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Biocidal effect of deltametrin against *Thaumetopoea wilkinsoni* Tams, 1924 (Lepidoptera: Notodontidae) in laboratory conditions

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Abstract
This study was carried out to determine the effect of deltamethrin, which is used against some urban pests, on *Thaumetopoea wilkinsoni* Tams, 1924 under laboratory conditions. The recommended dose of the biocidal against urban pests (60 ml / 10 liters of water), half dose (30 ml / 10 liters of water) and quarter dose (15 ml / 10 liters of water) were used in the study. At the highest dose of the biocidal, on day 1 (60 ml / 10 liters of water) 77.5% mortality was detected, three days showed 82.50% and five days showed 90% mortality. On day 5 of the study, the LD_{50} value for *T. wilkinsoni* was 34.03 and LD_{90} 56,21. As a result of the study, it has been determined that the Exdel 5 SC (Deltamethrin) has a biocidal effect for pine processionary moth.

Key words: Pine processionary moth, *Thaumetopoea wilkinsoni* ,deltamethrin, biocidal effect.

INTRODUCTION

Pine processionary moth (PPM), *Thaumetopoea* sp. (Lepidoptera: Notodontidae) is one of the most important forest pests in Turkey (Baronıo and Baldassari, 1997; Bilgili, 2002). This pest feeds on pine trees and spins webs on these trees (Androic 1956). The pine processionary moth (PPM), *Thaumetopoea* sp. is an endemic insect of pine trees, existing both in rural and urban areas causing economic damage throughout temperate regions of the Mediterranean, including southwestern Europe, the Balkan Peninsula and North Africa (Huchon and Demolin, 1971; Battisti 1988; Battisti et al., 2005; Simonato et al., 2007; Yılmaz et al., 2013; Kerdelhué et al., 2014; Battisti et al., 2015; Castagneyrol et al., 2016). It has been reported by some researchers that the pine processionary usually cause up to 60% losses in Turkey's at forest areas (Anonymous 1995; Kanat et al., 2002, 2004). Also, the weak trees that the pest feeds on become vulnerable to secondary pests like Scolytus (Kanat 2002; Ekerbiçer et al., 2002). Tree mortality is inevitable if control methods are not applied (Akkuzu and Selmi, 2002; Avcı and Ogurlu, 2002). Chemical control methods have been mostly preferred for management of this pest in forest areas. In addition to being a forest pest, this pest is seen in parks, houses and work places close to the forest. These harmful people cause diseases such as allergies, respiratory disease, conjunctivitis. For these reasons, this pest is considered an urban pest as well as a forest pest. Mechanical, biological and chemical control methods are applied against pine processionary moth, which is generally known for disturbing people and causing allergies in picnic areas. The mechanical control methods are not sufficient due to its limited application area. Today, there is no licensed biocidal for the control of *T. wilkinsoni*. Biocidal, whose active ingredient is

Deltametrin used today in the control of urban pests such as mosquitoes, houseflies, cockroaches and ticks (Ansaria and Razdan, 2001; Cao et al., 2006; Barile et al., 2008; Romera et al., 2009; Jankov et al., 2013; Jahan and Shadid, 2013). This study analyses the effects of this biocidal (Deltametrin and commercial name is Exdel 5 SC) on *T. wilkinsoni* in laboratory conditions.

MATERIALS AND METHODS

This study was carried out under controlled conditions (25 °C temperature and 65% humidity) in the laboratory of the Department of Plant Protection, in the Faculty of Agriculture, at Ondokuz Mayıs University. *Thaumetopoea wilkinsoni* Tams larvae (J3) were collected from red pine trees (*Pinus brutia*) in the campus area of the Ondokuz Mayıs University, Turkey. In the study, Anonymous (2016) and Koçak (2016) methods were revised. The recommended dose of the biocidal against urban pests (60 ml / 10 liters of water), half dose (30 ml / 10 liters of water) and quarter dose (15 ml / 10s liters of water) were used in the study. Four repetitions were made for each dose. Plastic containers were used in the study. All doses of the biocidal were sprayed in these containers (20 cm length, 10 cm width and 6 cm depth) with a suitable device; 0.5 ml per container. After waiting for 24 hours, 10 larvae were placed in the container and brought into contacted with the surface. After 30 minutes of contact time, larvae on the application surfaces were transferred into clean containers. The mortality was noted over 1,2,3,4 and 5 days following application. Dead individuals were counted and percent mortality was calculated. The mortality data was corrected by Abbott's Formula (Abbott, 1925). Fifty percent lethal dose (LD_{50}) and ninety percent lethal dose (LD_{90}) were determined using the probit analysis by SPSS (Ver. 21) program. The effects of mortality of the *T. wilkinsoni* was analyzed using one-way analysis of variance (ANOVA) (P=0.05), followed by a comparison of means using Duncan's multiple range test (SPSS, 2020).

