Kasetsart J. (Nat. Sci. Suppl.) Vol. 22 : 71-74 (1988)

Botanical Repellent Against the Diamondback Moth, *Plutella xylostella* L.

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ABSTRACT

The present study reveals two Thai plant species, i.e. *Scheffera venulosa* Harms (Hanumarn-prasanguy) and *Cymbopogon nardus* Rendle (Takraihorm) containing some quantities of repellent chemicals. These chemicals affected the diamondback moth larvae under the laboratory conditions. Both of them, moreover, showed an equal magnitude of repelling activity.

INTRODUCTION

Heavy use of toxic chemicals against the diamondback moth *(Plutella xylostella* L.*)*, one of the most serious pest of cruciferous crops around the world, creates some significant problems, e.g. resistant strain of the moth and environmental pollution. The most well known problem, however, is the development of resistance of the moth to many kinds of insecticides. It was reported recently that the moth has developed resistance to more than 46 insecticides (Miyata *et.al.*, 1986). If this situation continues in the foreseeable future, more insecticides and money will be used on the unpredictable larger scale for the control of this moth. In struggle for better life, therefore, human beings have to develop their own controlling methodology to avoid those undersirable problems. Thus, in this study the authors set their goal to find new kinds of chemicals extracted from plants and herbs that can repel the insect away and have no toxic effects to human-beings and beneficial animals.

MATERIALS AND METHODS

1. Insect

The larvae and pupae of the moth of Tupluang (Nakorn Pathom) strain were collected from February to June, 1987. The insect was reared in a laboratory at the Department of Entomology, at 25 ± 1°C under long day photoperiod (16 L : 8D) without exposure to any insecticides. The rearing method was slightly modified from the report of Noppun *et al.*, (1983) and identical to Miyata *et al.*, (1988). The cabbage seedlings were used for collecting eggs. Hatched larvae were reared on the same seedlings until the second instar. The larvae were then transferred to a paper padded plastic box (23 × 30.5 × 7 cm.) with the fine netted plastic window on the cover. These larvae were fed with fresh Chinese kale leaves.

2. Extraction of the bioactive repellent from plant

Plant samples were chopped, weighed (50-500 g) and completely soaked with 95% ethanol in Erlenmeyer flasks (1,000 ml. in size). The flasks were sealed with stopples. The samples were soaked for 3 days. The crude extracts of each day were removed and combined together for each specific sample. The volume of the crude extract of each sample was reduced by a rotary evaporator under low pressure condition, ca. 10 psi to near to near dryness. The dry-crude extract of each sample was removed from the machine then kept overnight in a dessicator to

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ensure complete dryness. The dry-crude extract was then weighed and kept at 5°C in a freezer for further studies.

3. Repellent study

3.1 Screening test

The crude extract of each sample and spreader (Linoh, Nihon Noyaku Co.) were dissolved in ethanol to make the solution of which concentration was adjusted to 20 mg. and 4×10^{-4} ml/ml solution for the crude extract and the spreader respectively. The solution, then, was ready for screening test using the leaf dipping method as described by Miyata *et al.* (1988). However, the method used here was slightly altered. The cabbage leaves of ca. 25 cm^2 were dipped in the test and the control (4×10^{-4} ml. spreader/1-4×10^{-4} ml. ethanol) solutions for 10 seconds. The treated leaves were air dried under room temperature condition and, thereafter, transferred into paper padded plastic cups. Each cup has 200 cm^3 capacity with 8 cm. bottom diameter. Ten of the third instar larvae were introduced onto each treated leaf. The cups, were capped with cup covers having 60 holes of about 1.0 mm. in diameter around the center. Each hole was 0.5 cm. apart and punched in a circular pattern. Treatments and replications were arranged to achieve the degree of freedom of error not lesser than 12 (Upradissakul, 1975). The completely randomized design was used in this experiment. Observation of each treatment was made at the first few hours, i.e. 24, 48, and 72 hours after treatment. Any result showing repellent and/or toxic action (as seen by % mortality) to the larvae were recorded and analyzed.

