Toxicity of plant essential oil from Khok Phutaka Resources Protection Area, Khon Kaen Province against storage pest, *Sitophilus oryzae*

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Abstract

Botanical insecticides may offer an alternative solution for pest control. The objective was to test on the repellant, contact, and fumigant effect of the essential oils of 10 indigenous plants from Khok Phutaka Resources Protection Area, Khon Kaen Province including *Limnophila aromatica*, *Piper sarmentosum*, *Clausena harmandiana*, *Streptocaulon juventas*, *Litsea glutinosa*, *Thunbergia laurifolia*, *Eupatorium odoratum*, *Rothmannia wittii*, *Ficus altissima*, *Clausena harmandiana* and *Gymnopetalum integrifolim* to control the rice weevil, *S. oryzae*. The essential oils of plants were extracted by using hydro-distillation method and then they were tested against rice grain weevil, *S. oryzae* for contact, fumigant and repellent activities in laboratory condition. Adults weevil were different tested oil at the concentrations of 0, 25, 50 75 and 100 percentage (w/v). The maximum repellency action, 80 % when *L. glutinosa* oil, at the concentrations of 100 % (w/v) were applied for after 72 hour follow by *L. aromatica* (73.33%) at the concentrations of 25 % (w/v) were applied for after 2 hour. The fumigant and contact test of all 10 essential oils resulted in all lower rate mortality (less than 50 %), at all the concentrations.

Keywords: essential oil, *Sitophilus oryzae*, repellency, fumigant, contact, Khok Phutaka Resources Protection Area

Introduction

The rice weevil, *Sitophilus oryzae* Linnaeus 1763 (Coleoptera: Curculionidae) is a serious and severe insect pest of stored products (Park I.K., 2003) and one of the most widespread and destructive stored product pests of rice throughout the world. Treatment of rice with synthetic insecticides is not recommended because of direct and indirect health hazards to humans. Plants are sources of natural insecticides that are produced to defend themselves against those insect pests. Many plants are rich in secondary compounds with insecticidal activities. The several efforts have been focused on the use of plant derived materials including essential oils as bio insecticides. The objective of this study was to screen plant oils of 10 indigenous plants from Khok Phutaka Resources Protection Area, Khon Kaen Province as repellent contact and fumigant against adults of rice weevil, *S. oryzae*.

Methodology

- Adults of *S. oryzae* were reared in the laboratory conditions at 25 ± 2ºC, 46.8 ± 5.0 % R.H. Approximately, 50 of *S. oryzae* adults were placed in 11×10×5 cm plastic containing 500g of rice grains. Colonies were reared on whole rice grains in plastic container. The insects were reared for several generations on rice. For the bioassays, the F1 generation of the adults from the rearing was used.
- Ten of indigenous plants were collected from Khok Phutaka Resources Protection Area, Khon Kaen Province.The essential oils of plants were extracted by using hydro-distillation method.
- Repellent activity bioassay. The repellency test was using the area preference method based on Lü and Ma (2015). The number of insects presents on the control and treated regions were recorded to 1, 2, 3, 4, 5, 6, 12 and 24 hours after treatment. Mean number of insects present on the control (NC) and treated (NT) regions during the experiment were used to estimate the Percent Repellency (PR)
- Contact toxicity bioassay. The contact toxicity test was using by impregnated filter paper test method modified from Fournet et al. (1996). Mortality rate was estimated and corrected according to Abott's formula (Abbott, 1925)
- Fumigant toxicity bioassay. The fumigant toxicity test was conducted by using space trial test method based on Keita et al. (2001). Mortality was recorded after 24, 48, and 72 hours. Mortality rate was estimated and corrected according to Abott's formula (Abbott, 1925)

Results and Discussion

Repellent activity bioassay

In general, repellency increases with increase in concentration in the treatment. The result indicated variation among the essential oils tested. The Percent Repellency (PR) ranged from 23.33 to 80.00 %. The maximum repellency action, 80 % when *L. glutinosa* oil, at the concentrations of 100 % (w/v) were applied for after 72 hour follow by *L. aromatica* (73.33%) at the concentrations of 25 % (w/v) were applied for after 2 hour (Fig.1).

