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Effects of Thai Plant Extracts on the Oriental Fruit Fly

II. Repellency Test.

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ABSTRACT

The repellent potency of plant extracts to the Oriental fruit fly,*Dacus dorsalis*, was determined on the basis of the rate of oviposition on cups containing 20% of citrus juice and coated outside with a mist spray of one gram equivalent of each plant extract per cup. One hundred and thirty extracts from 110 kinds of plants among which 97 were known species and 13 unknown were tested. Fifteen day old female flies which were known to lay high numbers of eggs were used in this experiment.

Plant extracts which exhibited high repellency to the oviposition of the female flies were obtained from *Azadirachta indica* var. *siamensis* Veleton, *Bixa orellana* Linn., *Citrus hystrix* D.C., *Cucumis melo* Linn., *Cymbopogon citratus* Stapf., *Hedychium coccineum* var. *angustifolium* Roxb., *Heliotropium indicum* R. Br., *Homalomena* sp., *Ocimum gratissimum* Linn., *Ricinus communis* Linn., and *Ternstroemia japonica* Thunb. Among the unidentified species, they included En-Luang and Phra-Taba.

Moderate levels of repellency were obtained from extracts of *Allium sativum* Linn., *Melodorum fruticosum* Lour, and Meha-Kamlang. Mild repellent to the oviposition of the flies was exhibited by plant part extracts of the following species: *Acharas sapota* Linn., *Alpinia siamensis* Schum., *Andrographis paniculate* Wall. ex Nees, *Anona squamosa* Linn., *Anthemis nobilis* Linn, *Bougainvillea spectabilis* Willd., *Cinnamomum siamense* Craib., *Cinnamomum zeylanicum* Linn., *Curcuma comosa* Roxb., *Curcuma longa* Linn. (= *C. domestica* Veleton), *Curcuma zedoaria* Roxae, *Elholtzia blanda* Benth., *Eupatorium adenophorum* Spreng., *Jatropha curcas* Linn., *Jatropha gossypifolia* Linn., *Litsea cubeba* Pers., *Mentha cordifolia* Opiz., *Momordica charantia* Linn., *Myristica fragrans* Linn., *Piper sarmentosum* R. ex H., *Portulaca pilosa* Linn., *Quisqualis indica* Linn., *Stemona tuberosa* Lour., and *Tinospora crispa* Miers. Of the unidentified species, they included Gai-Khan, Kan-Tha-Mala, Lai-Ma, Ma-Haw, and Maurakot.

INTRODUCTION

Female fruit flies, *Dacus dorsalis* Hendel, oviposit under the skin of ripe fruits and upon hatching the larvae feed and damage the inside of the fruits. A successful control method is possible when any chemical or substance has the power to prohibit effectively the female flies from laying eggs. Therefore, the emphasis in this experiment has been to test the repellent potency of plant extracts against the oviposition of the female flies.

MATERIALS AND METHODS

Extraction procedures from plant materials have been described previously (Areekul *et al,* 1987). One hundred and thirty extracts

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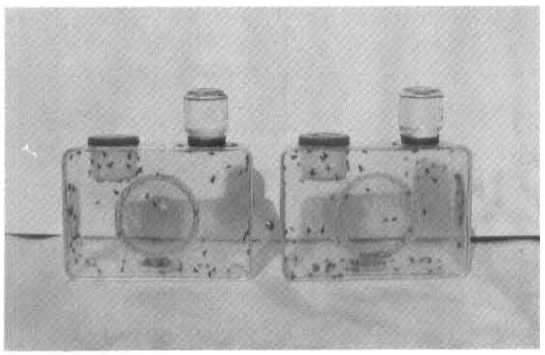

Figure 1 Oviposition cages used in the repellency test.

from 110 plant species were used in this test. Two ml of plant extract or 1 gm equivalent was sprayed on the external side of each oviposition cup using a topical mist machine at a pressure 15 lb per square inch. Water was used for spraying the check cups. The oviposition cups were plastic, 6 cm in diameter and 5.5 cm in depth, containing 50 oviposition holes. After spraying, each cup was filled up with five ml of 20% citrus juice, and was fixed inside the oviposition cage. These oviposition cages consisted of plastic boxes, each 17 × 25 × 9 cm in size and a wire screen sheet covering 10 cm diameter hole on the lid (Fig. 1) Water in a bottle was supplied for the flies on the top of each cage. One hundred adult flies, 15 days old and equal in number of both sexes, were placed inside each oviposition cage and were allowed to lay their eggs on the cup for 24 hours. The flies at this age were used because they were known to produce high rate of oviposition. The number of eggs deposited by the flies in each treatment was counted and compared with the check. The experiment was replicated three times. The percentages of relative oviposition were calculated by using the following formula:

$$\% \text{ relative oviposition} = \frac{\text{number of eggs in treatment}}{\text{number of eggs in check}} \times 100$$

The repellent potency of plant extracts was classified into seven groups based on the % relative oviposition as follows: Class VH = 39% to lower, very high; class H = 40 – 49%, high; class MH = 50 – 59%, moderately high; class M = 60 – 69%, moderate; class ML = 70 – 79%, moderately low; class L = 80 – 89%, low; and class N = 90 – 100%, non response. Only the results of class VH to L are shown in Table 1.

