Effectiveness of plant essential oils derived from *Curcuma longa*, *Illicium verum*, *Ocimum tenuiflorum*, and *Foeniculum vulgare* for controlling common cutworm (*Spodoptera litura*)

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Abstract. Four essential oils of *Curcuma longa*, *Illicium verum*, *Ocimum tenuiflorum* and *Foeniculum vulgare* were selected for insecticidal activity against the tobacco cutworm, *Spodoptera litura* (Fabricius) (Lepidoptera, Noctuidae) by using leaf dipping bioassay. Toxicity on second instar larvae was assessed after 24 hours of exposure. The result revealed that all the four essential oils effectively killed the larvae and showed high antifeedant activity. The highest killing amount for controlling the larvae and highest anti-feedant effect were observed in the essential oils of *Curcuma longa* and *Illicium verum* 0.75% concentration causing 100% mortality after 24 hours. These oils also presented the highest anti-feedant effect for controlling the larvae at 0.25% concentration. It seems that, plant essential oils derived from *Curcuma longa* and *Illicium verum* have an ability to be used as herbicide for controlling *Spodoptera litura*.

1. Introduction

Most agriculturists usually utilize synthetic insecticides since they are easy to use, fast action and convenient. However, the use of synthetic insecticides has disadvantageous result on the surrounding. In comparison some naturally occurring compounds are environmentally friendly, easy to decompose, low toxicity to non-prey organisms and normally inexpensive than inducted insecticides. The cutworm, *Spodoptera litura* is a cosmopolitan pest on fruits and vegetables with high reproductive rate [1]. The clusters of larvae eat gregariously by originally mashing the top of the leaf causing agricultural damages [2]. The pest management has been mostly depending on using the chemical pesticide; without any proper file of disadvantage surrounding, health of living things and rigorous surrounding rule on these insecticide [3]. Natural plant product extracts tend to be useful bio-pesticides. Chaaban et al. [4] reported the high effect of turmeric essential oil for controlling the larvae of *Lucilia cuprina*. Mukesh et al. [5] presented that the cumin essential oils cause death of adults and larvae of *Callosophruchus chinensis* by using them as fumigants. Sagnou et al. [6] informed that the curcuminoids components from *Curcuma longa* against mosquito larvae contained high insecticidal property. Akono et al. [7] investigated the biologically active of *Ocimum canum* and *Ocimum basilicum* essential oil for controlling *Plasmodium falciparum* and *Anopheles nopheles funestus*. Dris et al. [8] revealed that *Ocimum basilicum* essential oil was extremely toxic against *Culex pipiens* larvae. The *Illicium verum* essential oil was evaluate for controlling *Aede salbopicus* and *Culex pipiens* with satisfactory results [9]. Shukla et al. [10] studied toxicity of *Illicium verum* destroy
Tribeolium castaneum by using them as fumigants. Gunthanee et al. [11] showed that the crude extract of Illicium verum inhibited development from larvae to pupae of house fly, Musca domestica. The Pimpinella anisum and Foeniculum vulgare essential oil presented high efficiency against Paenibacillus larvae [12].

Herbicide play main part in defense for controlling pests. In using leaf dipping bioassay, the efficacy of plant essential oils, namely Curcuma longa, Illicium verum, Ocimumteniflorum, and Foeniculum vulgare were estimated for Spodoptera litura.

2. Methods

2.1. Essential oils preparation
Essential oils from Curcuma longa, Illicium verum, Ocimum tenuiflorum, and Foeniculum vulgare were chose. Essential oils were diluted at 0.25, 0.50, 0.75, 1.00 and 1.25% concentrations.

2.2. Insect samples
The second instar larvae of Spodoptera litura were used.

2.3. Bioassay
3 × 2 cm diameter Chinese cabbage leaves were dipped these essential oils. Then, the second instar larvae were put in each box (3 replications). After 24 hours, The death rate of larvae and amount feeding of leave were observed.

