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ФУМИГАНТНО ДЕЙСТВИЕ НА НЯКОИ ЕТЕРИЧНИ МАСЛА СПРЯМО ФАСУЛЕВИЯ ЗЪРНОЯД *ACANTHOSCELIDES OBTECTUS* SAY.
FUMIGANT ACTION OF SOME ESSENTIAL OILS TOWARDS BEAN WEEVIL *ACANTHOSCELIDES OBTECTUS* SAY.

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Abstract

Bean weevil *Acanthoscelides obtectus* Say (Coleoptera: Bruchidae) is considered the main storage pest of the bean crop. Its control is performed mainly by chemical treatment, which has the potential to cause resistance in pests, as well as environmental contamination and a lot of harmful effects on non-target organisms.

This study aimed at evaluating the insecticidal effect by fumigation in laboratory conditions of some essential oils upon *A. obtectus* adults. Essential oils of *Capsicum frutescens* L., *Origanum vulgare* L., *Juniperus communis* L., *Syzygium aromaticum* (L.), *Salvia officinalis* L., *Foeniculum vulgare* Mill. were evaluated.

Our results indicate that all of the tested essential oils have good potential for controlling bean weevil. The essential oils from *Foeniculum vulgare* Mill, *Origanum vulgare* L. and *Syzygium aromaticum* (L.) express the most toxic action upon *A. obtectus* adults.

Keywords: *Acanthoscelides obtectus* Say, bean weevil, essential oils, fumigation.

INTRODUCTION

The bean beetle *Acanthoscelides obtectus* Say (Coleoptera, Chrysomelidae, Bruchinae) is a cosmopolitan and polyvoltin insect which attacks its host plant *Phaseolus vulgaris* L. and other Fabaceae such as those in the genus Vigna (Leroi and Jarry, 1981; Dobie et al., 1984).

As in several other bruchids, *A. obtectus* can complete its development both in maturing seeds and in stored ones (Thiery et al., 1994). Its life cycle on stored beans can occur without returning to the field (Labeyrie, 1962) causing crop losses of about 80% after six to seven months of storage (Idi, 1994).

Chemical methods are commonly used to control *A. obtectus* in stored grains. Phosphine gas (PH_3) is the main molecule used for controlling bean weevil. However, chemical control is associated with the increase in resistance of storage pests and has a high potential to cause environmental pollution and poisoning, especially in the applicants (Soares et al., 2009).

Furthermore, the adoption of alternative control methods is important, given the increasing demands for high-quality food exempted from the application of chemical inputs, and the increase in organic areas and agro-ecological farming (Lima Júnior et al., 2012).

Insect control using plant material is an ancient practice all over the world. Aromatic plants and their essential oils are among the most efficient botanicals. Their activities are manifold. They induce fumigant and topical toxicity as well as antifeedant or repellent effects. They are toxic to adults but also inhibit reproduction.

Although mechanisms depend on phytochemical patterns and are not yet well known, this widespread range of activities is more and more being considered for both industrial and household uses: essential oils are presently regarded as a new class of ecological products for controlling insect pests (Regnault-Roger, 1997).

Essential oils of several aromatic plants have been studied as fumigants for the control of stored product pests Callosobruchus maculatus (F.), Bruchus lentis (F.), Bruchus rufimanus (Boh.) (Haouel et al., 2012) and A. obtectus (Bouchikhi et al., 2008, 2010; Jairoce et al., 2016, Scariot et al., 2016, Goucem et al., 2016).

The present study aims to evaluate fumigant insecticidal activity of essential oils of *Capsicum frutescens* L., *Origanum vulgare* L., *Juniperus communis* L., *Syzygium aromaticum* (L.), *Salvia officinalis* L., *Foeniculum vulgare* Mill. as control alternatives against a stored product beetle *A. obtectus*.

MATERIALS AND METHODS

Essential oils from tested plants were prepared in Laboratory of Pesticide Science and Ecotoxicology – Agricultural University, Plovdiv by extraction via petroleum ether of dry plant materials and evaporation with vacuum rotary evaporator (RVO 004).

