

Resistance of *Cydia pomonella* (L.) (Lepidoptera: Tortricidae) to thiacloprid and activities of some detoxification enzymes collected from an apple orchard in Isparta

Mesut İşci¹, Recep Ay²

¹Fruit Research Station, 32500 Eğirdir, Isparta, Turkey; ²University of Süleyman Demirel, Faculty of Agriculture, Department of Plant Protection, 32260 Çünür, Isparta, Turkey

Abstract: Codling moth is the most important pest of apple on world. The codling moth *Cydia pomonella* L. is controlled mostly with chemical insecticides in Turkey. In this study it was aimed to evaluate *C. pomonella* populations resistance to thiacloprid which were collected from an apple orchard in Isparta. Resistance was evaluated by bioassay and biochemical methods. Chemical concentrations in 6 different dosages had been prepared. The synergistic activity between thiacloprid and piperonyl butoxide (PBO; monooxygenases inhibitor of cytochrome P450), diethyl maleate (DEM; inhibitor of glutathione-S-transferase GST), and S,S,S, tributyl phosphorotrithioate (DEF; inhibitor of esterase) was studied. Activities of esterase and GST of codling moth were determined by photometric methods. The substrates 1-naphthyl acetate and 1-chloro-2,4-dinitrobenzene (CDNB) were used for esterase and GST, respectively. Thiacloprid resistance levels in Isparta populations were 14.99-fold compared to a susceptible laboratory population. Application of thiacloprid with synergists DEM, PBO and DEF resulted in 1.53-, 1.51-, 1.33- fold synergistic ratios, respectively. While esterase enzyme activity in Isparta populations was higher than SV population (1.55 fold), GST enzyme activities didn't show a significant difference between Isparta and SV populations.

Key words: *Cydia pomonella*, codling moth, detoxification enzymes, resistance, thiacloprid

Introduction

Codling moth is the most important pest of apple and, in Isparta, it typically has two generations per year. Adult female moths can lay 30-70 eggs. Larvae must find and enter fruit within a few hours of hatching, tunneling the fruit and eating the pulp and core. Pupate inside silken cocoons 7-30 day development period depending on temperatures (Anonymous, 2008).

Due to the constant use of pesticides against this and other pests, the sensitivities of these insects to the active ingredients are decreasing over a long period of time. The number of resistant individuals within populations is increasing, depending on the number of sprayings. To solve the resistance problem, growers either increase dose or the number of sprayings. Both increase the risk of residues on fruits, the effects on the non-target organisms, natural enemies and the environment and also produce economic loss (Ay *et al.*, 2007).

In this study it was aimed to evaluate the resistance of *Cydia pomonella* populations to thiacloprid which were collected from an apple orchard in Isparta.

Material and methods

Isparta population was collected from apple orchards in Isparta province in Turkey. A susceptible strain (Sv) of *C. pomonella* was provided by INRA, Avignon, France.

Resistance was evaluated by bioassay and biochemical methods. Chemical concentrations in 6 different dosages had been studied. These thiacloprid (Calypso OD 240 g/l, Bayer, Germany) concentrations were applied topically to the dorsal surfaces of thorax segment of 5th instar larvae. POLO computer program was used to calculate LD50 value. The resistant ratio of the population was calculated by dividing LD50 value to susceptible codling moth value (SV) The synergistic activity between thiacloprid and piperonyl butoxide (PBO; monooxygenases inhibitor of cytochrome P450), diethyl maleate (DEM; inhibitor of glutathione-S-transferase GST), and S,S,S, tributyl phosphorotrithioate (DEF; inhibitor of esterase) was also studied in the Isparta populations. Distilled water or distilled water–acetone without a synergist was applied to the control group. Activities of esterase and GST of codling moth were determined by photometric methods. The substrates 1-naphthyl acetate for esterase, 1-chloro-2,4-dinitrobenzene (CDNB) and 1,2-dichloro-4-nitrobenzene (DCNB) for GST were used (Qian, 2008). Esterase enzyme bands were analyzed according to Ay and Gurkan, 2005.

Results and discussion

The resistance level to Thiacloprid in a Isparta population was 14.99-fold compared to a susceptible laboratory population. The application of thiacloprid with synergists DEM, PBO and DEF resulted in 1.53-, 1.51-,1.33- fold synergistic ratios in Isparta population, respectively. Esterase enzyme activity was higher in Isparta population than SV population (1.55 fold) while GST enzyme activities didn't show a significant difference between Isparta and SV populations.

According to these results, esterase enzyme may play a role in the resistance mechanism to thiacloprid in codling moth. The presence of different mechanisms deserves further investigation.

Acknowledgments

We thank Mrs. Myriam Siegwart who kindly provide the susceptible codling moth population from the France. This project (TOVAG-1100631) is partly supported by the Scientific and Technical Research Council of Turkey.

References

- Anonymous 2008: Plant protection technical instructions. Volume:4. Ministry of Agriculture and Rural Affairs, General Directorate of Agricultural Research :145-155.
- Ay, R. & Gürkan, M. O. 2005: Resistance to bifenthrin and resistance mechanisms of different strains of the two-spotted spider mite (*Tetranychus urticae*) from Turkey. *Phytoparasitica* 33(3): 237-244.
- Ay, R., Yaşar, B., Demirözer, O., Aslan, B., Yorulmaz, S., Kaya, M. & Karaca, İ. 2007: The determination of the residue levels of some commonly used pesticides in Isparta apple orchards. *Turkish journal of entomology*: 31(4): 297-306.
- Qian, L., Cao, G., Song, J., Yin, Q. & Han, Z. 2008: Biochemical mechanisms conferring cross-resistance between tebufenozide and abamectin in *Plutella xylostella*. *Pesticide Biochemistry and Physiology* 91:175-179.