RESULTS

Data obtained on the effect of different doses of deltamethrin biocidal on *T. wilkinsoni* larvae are given in Table 1. There was a significant increase in mortality as the dose increased. At the highest dose of the biocidal, on one day (60 ml / 10 liters of water), 77.5% mortality was detected on three days showed 82.50% and on five days showed 90% mortality. On five days of the study, the LD_{50} value for *T. wilkinsoni* was 34.03 and LD_{90} 56.21 respectively.

Table 1. Effects of different doses of deltametrine on *T. wilkinsoni* larvae

Dose (ml/10 lt water)	**(Average % death±standard error)**										**LD_{50} -LD_{90} (ml) (for 5. day)**
	1.day		**2.day**		**3.day**		**4.day**		**5.day**		
0	0	**b***	0	**c**	0	**c**	0	**c**	0	**c**	
15	0,00 ± 0,00	**b**	7,50 ± 2,50	**bc**	7,50 ± 2,50	**c**	7,50 ± 2,50	**c**	12,50 ± 4,78	**c**	
30	15,00 ± 6,45	**b**	25,00 ± 12,58	**b**	37,50 ± 11,81	**b**	42,50 ± 11,08	**b**	50,00 ± 10,80	**b**	**34,03 – 56,21**
60	77,50 ± 7,50	**a**	80,00 ±7,07	**a**	82,50 ± 7,50	**a**	87,50 ± 9,46	**a**	90,00 ± 7,07	**a**	

* Lower case letters in same column indicate all doses comparisons (P<0.05)

DISCUSSION

Thaumetopoea sp. larvae are very harmful to pines and they also cause allergic reactions for people and animals. Generally this is used mechanic control against *Thaumetopoea* sp. But mechanical

control is applicable in small area. Different chemical and biological control methods with several insect growth regulators (diflubenzuron, triflumuron), pyrethroits (cypermethrin, cylfuthrin) and a microbial insecticide *Bacillus thuringiensis* have been applied in forest of Turkey since 1997. Small instars (1st-3rd) are especially susceptible to these applications, but late instars (4^{th}-5^{th}) need higher application doses. However, higher doses of chemical insecticides are harmful for many predators and non-target organisms (Demolın 1986; Altero and Moller, 2000; Beck et al., 2004). There are many studies in the forests to control this pest (Kanat and Alma, 2004; Kalender et al., 2005; Çetın et al., 2006; Semiz et al., 2006; Kesdek et al., 2014; Yiğit 2019). However, the measures to be taken against this pest in human living areas such as our homes and parks are limited. Chemicals used in forest areas are also objectionable and prohibited in human habitats. *Thaumetopoea* sp. is occasionally seen in human habitats. Therefore, people are not informed on precautions to take in protection against this pest. In addition, there is no biocidal products licensed against this pest to date. Insecticides used in forest are applied directly on the targeted pest. However, biocidal substances to be used in human habitats are not applied directly to the targeted pest; they are residual biocidal applied to the areas where insects may contact (Jankov et al., 2013). Deltametrin as Biocidal is used against urban pests such as mosquitoes, houseflies, cockroaches and ticks (Ansaria and Razdan, 2001; Cao et al., 2006; Barile et al., 2008; Romera et al., 2009; Jankov et al., 2013; Jahan and Shahid, 2013).

As a result of the study, it has been determined that Exdel 5 SC commercial name biocidal pine processionary moth with Deltametrin effective substance used in the control against urban pests such as mosquitoes, houseflies, cockroaches and ticks have been tried and found to be effective.

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