Fumigation bioassays were carried out with 10 adults (of 0 to 24 hold) exposed in Plexiglas bottles (333 cm^3 volume). Filter papers were attached to inner side of the bottle screw cap and on each paper were dropped with 0.1 ml of the given tested essential oils.

Four replications were made for each variant and control. The number of surviving individuals was recorded on the 48 hours after the treatment. The efficacy was estimated according to Henderson and Tilton formula (Henderson and Tilton, 1955).

The received data from conducted tests were statistically manipulated with R language for statistical computing (R Development Core Team, 2011) and *drc* R language package was used (Ritz and Streibig, 2005) for Dose-Response Modelling.

RESULTS AND DISCUSSION

The received results are listed below as Dose-Response Curves:

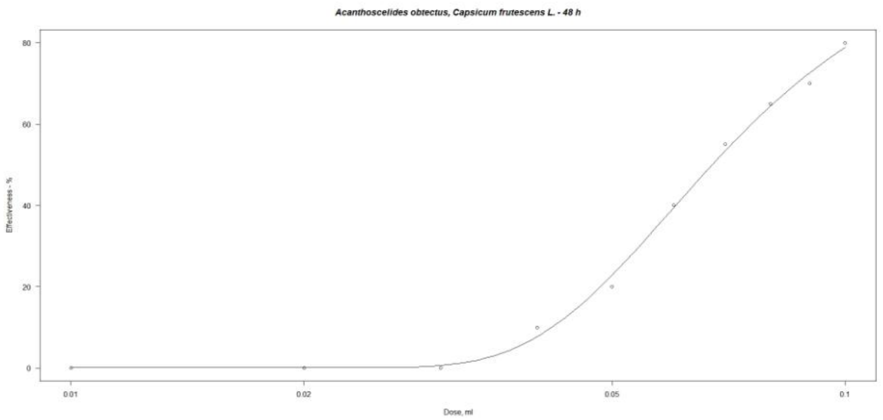

Fig. 1. *Dose-Response Curve – Capsicum frutescens* L.

The toxicological indicators:

- NOAEL – 0.035 ml
- LOAEL – 0.047 ml
- LD_{50} – 0.068 ml
- LD_{90} – 0.2 ml
- AIC = 47.69

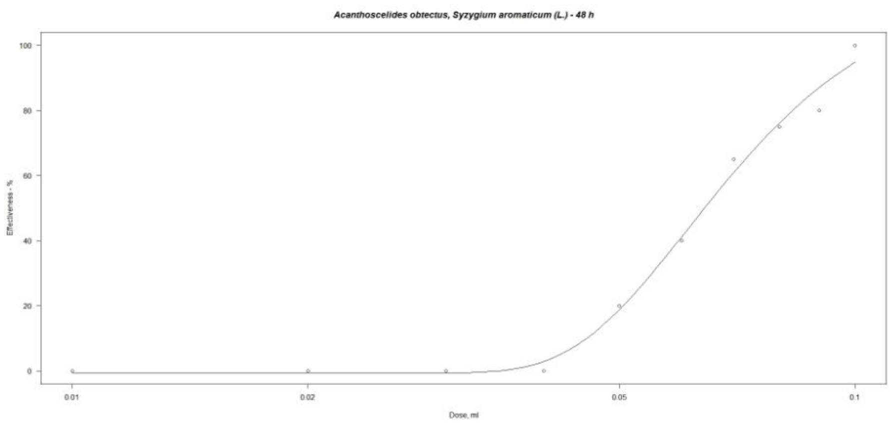

Fig. 2. *Dose-Response Curve – Syzygium aromaticum* (L.)

