The Insecticidal Studies from *Alpinia galanga* and *Cleome viscosa* Extract as Alternative Control Tool to *Bactrocera dorsalis* (Hendel)

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Abstract

The oriental fruit fly, *Bactrocera dorsalis* (Hendel), the most economically damaging pests in Thailand, is generally controlled by synthetic insecticides. Present study demonstrates the insecticidal activities of extracts prepared from *Alpinia galanga* and *Cleome viscosa* plant against *B. dorsalis*. While *Alpinia galanga* rhizome extract was toxic at 5,987.05 ppm level (LC_{50}) after 24 hours, the *Cleome viscosa* extract was much less active (LC_{50} = 27,867.80 ppm) than *Alphinia* extract treatment was. The *Alpinia galanga* is apparently good choice for alternative control of *B. dorsalis* in the future.

Keywords : *Bactrocera dorsalis* (Hendel), *Alpinia galanga, Cleome viscosa* Linn., Toxicity, Botanical insecticide

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Introduction

The oriental fruit fly, *Bactrocera dorsalis* (Hendel) is serious pest of fruit trees in Thailand. These flies attack different fruit including rose apple, mango, banana, etc. The female fly lays their eggs under the skin of premature fruits. The larvae hatch within 1-3 days and feed inside the fruits causing premature drop and rot of whole fruits. Pupae are in soil under the host plant and then adults emerge after 1-2 weeks. Synthetic insecticides are the mainly controlling method for *B. dorsalis*; however, insects including other *Bactrocera* species, such as *Bactrocera oleae* have developed resistance (Brown and Payne, 1988) as has been shown in laboratory (Vontas et al., 2002).

The botanical insecticides are considered to have potentials inkilling insects. It is unlikely to induce fast resistance problems and very friendly many animals and in Thailand. Many studies have reported efficacy of botanical against various pests. For instance, *Cymbopogon winterinus* (Jewitti) for the control of *Culex pipien quinquefasciatus* (Thummasarangkoon, 2000), *Capsicum frutescans* for *Sitophilus zeamais* (Motschulsky) (Bullangpoti et al., 2002), *Cleome viscosa* extract as the oviposition inhibitor for *Sitophilus oryzae* L. (Somboon and Pimsamarn, 2006).

Alpinia galangal or "Kha" is Thai spice plant (Larsen et al., 1999). Its essential oil from rhizomes have antimicrobial activity . Mayachiew and Devahastin (2007) reported that compounds like 1,8-cineole, β-bisabolene, β-caryophyllene and β-selinene, showed insecticidal activity against various pets (Areekul et al., 1987). *Cleome viscosa,* on the other hand, has been used as medicinal plant having active compound, like glucocapparin and glucocleomin (Songsak and Lockwood, 2002). *C. viscosa* is also known to have contact insecticidal, repellent, antifeedant and nematicidal properties (Ndungua et al., 1999; Williams et al., 2003; Lazzeri et al., 2004).

The objective of the present work is to determine the activity of these plants against Dipteran pest. *B. dorsalis* was chosen as it is dangerous fruit pest in Thailand.

Materials and Methods

1. Rearing method

B. dorsalis was received from the Division of Entomology and Zoology, Department of Agriculture Bangkok. Insetcs were reared on the artificial diet in the cage (30 cm x 30 cm x 30 cm) in the laboratory of the Zoology Department, Faculty of Science, Kasetsart University, Bangkhen Campus, at 25±2 °C and 70% RH. Adults were provided with 10% honey solution via a cotton pad and were allowed to lay eggs in a plastic jar.

2. Extraction method

Dried powder of *Cleom viscosa* leave and *A.galanga* rhizomes were received from Surat Thani (600 km from Bangkok) and were extracted using a modified method of Bullangpoti et al. (2006). The extraction was done with Soxhlet's extractor in 99% ethanol for 8 hrs. Extracts were concentrated using rotary evaporator (BUCHI B-850) under reduced pressure at 60 °C. The extracts were stored at 4°C until preparation of a stock solution. Stock solution was prepared by weighing a certain amount of the extracts and diluting in distilled water to give a series of concentrations.

3. Bioassay method

Bioassays were conducted using 5 concentrations in range of 5,000-40,000 ppm of crude extract along with control treatments (distilled

water). Topical mist sprays on 1 day old- adult *B. dorsalis* were made using 60 insects in 5 replicates. Mortality, were recorded after 24 and 48 hours. LC_{50} vaules was calculated using Probit analysis (StatPlus 2008). The data were analyzes with SPSS statistical software version 10.

Results and Discussion

The toxicity of *Alpinia galangal* rhizome and *Cleome viscosa* Extract against *B. dorsalis*

The rhizomes of *Alpinia galanga* extracts exhibited remarkable insecticidal activity against adult *B. dorsalis* in the topical mist sprayer application. After 24 hours, *Alpinia galanga* extract showed an LC_{50} of 5,987.05 ppm (r^2 = 0.82) and after 48 hours 5,652.53 ppm (r^2 = 0.83). Significant difference was observed between these two values (t-test, $p< 0.05$), suggesting that the exposure time might be correlated with the acute mortality and long exposure can give higher mortality.