RESULTS AND DISCUSSION

Results of the repellency tests of 130 plant extracts from 110 plant species against the oviposition by 15 day old adult flies reveal that the numbers of plants which contained repellent active principles, ranging from very high to ineffective, were as follows : 6 very high, 1 high, 7 moderately high, 3 moderate, 16 moderately low, 17 low, and 80 ineffective (Table 1). Two or more classes were derived from some extracts of a plant species depending upon the plant part used for extraction and the solvents and methods of extraction.

In our review of the literatures, we found no research findings concerning the repellent action of plant extracts against the Oriental fruit fly. However a number of reports dealing with the repellency to other insects of some plants which were used in our tests were published by some workers. They will be discussed first by comparing with our results in the tests.

Dixit *et al.* (1965) reported that oil of *Acorus calamus* in combination with oil of *Curcuma* sp. or synthetic pine oil gave good protection against mosquitoes which were comparable to dimethyl phthalate in their repellent action. In our tests against the Oriental fruit fly oviposition using the petroleum extract of clones and steam volatile fraction of fresh leaves of *A. calamus* showed ineffective. All three species of *Curcuma* including. *C. comosa, C. longa,* and *C. zedoaria* which were tested, exhibited some active principles against the fly oviposition, but the results were generally low.

The common Indian neem tree, *Azadiracta*

Table 1 Repellency tests of plant extracts against the oviposition of 15 day old adult flies, *Dacus dorsalis* Hendel

Plant Species and plant parts	Methods of extraction & fraction	% Relative oviposition	Class
Achras sapota			
Dried Seeds	Rolling-Pet. Ether	77.23	ML
Allium sativum			
Fresh Bulbs	Rolling-Pet. Ether	86.07	L
	Distill.-Condensate	66.69	M
Alpinia siamensis			
Fresh Rhizomes	Soxhlet-Pet. Ether	86.20	L
Andrographis paniculata			
Whole Plants (except roots)	Soxhlet-Pet. Ether	85.45	L
Annona squamosa			
Dried Seeds	Soxhlet-Pet. Ether	76.40	ML
Anthemis nobilis			
Whole Plants (except roots)	Distill.-Condensate	79.70	ML
Azadirachta indica var. *siamensis*			
Fresh Leaves	Rolling-Pet. Ether	18.61	VH
Bixa orellana			
Dried Leaves	Soxhlet-Pet. Ether	59.36	MH
Bougainvillea spectabilis			
Dried Flowers	Soxhlet-Pet. Ether	79.32	ML
Cinnamomum siamense			
Fresh Leaves	Distill.-Condensate	79.61	ML
Cinnamonum zealanicum			
Fresh Leaves	Distill.-Condensate	79.61	ML
Citrus hystrix			
Fresh Leaves	Rolling-Pet. Ether	27.56	VH
Fresh Leaves	Distill.-Oil	57.97	MH
Cucumis melo			
Fresh Seeds	Distill.-Condensate	35.07	VH
Curcuma comosa			
Fresh Rhizomes	Distill.-Oil	71.79	ML
Curcuma longa			
Dried Rhizomes	Soxhlet-Pet. Ether	73.96	ML
Curcuma zedoaria			
Dried Rhizomes	Soxhlet-Pet. Ether	83.53	L
Cymbopogon citratus			
Fresh Leaves	Rolling-Pet. Ether Distill.-Oil	21.12	VH
Elsholtzia blanda			
Fresh Whole Plants (except roots)	Distill.-Condensate	89.78	L
Eupatorium adenophorum			
Fresh Leaves	Distill.-Condensate	79.04	ML
Hedychium coccineum var. *angustifolium*			
Fresh Rhizomes	Distill.-Condensate	30.17	VH
Heliotropium indicum			
Whole Plants (except roots)	Distill.-Condensate	30.66	VH

Table 1 (Cont.)