The toxicological indicators:

- NOAEL – 0.046 ml
- LOAEL – 0.054 ml
- LD_{50} – 0.07 ml
- LD_{90} – 0.08 ml
- AIC = 61.92

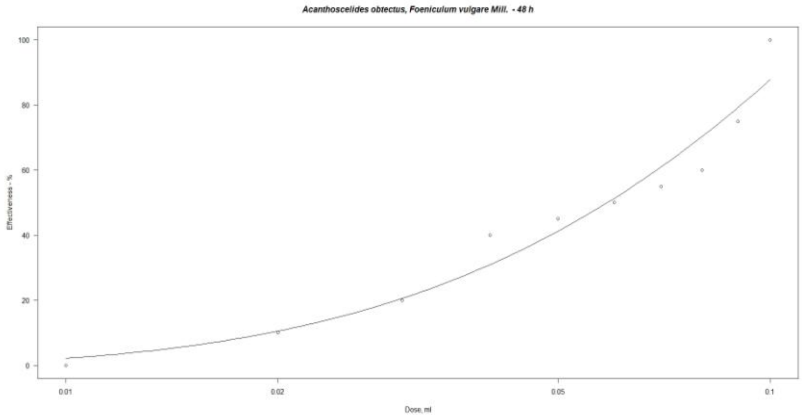

Fig. 3. *Dose-Response Curve – Foeniculum vulgare Mill.*

The toxicological indicators:

- NOAEL – 0.01 ml
- LOAEL – 0.03 ml
- LD_{50} – 0.066 ml
- LD_{90} – 0.09 ml
- AIC = 75.52

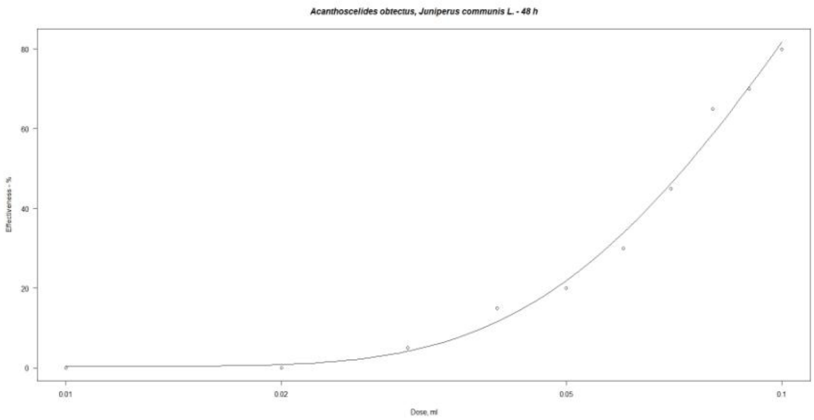

Fig. 4. *Dose-Response Curve – Juniperus communis* L.

The toxicological indicators:

- NOAEL – 0.027 ml
- LOAEL – 0.045 ml
- LD_{50} – 0.061 ml
- LD_{90} – 0.18 ml
- AIC = 58.88

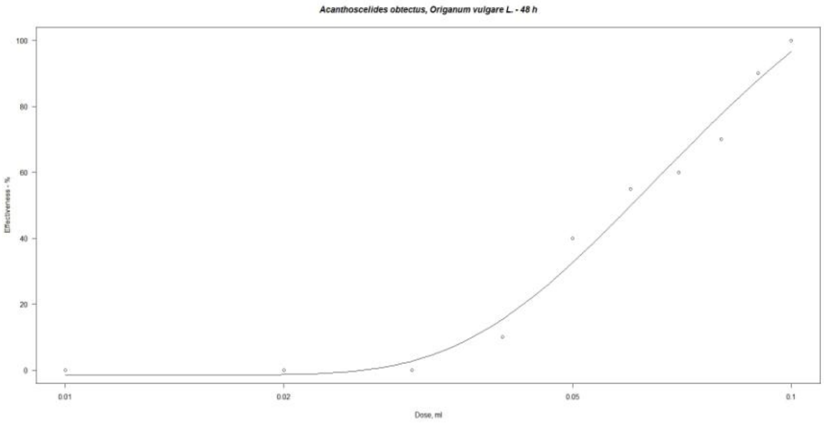

Fig. 5. *Dose-Response Curve – Origanum vulgare* L.