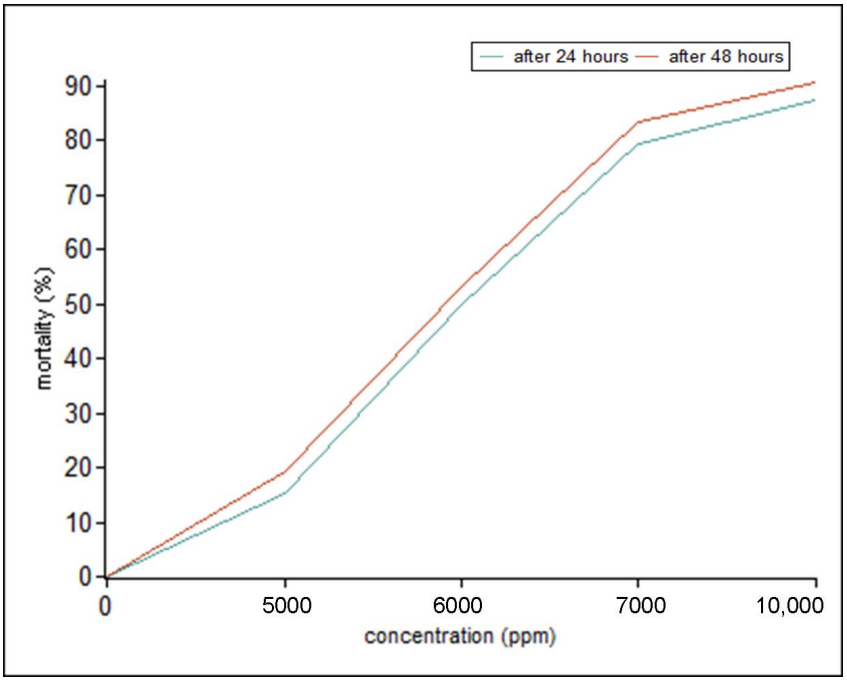

Figure 1. Mortality of *B. dorsalis* after *Alpinia galanga* application after 24 and 48 hours of treatment.

The concentrations report for kill of *B. dorsalis* by *Cleome viscosa* extracts was much higher (Figure 2). The LC_{50} values after 24 and 48 hours were 27,867.80 ppm (r^2= 0.96) and 25,841.43 ppm (r^2 = 0.97) respectively. The significant difference between these two values (t-test, $p< 0.05$) again suggest that the exposure time might be correlated with the acute mortality and long exposure can give higher mortality than short one, as was observed in case of *A. galanga* treatments.

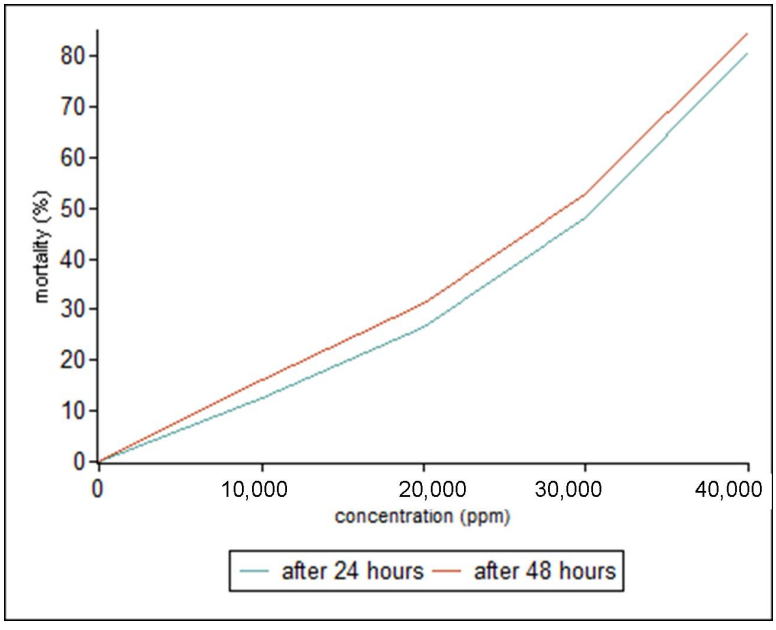

Figure 2. Mortality of *B. dorsalis* after 24 and 48 hours after treatment *Cleome viscosa* extracts.

However, both extracts have insecticidal activity similar to other botanical extracts, such as *Alphinia offinarium, Acorus calamus or Azadirachta indica* (Areekul et al., 1986). Earlier research show the efficacy of *Ternstroemia japonica* (LC_{50} = 4,067 ppm), *Cymbopogon citrates* (LC_{50} = 8,150 ppm) and *Citrus hystrix* (LC_{50} = 31,000 ppm) to *B. dorsalis,* which is lower than efficacy obtained with present extracts (Kitibumrungsuk, 1980).

Although the toxicity from both extracts is less than synthetic insecticide; the botanical products used here are biodegradable and safe to be used in any integrated pest management system.

Conclusions

The toxicity of *Alpinia galanga* and *Cleome viscosa* extract against *B. dorsalis* was determined using topical mist spray method. *Alpinia galanga* showed higher insecticidal efficiency than that of *Cleome viscosa* extract. Both plant extracts, however, significantly increase in toxicity over the time. This is the first and preliminary research of insecticidal activity of *Alpinia galanga* and *Cleome viscosa* extract against *B. dorsalis,* suggesting that these botanicals could be use to control pest. However, detailed investigation of active ingredients and delivery system and the toxicity to non-target organisms are the future prospects of this research.

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