Plant Species and plant parts	Methods of extraction & fraction	% Relative oviposition	Class
Homalomena sp.			
Fresh Stems	Distill.-Condensate	75.08	ML
Dried Rhizomes	Soxhlet-Pet. Ether	50.37	MH
Jatropha curcas			
Dried Seeds	Soxhlet-Pet. Ether	87.53	L
Jatropha gossypifolia			
Dried Leaves	Soxhlet-Pet. Ether	75.98	ML
Litsea cubeba			
Fresh Leaves	Distill.-Condensate	85.34	L
Melodorum fruticosum			
Dried Leaves	Soxhlet-Pet. Ether	62.07	M
Mentha cordifolia			
Fresh Whole Plants (except roots)	Distill.-Condensate	88.07	L
Momordica charantia			
Dried Leaves	Soxhlet-Pet. Ether	87.50	L
Myristica fragrans			
Leaf Nest	Distill.-Condensate	86.97	L
Ocimum gratissimum			
Fresh Leaves	Soxhlet-Pet. Ether	53.28	MH
Piper sarmentosum			
Dried Leaves	Soxhlet-Pet. Ether	88.26	L
Portulaca pilosa			
Fresh leaves	Distill.-Condensate	80.26	L
Quisqualis indica			
Fresh Leaves	Distill.-Condensate	77.61	ML
Ricinus communis			
Dried Seeds	Soxhlet-Pet. Ether	57.32	MH
Stemona tuberosa			
Dried Leaves	Soxhlet-Pet. Ether	85.44	L
Ternstroemia japonica			
Dried Barks	Rolling-Pet. Ether	55.83	MH
Tinospora crispa			
Dried Stems	Soxhlet-Pet. Ether	83.02	L
Fresh Stems	Distill.-Condensate	84.46	L
En-Luang			
Fresh Rhizomes	Distill.-Condensate	39.94	H
Gai-Khan			
Fresh Rhizomes	Distill.-Condensate	85.14	L
Kan-Tha-Mala			
Fresh Rhizomes	Distill.-Condensate	72.96	ML
Lai-Ma			
Fresh Leaves	Distill.-Condensate	79.86	ML
Ma-Haw			
Fresh Rhizomes	Distill.-Oil	70.07	ML
Maha Kamlang			
Fresh Rhizomes	Distill.-Oil	68.35	M
Maurakot			
Fresh Rhizomes	Distill.-Oil	79.26	ML
Phra-Taba			
Fresh Rhizomes	Distill.-Condensate	58.98	MH

indica, has been known to contain a chemical feeding deterrent, azadirachtin, extracted from seed kernels which repel some species of insects, particulary the grasshoppers such as *Schistocerca gregaria* and *Locusta migratoria.* However the crude and refined total bitters of the neem were ineffective against larvae of *Euproctis lunata* and *Prodenia litura* (Pradhan *et al.,* 1963). In our experiment with the common Thai neem tree, *A. indica* var. *siamensis,* the cold petroleum ether extract from fresh leaves showed very high repellency against the fruit fly oviposition, and only 18.61% relative oviposition was observed compared to the check. The extracts from *Melia azedarach* either hot or cold and including volative fractions from fresh leaves were inactive.

The oil of the lemongrass, *Cymbopogon citratus,* was reported an effective repellent for 20 – 30 minutes against the housefly, *Musca nebula,* and mosquitoes, *Aedes aegypti* and *Culex fatigans* (Tiwari *et al.,* 1966). Results of our test using cold petroleum ether extracts of fresh leaves of this plant reveal its high repellency when only 21.12% relative oviposition was obtained.

In the test on the repellency against feeding of the boll weevil using alcoholic extracts from *Eupatorium serotinum,* Matteson *et al.* (1963) found no active principle from this plant. Our trials on *E. adenophorum* using the volatile fraction of fresh leaves demonstrated some repellency but the potency was classified as moderately low. On the otherhand, the petroleum ether extract of fresh leaves of *E. odoratum* failed to exhibit any effective repellency. Only *E. heterophylla* was tested in this experiment and the results showed no potency in the preventing egg laying by the fruitfly. Watt and Breyer Brandwijk (1962) have recorded that plant extracts of *E. tirucalli, Ocimum americanum, O. suane,* and *O. viride* have been used as mosquito repellents in Africa. In our tests against the fruit fly oviposition with two species of *Ocimum,* the volatile fraction of fresh leaves of *O. grasstissimum* was promising while the petroleum ether extract from fresh leaves of *O. basilicum* was ineffective.

The oil, extracted from *Tagetes minuta,* was reported to be strongly repellent to the blowfly and is useful as a blowfly dressing (Watt and Breyer Brandwijk, 1962). In the test against the fruit fly oviposition using petroleum ether extract of fresh roots of *T. erecta,* we found that it was ineffective.

Other plant extracts which exhibited high repellency in our tests against the Oriental fruit fly oviposition were petroleum ether extracts of fresh leaves of *Citrus hystrix,* volatile fractions of fresh seeds of *Cucumis melo,* fresh rhizomes of *Hedychium coccineum* var. *angustifolium,* whole plants excluded roots of *Heliotropium indicum* and fresh rhizomes of En-luang.

SUMMARY

Results of the repellency tests of 130 plant extracts from 110 species against the oviposition by 15 day old adult Oriental fruit flies, *Dacus dorsalis* Hendel, revealed that the numbers of extracts which contained repellent active principles ranged from very high to ineffective were, 6 very high, 1 high, 7 moderately high, 3 moderate, 16 moderately low, 17 low, and 80 ineffective. Two or more classes were included for some plant species depending upon plant parts, solvents used, and methods of extraction.

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