The toxicological indicators:

- NOAEL – 0.031 ml
- LOAEL – 0.044 ml
- LD_{50} – 0.067 ml
- LD_{90} – 0.08 ml
- AIC = 69.16

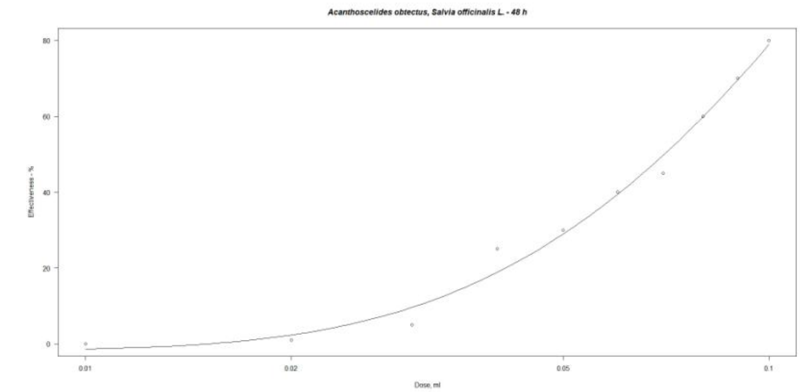

Fig. 6. *Dose-Response Curve – Salvia officinalis* L.

The toxicological indicators:

- NOAEL – 0.018 ml
- LOAEL – 0.04 ml
- LD_{50} – 0.07 ml
- LD_{90} – 0.17 ml
- AIC = 60.09

The summarized results from conducted Dose – Response Modellings are presented in the next diagram (Fig. 7).

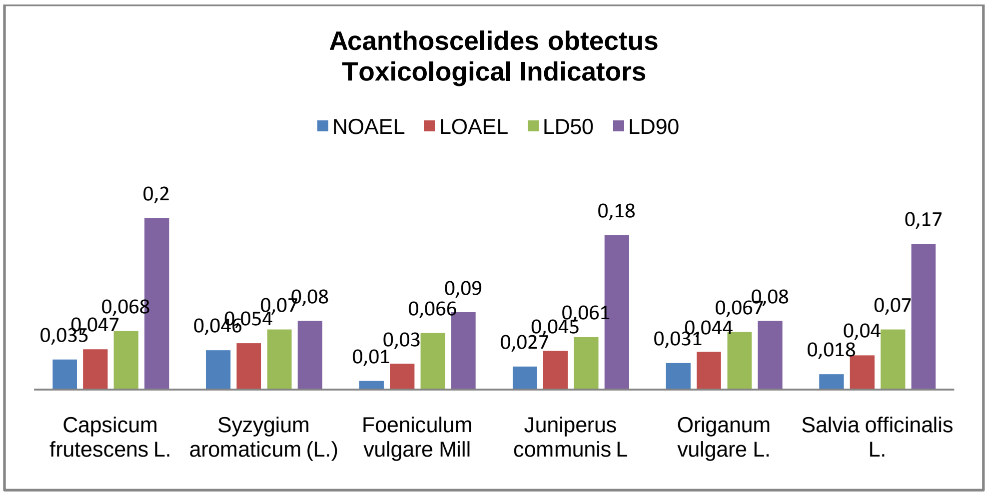

Fig. 7. *Toxicological indicators according to fumigant action of some essential oils towards Acanthoscelides obtectus Say*

CONCLUSIONS

1. In conclusion, results indicate that the tested essential oils have excellent fumigant effectiveness towards *A. obtectus* adults.

2. The essential oils from *Foeniculum vulgare* Mill, *Origanum vulgare* L. and *Syzygium aromaticum* (L.) express the most toxic action.

3. All of the tested oils have good potential for controlling bean weevil and shown very similar effectiveness.

4. Further research into the bioactivity of these oils against other stored product insects is needed before a commercial application can be considered.

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