity to diamondback moth larvae by the same procedure as described in previous work (Sinchaisri *et al.*,1988). Two grams of the crude extracts were dissolved in a series of solvents consisting of 13 ml of distilled water, 8 ml of ethanol, 26 ml of acetone, 4 ml of ethyl acetate. After the crude extract had been completely dissolved, 0.04 ml of spreader (Linoh® , Nihon Noyaku Co.) was added and then made up to 100 ml with 70% ethanol. The concentration of the crude extracts became 20 mg/ml. The control solution was only the mixed dissolving solvents and spreader. Ten larvae (third instar) of diamondback moth were used in each replicate. The Abbott's formula (Abbott,1925) was used for calculation of the corrected mortality of larvae. The effective one was retested again with 40 mg/ml and 60 mg/ml concentrations. All experiments were replicated 3 times.

RESULTS

Table 1 shows the corrected mortality of diamondback moth larvae at 72 h after treatment with 20 mg/ml concentration of crude-extract. Seven plant species from the total of 40 spp. showed the insecticidal activity against the diamondback moth larvae. They were *Abrus precatorius* Linn., *Acorus calamus* Linn., *Aglaia odorata* Lour., *Andrographis paniculata* wall ex Nees, *Bixa orellana* Linn., *Cassia spectabilis* DC., and *Duranta repens* Linn.

These effective plant crude-extracts were further tested for insecticidal activity with higher concentration (40 mg/ml and 60 mg/ml) as shown in Table 2. The crude-extracts from the seeds of *Abrus precatorius* Linn., the leaves of *Duranta repens* Linn. and the rhizome of *Acorus calamus* Linn. showed the high insecticidal activities. The moderate insecticidal activities were found in the crude-extracts of the *Aglaia odorata* Lour. leaves and the *Bixa orellana* Linn.

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seeds. While the crude-extract from the leaves of *Cassia spectabilis* DC. exhibited low activity. The crude-extract from the leaves of *Andrographis paniculata* Wall ex Nees had very low activity.

In addition, it was found that the crude-extracts of *Aglaia odolata* and *Andrographis paniculata* showed the tendency of antifeedant action, since the larvae did not eat the cabbage leaf dippied with higher concentration of crude-extract. The crude-extract of *Acorus calamus* was phytotoxic to the cabbage leaf. It exhibited 20%, 98%, and 100% phytotoxic at 20 mg/ml, 40 mg/ml, and 60 mg/ml of crude-extract respectively.

Table 1 The insecticidal activities of ethanol plant crude-extracts against the third instar diamondback moth larvae *in vitro*.[1]

Botanical name (Thai name)	plant parts	Corrected mortality (Mean,%) at 72 h[2]
Abrus precatorius Linn. (Ma-glum-ta-nuu)	seed	56.70
Acorus calamus Linn. (Wan-naam)	Rhizome	63.30
Achyranthes aspera Linn. (Pan-nguu)	Whole plant	0.80
Aglaia odorata Lour. (Pra-yoong)	Leaf	43.30
Andrographis paniculata Wall ex Nees (Faa-ta-lai)	Stem & leaf	13.30
Annona squamosa Linn. (Noi-naa)	leaf	0.00
Argyreia capitiformis (P.) Oosttz. (Fon-saen-haa)	Stem & leaf	0.00
Artocarpus communis Forst. (Kanoon-sum-palaw)	Leaf	0.80
Azima sarmentosa Benth & Hook	Root	0.00
(Naam-pong-doa)	Leaf	0.00
Bauhinia purpurea (Chong-koo)	Flower	0.00
Bixa orellana Linn.	Seed	13.30
(Kum-seed)	leaf	0.00
Blumea aurita D.C. (Saap-raeng-saap-ka)	Whole plant	0.00
Blumea balsamifera D.C. (Naad-yai)	Leaf	0.80
Boerhavia erecta Linn. (Yaa-noed-meaw)	Stem & leaf	0.90
Calophyllum inophyllum Linn. (Kra-ting)	Leaf	0.00
Calotropis gigantea R.Br. (Rug-doog-moung)	Stem & leaf & flower	0.00
Cassia fistula Linn. (Koon)	Mature pod	0.00
Cassia spectabilis DC. (Kei-leag-america)	Leaf	23.30

Table 1 The insecticidal activities of ethanol plant crude-extracts against the third instar diamondback moth larvae *in vitro*.[1] (con't)