2.4. Data analysis
In this study, the results were calculated using probit analysis.

3. Results and discussion
After 24 hours. The highest killing rate against the larvae were observed in the 0.75% concentration Curcuma longa and Illicium verum treatments essential oils treatments giving a LC50 value of 0.292 and 0.392 % (v/v) and LC90 of 0.541 and 0.646% (v/v), respectively. At 1.25% concentration of Ocimum tenuiflorum, and Foeniculum vulgareessential oils treatments with LC50 of 0.604% and 0.559 (v/v) and LC90 of 1.158% and 1.054 and (v/v), respectively (Table1) with100% mortality. At 0.25% concentration Curcuma longa and Illicium verum essential oils presented the highest anti-feedant effect for controlling the larvae. At 0.75% concentration Ocimum tenuiflorum and Foeniculum vulgare essential oils of showed the highest anti-feedant effect for controlling the larvae of Spodoptera litura (Table 2)

Our results obtained are similar to other previous studies, curcumin from Curcuma longa essential oil revealed most powerful larvicide in mosquito larvae [6]. Tumeric containing pungent, odoriferous oils and oleoresins was reported to possess biological activities and the toxicity against Aedes aegypti [13]. Zhu et al. [14] presented the larvicide of turmeric essential oils for controlling mosquitoes. The pure compounds, ar-tumerone in turmeric essential oil controled larvae of Anopheles quadriraculatus and Aedes aegypti. Additionally, essential oils from Curcuma longa caused the formation of highest number of abnormal pupae of common cutworm, Spodoptera litura [15]. Anise, Pimpinella anisum was reported effective against larvae and pupae of Culex quinquefasciatus [16]. Kim et al. [17] reported about contact activity of the extract from Illicium verum fruits at 3.5x103 mg/l by filter paper diffusion method with100% mortality after1 day treatment against Lasioderma serricorne (F.) and Callosobruchus chinensis (L.) adults; besides, it caused 100% mortality of Sitophilus oryzae (L.) adults after 4 days treatment.

The results of this study indicated that Curcuma longa and Illicium verum essential oils had high possible to be used as herbicide. These oils contain insecticidal qualification causing successful killing larvae and also have a prominent antifeedant effect. Future research should explore field evaluations of these compounds.
Table 1. The death rate of larvae of *Spodoptera litura* were affected from different plant essential oils.

| Essential oils       | Concentrations (%), (v/v) | Average mortality percentage | LC50  | LC90  |
|----------------------|---------------------------|-------------------------------|-------|-------|
|                      |                           | 0    | 0.25 | 0.50 | 0.75 | 1.00 | 1.25 |
| *Curcuma longa*      |                           | 0    | 60.47 | 75.45 | 100  | 100  | 0.292 | 0.541 |
| *Illicium verum*     |                           | 0    | 36    | 56.66 | 100  | 100  | 0.392 | 0.646 |
| *Foeniculum vulgare* |                           | 0    | 36.66 | 42.67 | 53.33| 73.33| 100  | 0.559 | 1.054 |
| *Ocimum tenuiflorum* |                           | 0    | 27.66 | 53.83 | 70.67| 76.66| 100  | 0.604 | 1.158 |

Table 2. The antifeedant affect from different plant essential oils

| Essential oils       | Concentrations (%), (v/v) | Leaf eating area (%) |
|----------------------|---------------------------|----------------------|
|                      |                           | 0    | 0.25 | 0.50 | 0.75 | 1.00 | 1.25 |
| *Curcuma longa*      |                           | 100  | 0    | 0    | 0    | 0    | 0    |
| *Illicium verum*     |                           | 100  | 0    | 0    | 0    | 0    | 0    |
| *Foeniculum vulgare* |                           | 100  | 16.08| 10.52| 0    | 0    | 0    |
| *Ocimum tenuiflorum* |                           | 100  | 21.63| 20.75| 0    | 0    | 0    |

4. Conclusion

Essential oils from *Curcuma longa* and *Illicium verum* at the concentration of 0.75% are most successful in killing larvae with potent antifeedant effect against *Spodoptera litura*.

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