BIOLOGICAL ACTIVITY OF CARUM CARVI ON TRIBOLIUM CONFUSUM (COLEOPTERA, TENEBRIONIDAE) ADULTS

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Abstract

Tribolium confusum duVal, 1863 (Coleoptera: Tenebrionidae) is one of the most serious pests in stored grain and related products. *T. confusum* was reared on a diet of wheat flour. The colonies were maintained in a growth chamber (Witeg, Germany, Model: GC-450) at 25±1oC, 45-50% r.h. Only adults were used for the experiments. The aerial parts of *Carum carvi* L. plants were collected from the Mošorin village, Vojvodina region (N 45o 18' 21.5'' E 20o 10' 53.9'', 90 m above sea level) on the 15 May 2015. The bioassays were carried out using groups of ten adult insects of *T. confusum*.The experiment was set in four replicates and control. The 50µl of known concentrations (6,32µl/l, 5,17µl/l, 4,02µl/l, 2,87µl/l, 2,3µl/l) of *C.carvi* was applied on filter papers. Mortality was determined 24h, 48h and 72h after the treatment.The highest concentrations 6,32 µl/l and 5,17 µl/l led to death more than 50% of insect population, after 48h and 72h. Also, lower concentartion showed strong insecticidal effect, where the mortality rate was 52,5% after 48h at the concentration of 4,02 µl/l and 47,5% at the concentration of 2,87µl/l.

Introduction

Tribolium confusum duVal, 1863 (Coleoptera: Tenebrionidae) is one of the most serious pests in stored grain and related products. It is considered as a secondary pest, which can easily infest damaged or broken kernels, and apart from grain, it is particularly destructive to flour and other processed grain products [1].

Concerns over health and environmental problems associated with synthetic insecticides currently in use in agriculture have led to an intensification of efforts to find safe, effective and viable alternatives. In this regard plant-based insecticides (PBIs) as described by Rosenthal [2] can be less toxic to man, readily biodegradable, suitable for use by small scale farmers and yet capable of protecting crops from attack by a wide range of insect pests [3]. Essential oils (EO) are complex mixtures of volatile compounds isolated from a large number of plants [4]. Generally EOs are less toxic to mammals and the environment than conventional insecticides, they degrade rapidly and do not accumulate in the environment [5].

Experimental

Test insects

T. confusum colonies were maintained in the laboratory of the Department of Environment and Plant Protection, Factulty of Agriculture, University of Novi Sad, without exposure to any insecticide. Insects were reared in plastic container (22 cm length x 10 cm height) covered by fine mesh cloth for sufficient ventilation. *T. confusum* was reared on a diet of wheat flour. The colonies were maintained in a growth chamber (Witeg, Germany, Model: GC-450) at 25±1oC, 45-50% r.h. Only adults were used for the experiments.

Plant material and essential oil isolation

The aerial parts of *Carumcarvi* L. (caraway) plants were collected from the Mošorin village, Vojvodina region (N 45o 18' 21.5'' E 20o 10' 53.9'', 90 m above sea level) on the 15. May 2015. The air-dried plant material (30g) was submitted to hydro-distillation using a Clenger-type apparatus for 3h. The oils were dried over anhydrous sodium sulphate and stored in a sealed vial at -20oC before analysis. The yield of essential oils was 4.1%.

Toxicity test

The bioassays were carried out using groups of ten adult insects of *T. confusum*. All the insects were starved for 24h before tests.The experiment was set in four replicates and control. The 50µl of known concentrations (6,32µl/l, 5,17µl/l, 4,02µl/l, 2,87µl/l, 2,3µl/l) of *C.carvi* was applied on filter paper. Flour disks have been added to avoid insect starvation. The treated filter papers were left on the room temperature for 5 min to allow the n-hexane to evaporate and dry. After drying, the treated filter papers were introduced into petri dishes which contained insects. To compare the toxicity of tested EO, filter papers with 50µl n-hexane served as a control. After placing filter papers, in the petri dishes, petri dishes were sealed with the parafilm. Mortality was determined 24h, 48h and 72h after the treatment. Treated insects were held in dark at 25±1^{o}C, 45-50% r.h. Adults were considered dead if legs and antennae did not move when observed under stereo zoom microscope (Motic, SMZ 171).

Results and discussion

Table 1 shows mortality rate of *T. confusum* adults. Concentrations, which were used, caused mortality of tested insects. After 24h, the highest concentrations (6,32 µl/l and 5,17 µl/l) caused death of the largest number of insects 45% and 25% and the diference beatween these two mortality rates was significant. After 48h, again the highest concentrations (6,32 µl/l and 5,17 µl/l) affected mortality of 77,5% and 60%. The similar situation was after 72h, when the number of died insects was also in the range from 60% to 80%. Lower concentration 4,02 µl/l caused over 50% of moratlity after 48h and 72h. The death of insects was the lowest at the concentartions 2,87 µl/l and 2,3 µl/l and on the first day moratlity rates were 5% and 2,5% and the last day were 47,5% and 32,5% (Figure 1).