3.2 Repellent test

All potential crude extracts showing repellent activity to the moth larvae were proved statistically using a completely randomized design. Treatments and replications were arranged to obtain the degree of freedom of error not lesser than 12 (Upradissakul, 1975). All data was analyzed by an analysis of variance and a Duncan's new multiple range test (Upradissakul, 1975 ; Gomez and Gomez, 1984). However, repellent test procedure was done in a manner that was quite similar to those mentioned in the screening test except the cabbage leaves used for treatments were cut to make circular dishes having a diameter of 7 cm. This would make the dish area become 38.5 cm^2 which made the treated leaf space adequate for the larvae (10 larvae of the third instar/cup). Immediately after treatment, the larvae were repelled away from the treated cabbage leaf (containing the same ingredient concentration as did in the screening test) to the holes on the cover. At this moment all distances that the larvae departed from the bottom of the cup which was the original limit-line were measured within the time-limit of 10 minutes.

RESULTS AND DISCUSSION

Nine crude extracts from 8 plant species listed in Table 1 were tested. Two of them, i.e. *Scheffera venulosa* Harmas and *Cymbopogon nardus* Rendle, showed a potential repellent activity (Table 1) against the third instar larvae of the moth immediately after treatment. This was noticed while they were trying to escape from the cup via the ventilating holes on the cup cover. This activity, moreover, lasted for about 2 hours. Data in Table 1 also shows that none of the plants tested contained a toxic ingredient which was capable of killing the tested larvae after 72 hr.

It would be a good idea, however, to prove the repelling potentiality shown in Table 1. Therefore, the result in Table 2 indicated that within the modified atmosphere of 200 cm^3 of air plus the treated extract chemical of 60 ventilating holes of 1 mm. in diameter ; the third instar larvae escaping away from the treated cabbage leaf with the crude extract of *Scheffera venulosa* Harms and *Cymbopogon nardus* Rendle significantly differed from control with the level of 99% confidence. Moreover, the degree of repel-

Table 1 Percent mortality of the diamondback moth and some other information following different crude extract solution of some plant and/or herb treatments under laboratory conditions.[1]

Local	Treatment of crude extract of plant and/or herb name: Scientific	Plant part	Other Information	Mean % mortality[2]
Hanumarn prasanguy	*Scheffera venulosa* Harms	Leaf	R	0
Takrai-horm	*Cymbopogon nardus* Rendle	Whole plant	R	0
Puk-boong-taley	*Ipomoea pes-carprae* Sweet	,,	—	*0*
Harng-nok-yoong-thai	*Caesalpinia pulcherrima* (L.) Swartz	Flower	—	10.0
Sa-yek	*Pedelanthus tithymaloides* Poit	Whole plant	—	3.3
Rug-dorg-karw	*Calotropis procera* R.Br.	" + flower	—	3.3
Pun-ngoo-keaw	*Stachytarpheta Jamaicensis* (L.) vahl	Whole plant	—	3.3
Saboo-dum	*Jatropha curcas* L.	Stem	—	0
Saboo-dum	*Jatropha curcus* L.	Leaf	—	0
Control (4×10^{-4}ml. spreader/$1\text{-}4 \times 10^{-4}$ml. ethanol)	—	—	—	6.7

Significance based on F-test : treatment.....Not significant

[1] All treatments were arranged in a completely randomized design and the concentration used in each treatment was 20 mg. of the crude extract + 4×10^{-4} ml. spreader/ml. solution. Data are averages of 3 replications.

[2] At 72 hrs. after treatment.

R. Showing repellent action for ca. 2 hrs. after treatment.

Table 2 Repellent action of some potential crude extracts from plants and/or herbs against the third instar diamondback moth larvae under laboratory conditions.[1]

Local	Treatment of crude extract of plant and/or herb name: Scientific	Plant part	Mean distance in mm.[2]
Hanumarn-prasarngauy	*Scheffera venulosa* Harms	Leaf	29.1 a
TaKrai-horm	*Cymbopogon nardus* Rendle	Whole plant	30.1 a
Control (4×10^{-4}ml. spreader /$1\text{-}4 \times 10^{-4}$ml. ethanol)	—	—	1.4 b

C.V. = 5.6%

[1] All treatments were arranged in a completely randomized design and the concentration used in each treatment was 20 mg. of the crude extract + 4×10^{-4}ml. spreader/ml. solution. Data are averages of 7 replications.

[2] At 10 mins. after treatment. Data having the same letter are not significantly different at the 1% level of significance.

ling between the two crude extracts were not significantly different at the 1% level of significance. Thus, *Scheffera venulosa* Harms and *Cymbopogon nardus* Rendle crude extracts proved to have the repellent ability of equal action for the larvae under the limitation of laboratory conditions.

In addition to these results, further attempt to prove the stabilities of these repellents and their efficacies to the adult stage of the moth should be made.

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