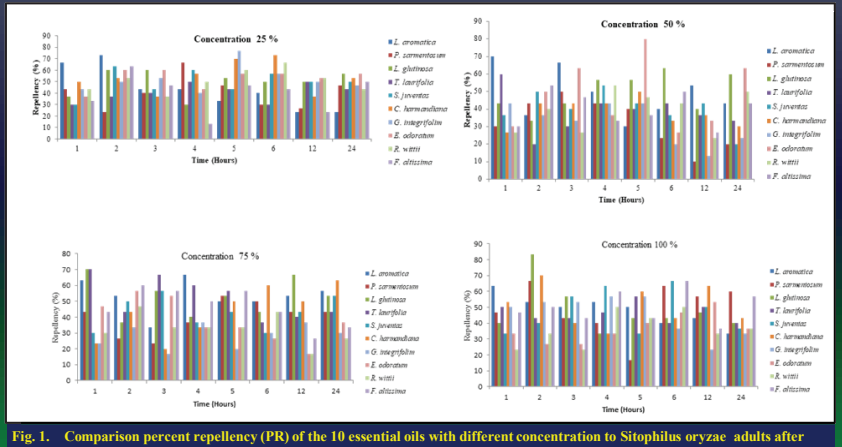

Fig. 1. Comparison percent repellency (PR) of the 10 essential oils with different concentration to Sitophilus oryzae adults after exposure time using the area preference method

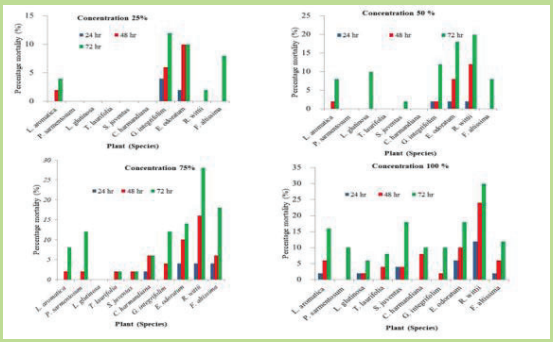

Fig. 2 Comparison contact effect of plant extracts with different concentration to S. oryzae adults after exposure time using impregnated filter paper test.

Contact toxicity bioassay

The results demonstrate (Fig.2) that Oil from *R.wittii* was the most efficient, causing 30% mortality at concentrations of 100 % (w/v) in 72 h. The result indicated that all concentrations are lower rate mortality.

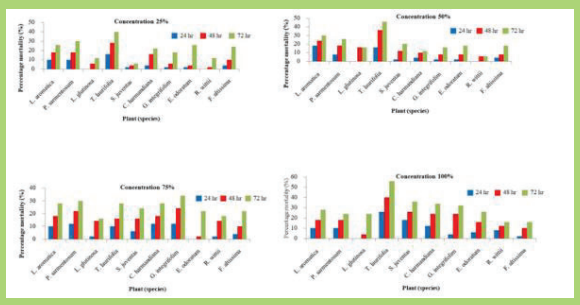

Fig. 3 Fumigant effect of plant extracts with different concentration to *S. oryzae* adults after exposure time using space trial test

Fumigant toxicity bioassay

The result of fumigant toxicity (Fig.3) showed that adult rice weevil exposure to the 10 essential oil of plant different concentration had lower effect on mortality (less than 50 %) except the oil from T. laurifolia was the most efficient, causing 56% mortality at 100 % (w/v) concentration in 72 hr. Fumigant toxicity of the essential oils gradually increased with increasing exposure time and concentration.

Conclusion

The results obtained in this study demonstrate that the essential oils tested can be used to control stored grain pests and to support further studies. The toxic effects of essential oils involve many factors, among which are the entry points of toxins and which may have contact, fumigation and repellent effects. However, in the present study some of the plant oils did not show any mortality or showed least mortality which might be due to the presence of weak volatile compounds. However the results of this study indicate that the essential oils might be useful for managing the insect pests in storage especially *S. oryzae*.

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