https://doi.org/10.17221/63/2019-JFS

The effect of some commercial plant oils on the pine processionary moth *Thaumetopoea pityocampa* (Lepidoptera: Notodontidae)

Şeyma Yiğit[1], İslam Saruhan[1], İzzet Akça[1,2]*

[1]Department of Plant Protection, Ondokuz Mayıs University, Samsun, Turkey
[2]Agrobigen, Samsun Technopark, Ondokuz Mayıs University, Samsun, Turkey
**Corresponding author: seyma.yigit@omu.edu.tr*

Citation: Yiğit Ş., Saruhan İ., Akça İ. (2019): The effect of some commercial plant oils on the pine processionary moth *Thaumetopoea pityocampa* (Lepidoptera: Thaumetopoidae). J. For. Sci., 65: 309–312.

Abstract: *Thaumetopoea pityocampa* (Lepidoptera: Notodontidae) is one of the major forest pests and causes serious damage especially to pine trees. Mechanical and chemical methods are used in the control of this pest in Turkey's forests. In recent years, a chemical control has been the most preferred method against this pest. Due to the chemical control's harmful effects on the environment and the human health, alternative methods of control are being emphasised today. There are many studies on the use of plant oils against pests in agricultural areas. However, studies on the effect of plant oils against the pine processionary larvae are very limited. In this study, commercial oils containing 8 different essential oil types (thyme oil, peppermint oil, poppy oil, garlic oil, rosemary oil, pine oil, sage oil, lavender oil) were applied in 3 different doses (0.1%, 0.5%, 1%) and 4 repetitions against the pine processionary larvae. The experiments were conducted at 65% humidity and 25°C in laboratory conditions. The study was monitored for five days and the results were evaluated through the mortality rates. On the 5th day of the study, 1% dose of thyme oil was found to be most effective with 100% mortality followed by the poppy oil (95%), the sage oil (95%), the garlic oil (90%), the rosemary oil (70%), and the pine oil (45%). The peppermint (40%) and lavender oil used in the study were found to be ineffective. As a result of the study, it was determined that thyme oil, poppy oil, sage oil, and garlic oil were effective against the pine processionary larvae and that they had the potential to be used in the control of this pest.

Keywords: essential oil; toxic effect; control; pine moth

The pine processionary (*Thaumetopoea pityocampa* Denis et Schiffmüller, 1775) is an important pest due to the loss they cause in the yield of trees by eating the needles in the pine species, which constitute a large part of Turkey's forests. *Thaumetopoea pityocampa* (the pine processionary moth) is one of the most important pine pests in the forests of the Mediterranean countries, Central Europe, the Middle East, and North Africa (Vega 1999), but they have also been seen in the middle Black Sea region in 2007 (Ince 2007). This pest reproduces once a year. 1,500,000 ha of the forest areas in Turkey are infested with this pest. The infestation rate is 47% in the Mediterranean region, 40% in the Marmara region and 10% in the Aegean region (Kanat et al. 2002). It has been reported by some researchers that the pine processionary usually cause up to 60% losses in Turkey's forest areas (Anonymous 1995; Kanat et al. 2002, 2005). In addition, trees become vulnerable to secondary pests such as *Scolytidae* since they are weakened by the pest feeding on them. In addition to all this damage, the hairs on the larva cause allergic reactions such as respiratory failure, conjunctivitis, and

https://doi.org/10.17221/63/2019-JFS

asthma in humans and animals (Ekerbiçer 2002; Kanat 2002). Tree mortality is inevitable if control methods are not adopted (Akkuzu, Selmi 2002; Avci, Oğurlu 2002).

Mostly, mechanical and chemical control methods are applied against the pine processionary. The mechanical control methods are not sufficient due to its limited application area, and the insecticides used in the chemical control have a negative effect on the human health and other organisms and they also cause the population of useful species in nature to decrease. Since insecticides do not provide a permanent solution, it should be repeated again over certain periods. Due to the negative effects of the mechanical and chemical control methods, the importance given to methods that do not harm the ecological balance (biological control, biotechnical control, etc.) have increased. Plant insecticides are important in terms of not harming nature. The studies carried out to date have shown that the etheric oil components show insecticide, ovicidal, attractant, repellent, antifeedant, and growth and reproduction prevention properties against pests (Saxena, Koul 1978; Shukla et al. 1989; Singh et al. 1989; Mwangi et al. 1992; Shaaya et al. 1993; Singh, Upadhyay 1993; Schmitt 1994; Ndungu et al. 1995; Shaaya et al. 1997).