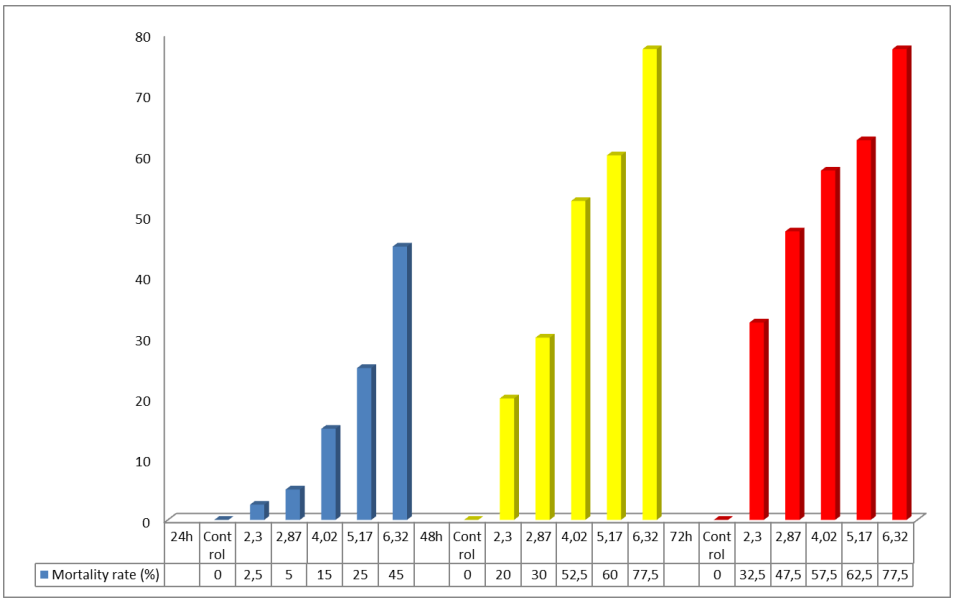

Figure 1. Moratlity of *T. confusum* after exposition of essential oil of *C. carvi*

Table 1. Number of died insects after applying essential oil of *C.carvi*

24h	Replicates				
Concentration (µL/L)	1.	2.	3.	4.	Mortality rate (%)
6,32	5	4	5	4	45,0
5,17	4	2	1	3	25,0
4,02	1	0	3	2	15,0
2,87	1	0	0	1	5,0
2,3	1	0	0	0	2,5
control	0	0	0	0	0
After 8h	Replicates				
Concentration (µL/L)	1.	2.	3.	4.	Mortality rate (%)
6,32	8	9	8	6	77,5
5,17	7	7	4	6	60,0
4,02	5	4	6	6	52,5
2,87	2	5	2	3	30,0
2,3	1	1	3	3	20,0
control	0	0	0	0	0
Nakon72h	Replicates				
Concentration (µL/L)	1.	2.	3.	4.	Mortality rate (%)
6,32	8	9	8	6	77,5
5,17	7	7	4	7	62,5
4,02	6	4	7	6	57,5
2,87	5	6	3	5	47,5
2,3	2	1	6	4	32,5
control	0	0	0	0	0

According to the [6] the essential oil of *Carumcarvi* fruits shows strong contact toxicity against *Sitophilus zeamais* and *Tribolium castaneum* adults with LD_{50} values of 3.07 and 3.39 µg/adult.

Furthermore, the essential oil of *C. carvi* has been demonstrated to possess strong contactand fumigant toxicity as well as repellency against several insects and mites, e.g. Japanese termite (*Reticulitermes speratus*), rice weevil (*S. oryzae*), sciarid fly *Lycoriella ingenua* larvae, the two-spotted spider mite *Tetranychus urticae* and its predator *Phytoseiulus persimilis*. The same authors mentioned that the insecticidal activity of the essential oil of caraway (*Carum carvi*) was investigated for the control of greenhouse whitefly (*Trialeurodes vaporariorum*). The results indicated that essential oil from caraway were the most effective at concentrations of 5 ppm (82. 95%) [7].

Conclusion

Different concentartions of essentail oil indicated very strong insecticidal activity. The highest concentartions (6,32µL/L and 5,17µL/L) caused mortality rate above 50% after 48h. Taking into account results of this experiment and other authors, it could be concluded that essential oil of caraway possesses strong insecticidal effect and it can be used as alternative method in the control of harmful insects.

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