FORESTRY IDEAS, 2023, vol. 29, No 1 (65): 18–20

Test for contact toxicity of *Thymus pulegioides* L. essential oil on *Helicoverpa armigera* Hub. in tobacco and *Apis mellifera* L.

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Received: 25 October 2022 / Accepted: 09 January 2023 / Available online: 18 January 2023

Abstract

Thymus pulegioides L. essential oil (EO) in different concentrations was tested in laboratory conditions on *Helicoverpa armigera* Hub. 3rd instar larva on tobacco and *Apis mellifera* L. bees, and the results showed bioinsecticidal activity. Differences were found between the effectiveness of various concentrations as higher concentrations showed higher efficiency. Low toxicity of 36 % was found at concentration of 1.25 % essential oil, concentration of 2.5 % produced high toxicity of 76 % while concentration of 5 % produced 100 % toxicity. All the concentrations of *T. pulegioides* EO tested in the same conditions on *A. mellifera* showed 100 % toxicity.

Key words: cotton bollworm, honey bees, mountain thyme.

Introduction

The species *Helicoverpa armigera* Hub. is a major pest in agrocenoses (Santos et al. 2017). This species causing huge damage to many crops (Sharma 2007). When insecticides are applied incorrectly this could lead to pest resistance and oppression of beneficial entomofauna which makes the pest control difficult (Turchen et al. 2016). Some pesticides are limited for usage in Europe (Cressey 2017). Alternative for control, such as plants substances containing insecticide ingredients could be used (El-Wakeil 2013). Essential oils (EOs) have such impact (Boulamtat et al. 2021). According to Muturi et al. (2017) 10 % from the studied EOs are available as potential insecticides. The species *Thymus pulegioides* L. spread in forest areas, could be used for EO yield. Thyme EO is characterised by antimicrobial activity (Elfellah et al. 1984).

The aim of this study is to test contact toxicity of EO of *T. pulegioides* on *H. armigera* 3rd instar larva in tobacco and *Apis mellifera* L. in laboratory conditions.

Materials and Methods

In July 2021 stems and flowers from *T. pulegioides* were harvested from forest area in the Central Rhodopes mountain to

produce EO. The mass of 1.5 kg was distilled in a micro-distiller. The EO was kept in a glass package at room temperature.

The collection of *H. armigera* larvae was done by methodology of Papulwar et al. (2018) from tobacco plants at the fields of Tobacco and tobacco products institute, Markovo. Larvae of 3rd instar were determined according to DPI&F (2005) and placed in Petri dishes 90×20 mm with filter paper at the bottom. The test treatment was provided according to Boulamtat et al. (2021) methodology, 0.01 % Tween 80 was used as emulsifier. The efficiency was calculated according to Abbott (1925). Larva which not react on touching was counted as dead.

The same concentrations were tested on 3 days old *A. mellifera* bees according to Radev (2022), bees were treated with EO for 48 h under the same conditions as *H. armigera* larvae.

The results were statistically processed by using one-way Anova in Excel, at $p \leq 0.05$.

Results and Discussion

The data indicated toxicity effect of *T. pulegioides* EO on *H. armigera* 3rd instar larva. Low toxicity of 36 % was found at concentration of 1.25 % EO, quite high effect of 76 % at concentration of 2.5 % and 100 % toxicity at 5 % concentration. Differences between the effectiveness of the tested concentrations were found ($F > F_{crit}$, $p = 0.000$) (Fig. 1). The study results showed that 6 h after treatment mortality was reported only at 5 % concentration, after 24 h at the three tested concentrations. Bioinsecticidal effectiveness of *T. pulegioides* EO for all concentrations was much higher compared to those of Boulamtat et al. (2021) for *Thymus vulgaris* L. EO. The plant chemical substances show bioactivity against insects (Listiyani 2012).

All the concentrations of *T. pulegioides*

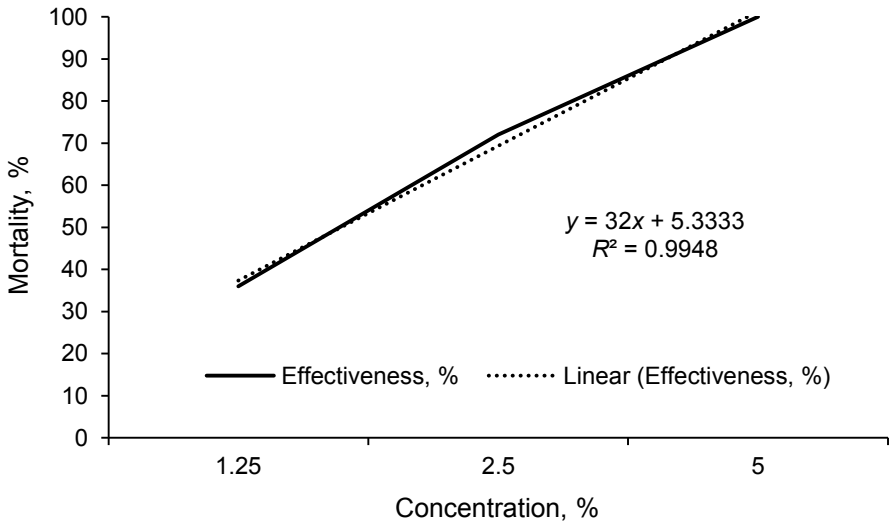

Fig. 1. Insecticidal efficacy of *T. pulegioides* EO on *H. armigera* in concentrations applied.

EO tested on *A. mellifera* showed 100 % toxicity (means ±SD 100 ±0.0). Differences between the treated and control groups were found to be highly significant ($F > F_{crit}$, $p = 0.000$).

Conclusions

These findings can be tested at field work with tobacco plants, but measures for bees' protection should be taken beforehand. Future field studies need to be done.

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