Plant oils are preferred in control methods against pests due to the fact that they are found in nature have no additional toxic substances, they do not cause soil and water pollution because they decompose over a short time, they do not threaten human health with residue, and they are specific. As essential oils have a wide biological spectrum for pests, they have insecticide and repellent properties, and can also affect the growth and reproduction of the pest (Harwood et al. 1990; Isman 2000; Papachristos, Stamopoulos 2002, 2004; Petrakis et al. 2005; Isman et al. 2008). Essential oils are also preferred for their low toxicity against mammals and the absence of any known harmful effects to the environment compared to the insecticides (Rebenhorst 1996; Misra, Pavlostathis 1997; Isman 2000). Studies of the effect of essential oils, which show insecticide properties against many pests, against the pine processionary are very limited (Kanat, Alma 2003; Çetin et al. 2006; Kesdek et al. 2014).

The aim of this study was to investigate the effect of some plant based commercial oils on the *T. pityocampa* larvae.

MATERIAL 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 Mayis University. Commercial plant oils obtained from an herbalist – thyme oil, poppy oil, sage oil, garlic oil, rosemary oil, pine oil, peppermint oil, and lavender oil – were used in the study.

Thaumetopoea pityocampa larvae (J3) were collected from red pine trees (*Pinus brutia*) in the campus area of the Ondokuz Mayis University. The experiment was conducted in 4 different iterations with different doses (0.1, 0.5 and 1.0%) of each type of essential oil against the larvae. As a nutrient, a certain amount of pine needles was placed on a drying paper moistened with pure water in 10 × 10 cm plastic containers. Ten larvae were then placed in each plastic box. The larvae used in the experiment were selected from a single colony.

The different doses of the essential oils used in the study were prepared using pure water and Tween 80 (0.3%). 2 ml of the prepared doses were sprayed in each plastic box with the larvae. Only pure water was sprayed in the control boxes. Five days after the application, the dead larvae in each box were counted and the mortality rates were determined. The mortality rates were compared by a one-way analysis of variance (ANOVA), followed by Duncan's test when significant differences were found at $P < 0.05$ (SPSS, Version 21).

RESULTS AND DISCUSSION

Table 1 shows the data obtained from the study of the different commercial plant oils against the pine processionary. Depending on the type of oil, the toxicity of the application increased as the dose increased. The study showed that the highest mortality rate in the highest dose (1%) was in the thyme oil (100%), followed by the poppy (95%), sage (95%), garlic (90%), rosemary (70%), and pine (45%) oils. The peppermint (40%) and lavender oil used in the study were ineffective compared to other oils. As a result of the study, it was determined that the thyme, poppy, sage, and garlic oils were effective against the pine processionary larvae and they had the potential to be used in control methods against this pest. The rosemary, pine,

https://doi.org/10.17221/63/2019-JFS

Table 1. The toxic effects of some of the essential oils on the *T. pityocampa* larvae

Essential oil	Mortality rate – dose		
	0.1 (%)	0.5 (%)	1 (%)
Sage	30.00 ± 5.77^{cAB}	55.00 ± 9.57^{bBC}	95.00 ± 5.00^{aA}
Lavender	20.00 ± 8.16^{aBC}	20.00 ± 8.16^{aDE}	40.00 ± 8.16^{aC}
Peppermint	0.00 ± 0.00^{bC}	15.00 ± 5.00^{bE}	40.00 ± 8.16^{aC}
Garlic	35.00 ± 5.00^{bAB}	40.00 ± 8.16^{bCD}	90.00 ± 5.77^{aA}
Rosemary	45.00 ± 9.57^{bA}	50.00 ± 5.77^{abBC}	70.00 ± 5.77^{aB}
Thyme	40.00 ± 8.16^{bAB}	90.00 ± 5.77^{aA}	100.00 ± 0.00^{aA}
Poppy	40.00 ± 8.16^{cAB}	70.00 ± 5.77^{bAB}	95.00 ± 5.00^{aA}
Pine	5.00 ± 5.00^{bC}	20.00 ± 8.16^{abDE}	45.00 ± 9.57^{aC}

*the same lower-case letters in the same row indicate no statistically significant difference between the doses, **the same capital letters in the same column indicate no statistically significant difference between the essential oils

peppermint and lavender oils were found to be less effective.