Botanical name (Thai name)	plant parts	Corrected mortality (Mean,%) at 72 h[2]
Cleome viscosa Linn. (Phuk-sean-pee)	Stem & leaf	0.00
Datura metel Linn. (Lum-poong)	Leaf	0.80
Duranta repens Linn. (Tien-yod)	Leaf	73.30
Eupatorium odoratum Linn. (Sarb-seir)	Stem & leaf	0.80
Euphobia heterophylla Linn. (Phug-boung-yaang)	Whole plant	0.00
Euphobia hirta Linn. (Nam-nom-raas-cha-sri)	Leaf	0.00
Gynandropsis gynandra (L.) Briq. (Phug-sean)	Stem & leaf	0.00
Homalomena rubercens Kunth. (Sa-nae-jan-deang)	Leaf	0.00
Hyptis suaveolens Poit. (Maeng-kaa-lug)	Leaf	0.00
Jatropha gossypifolia Linn. (Sabu-deang)	Stem	0.00
Lagascea mollis Cav. (Yaa-gum-ma-yee)	Stem & leaf	0.00
Lantana camara Linn. (Pha-gaa-grong-paa)	Leaf	3.30
Luffa cylindrica L. Roem. (Boub-glom)	Fruit	0.00
Mimosa pigra Linn. (Mai-yaa-raap-yag)	Leaf	0.00
Ocimum sanctum L. Var. nir. Baek	Leaf	0.00
(Gra-praow-phee)	Stem	0.00
Plumeria rubra Linn. (Lun-tom-deang)	Leaf	0.00
Polygonum tomentosum Willd (Oeng-ped-maa)	Leaf & Flower	0.00
Portulaca oleracea Linn. (Phug-beay-yai)	Stem & leaf	0.00
Ruellia tuberosa Linn. (Toiy-ting)	Flower	0.00
Sphenoclea zeylanica Gaerth. (Phug-pord-na)	Stem & leaf	0.00
Synedrella nodiflora Gaerth. (Phug-kaerd)	Stem & leaf	0.00
Tridax procumbens Linn. (Teen-tug-kae-suphanburi)	Whole plant	0.00

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

2 The data are the mean (%) of corrected mortality of the moth larvae of 3 replications at 72 h after treatment.

Table 2 **Insecticidal activities of highly effective plant crude-extracts against the third instar diamondback moth larvae *in vitro* at 40 mg/ml and 60 mg/ml concentrations[1].**

Botanical name (Thai name)	Plant parts	Corrected mortality (Mean,%)[2]	
		40 mg/ml	60 mg/ml
Abrus precatorius Linn. (Ma-glum-taa-nuu)	Seed	96.60	100.00
Acorus calamus Linn. (Wan-naam)	Rhizome	80.00	100.00
Aglaia odorata Lour. (Pra-yoong)	Leaf	76.70	100.00
Andrographis paniculata Wall ex Nees (Faa-ta-lai)	Whole plant	23.30	60.00
Bixa orellana Linn. (Kum-saed)	Seed	60.00	100.00
Cassia spectabilis DC. (Kei-leg-america)	Leaf	53.30	76.70
Duranta repens Linn. (Tien-yod)	Leaf	83.30	100.00

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

2 The data are the mean (%) of corrected mortality of the moth larvae of 3 replications at 72 h after treatment.

DISCUSSION

The insecticidal activity of *Abrus precatorius* seeds had been already bioassayed on mosquitoes, grasshopper (Grainge and Ahmed, 1988), and cattle tick larvae (Chungsamarnyart *et al.*,1988). The ethanol crude-extract of these seeds also had insecticidal activity on diamondback moth larvae (Table 2). It showed higher toxicity on the moth larvae than the tick larvae. Unfortunately, the present paper could not demonstrate that this larvicidal compound was the toxic substance to human, toxalbumin, heat labile substance, "Abrin", or not. However, it should not be used practically for the moth control.

The larvicidal and insecticidal activity of *Acorus calamus* rhizome extract had been investigated against other insects. Its extract showed toxicity to the *Musca nebulo* and *Culex fatigans* (Dixit, *et al.*,1956) and also to *Musca domestica* and *Aedes aegypti* (Anonymous, 1975), but it had low toxicity to fruit fly (Areekul, *et al.*, 1987). The ethanol extracted of *A. calamus* exhibited high contact poison to the cattle tick larvae (Chungsamarnyart *et al* ., 1988), and also high toxicity to diamondback moth larvae (Table 2).

The ethanol extract of *Duranta repens* leaves had never been bioassayed on diamonback moth larvae. It showed high toxicity on the moth larvae (Table 2). The toxic substance of its leaves might be similar compounds as in the previous works on *Aedes aegypti* and that of fruit extract on mosquitoes (Grainge and Ahmed, 1988). The fruit extract also has antifeedant activity on black carpet beetle (Grainge and Ahmed, 1988). The active substance of this plant is further studied on its chemical structure and activity.

The insecticidal activity on the moth larvae of *Aglaia odoranta* leaf extracted and *Bixa orellana* seed extracts (Table 2) have not been reported. The previous investigation found that the fruit extracted of *Bixa orellana* had repellent activity on mosquitoes (Grainge and Ahmed, 1988). The ethanol extract of *B. orellana* seeds showed lower larvicidal activity than that of the leaves on the cattle tick larvae (Chungsamarnyart *et al.*, 1988). However, the higher concentration of these two plants at 60 mg/ml also showed high toxicity on the diamondback moth larvae. This high toxicity of *Aglaia odorata* might be its antifeedant activity that the larvae could not eat the cabbage leaf. The purification of the active substance and determination of its chemical structures of these two plants are also being studied.

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