Çetin et al. (2006) topically applied 3 different doses (0.1%; 0.5%; and 1%) of thyme oil (*Origanum onites* L.) against the pine processionary larvae and reported that the thyme oil was effective as a result of the study. Similarly, Kanat and Alma (2004) reported that thyme oil killed the larvae suddenly, but that lavender oil killed the larvae slowly and to a lesser extent. In addition, Kestek et al. (2014) stated that the extracts obtained from the thyme plant were effective against the pine processionary. As a result of both the study and the previous studies, thyme, sage, poppy, garlic and rosemary oils have been shown to be a potential alternative to synthetic insecticides especially in the control against the pine processionary.

CONCLUSIONS

In recent years, studies on measures that may be an alternative to chemical control methods have gained importance in the control against pests. The use of plant extracts and oils is an important part of the alternative measures in the control methods against pests and there are many scientific studies on this subject. Although limited, there are studies on the effects of plant oils against the pine processionary, which is an important pest in forests and sometimes human habitats such as parks and gardens due to their disturbing nature (Kanat, Alma 2003; Çetin et al. 2006; Kesdek et al. 2014). In our study, some commercial essential oils (thyme, sage, poppy, garlic, and rosemary) have been found to be 70–100% effective against the pine processionary larvae. The data obtained from the study is thought to contribute significantly to the control of the pine processionary.

Acknowledgement

We would like to thank Emine Cebeci and Arif Bagci for their contributions to the laboratory studies.

References

Akkuzu E., Selmi E. (2002): The use of microbial control agents against *Thaumetopoea pityocampa* (Den. & Schiff.). Proceedings of Pine Processionary Moth Symposium, Kahramanmaras, Turkey, April 24–25, 2002: 67–74.

Anonymous (1995): Harmful Insects of Forests. The Reports of the 5th Annual Development Plan. Ankara, State Planning Organization: 1.

Avcı M., Ogurlu I. (2002): The importance, biology and natural enemies of the pine processionary moth (*Thaumetopoea pityocampa* (Schiff.)) in the lakes district. Proceedings of Pine Processionary Moth Symposium, Kahramanmaras, Turkey, April 24–25, 2002: 28–36.

Çetin H., Yanıkoglu A. (2006): A study of the larvicidal activity of Origanum (Labiatae) species from southwest Turkey. Journal of Vector Ecology, 31: 118–122.

Ekerbicer H., Celik M., Aral M., Sasmaz S. (2002): Harmful effects of the pine processionary moth (*Thaumetopoea pityocampa*) on human health. Proceedings of Pine Processionary Moth Symposium, Kahramanmaras, April 24–25, 2002: 203–205.

https://doi.org/10.17221/63/2019-JFS

Ince I. A., Demir I., Demirbag Z., Nalcacioglu R.A. (2007): Cytoplasmic polyhedrosis virus isolated from the pine processionary caterpillar, *Thaumetopoea pityocampa*. Journal of Microbiology and Biotechnology, 17: 632.

Isman M.B. (2001): Plant essential oils for pest and disease management. Crop Protection, 9: 603–608.

Isman M.B., Wilson J.A., Bradbury R. (2008): Insecticidal activities of commercial rosemary oils (*Rosmarinus officinalis*) against larvae of *Pseudaletia unipuncta* and *Trichoplusia niin* relation to their chemical composition'. Pharmaceutical Biology, 46: 82–87.

Kanat M., Alma M.H. (2004): Insecticidal effects of essential oils from various plants against larvae of pine processionary moth (*Thaumetopoea pityocampa* Schiff) (Lepidoptera: Thaumetopoeidae). Pest Management Science, 60: 173–177.

Kanat M., Sivrikaya F., Serez M.A. (2002): Research on the effects of pine processionary moth (*Thaumetopoea pityocampa* Schiff)), *Pinus brutia.* Ten trees and tending activities on the diameter increment of calabrian pine in Kahramanmaras, Pine Processionary Moth Symposium, Kahramanmaras, Turkey, April 24–25, 2002: 44–51.

Kanat M. (2002): The usage of *Calosoma sycophanta* L. (Coleoptera: Carabidae) against pine processionary moth (*Thaumetopoea pityocampa* Schiff) (Lepidoptera: Thaumetopoeidae) in biological control, Pine Processionary Moth Symposium, Kahramanmaras Turkey, April 24–25, 2002: 93–101.

Kesdek M., Kordali S., Coban K., Usanmaz A., Ercisli S. (2014): Larvicidal effect of some plant extracts on the pine processionary moth, *Thaumetopoea pityocampa* (Denis & Schiffermuller) in laboratory conditions. Acta Scientiarum Polonorum, Hortorum Cultus, 13: 145–162.

Mwangi J.W., Addae-Mensah I., Muriuki G., Munavu R., Lwande W., Hassanali A. (1992): Essential oils of lippia species in Kenya. IV: Maize weevil (*Sitophilus zeamais*) repellency and larvicidal activity. International Pharmacognosy, 30: 9–16.

Misra G., Pavlostathis S.G. (1997): Biodegradation Kinetics of Monoterpenes in Liquid and Soil-Slurry Systems. Applied Microbiology and Biotechnology, 47: 572–577.

Ndungu M., Lwande W., Hassanali A., Moreka L., Chhabra S.C. (1995): Cleome monophylla essential oil and its constituents as tick (*Rhipicephalus appendiculatus*) and maize weevil (*Sitophilus zeamais*) repellents. Entomology Experimentalis et Applicata, 76: 271–222.

Papachristos D.P., Karamanoli K.I., Stamopoulus D., Spiroudi U.M. (2004): The relationship the chemical composition of three essential oils and their insecticidal activity against *Acanthoscelides obtectus*. Pest Management Science, 60: 514–520.

Petrakis V. (2005): The effect of terpenoid extracts from 15 pine species on the feeding behavioural sequence of the late instars of the pine processionary caterpillar *Thaumetopoea pityocampa*. Behavioural Processes, 69: 303–322.

Rabenhorst J. (1996): Production of methoxyphenol-type natural aroma chemicals by biotransformation of eugenol with a new *Pseudomonas* sp. Applied Microbiology and Biotechnology, 46: 470–474.

Saxena B.P., Koul O. (1978): Utilisation of essential oils for insect control. Indian Perfumer, 22: 139.

Schmitt A. (1994): Plant Extracts as Pest and Disease Control Agents. Proceedings of the International Meeting, Trento, June 2–3, 1994: 264–272.

Shaaya E., Ravid U., Paster N., Kostjukovsky M., Menasherov M., Plotkin S. (1993): Essential Oils and their Components as Active Fumigants against Several Species of Stored Product İnsects and Fungi. ISHS Acta Horticulturae 344, International Symposium on Medicinal and Aromatic Plants, Tiberias on the Sea of Galilee, Israel, November 1, 1993: 131–137.

Shaaya E., Kostjukovski M., Eilberg J., Sukprakarn C. (1997): Plant oils as fumigants and contact insecticides for the control of stored product insects. Journal of Stored Products Research, 33: 7–15.

Singh G., Upadhyay R.K. (1993): Essential oils: a potent source of natural pesticides. Journal of Scientific and Industrial Research, 52: 676–683.

Singh D., Siddiqui M.S., Sharma S. (1989): Reproduction retardant and fumigant properties in essential oils against rice weevil (Coleoptera: Curculionidae) in Stored Wheat. Journal of Economic Entomology, 82: 727–733.

Vega J.M., Moneo I., Armentia A., Fernandez A., Vega J., De La Fuente J.R., Sanchez P., Sanchis M.E. (1999): Allergy to the pine processionary caterpillar (T*haumetopoea pityocampa*). Clinical and Experimental Allergy, 29: 1418–1423.

Received for publication May 27, 2019
Accepted after corrections August 9, 2019