International Journal of Innovative Engineering Applications

Journal homepage: https://dergipark.org.tr/ijiea

EFFECT OF INCREASED DOSES OF THREE MUSTARD OIL AND TWO TEA TREE OIL FORMULATIONS ON *CIMBEX QUADRIMACULATA*

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Abstract

Original scientific paper

The female of almond saw fly lays eggs in and on plant tissue in spring and summer time, once the eggs hatch the young larvae start to feed on the almond leaves, causing defoliation of the trees depending on the population levels. In this study; It is aimed to evaluate the effects of three mustard oil and two tea tree oil formulations used against larval stages of the almond insect pest *Cimbex quadrimaculata* (Müller, 1766) (*Hymenoptera: Cimbicidae*). The five botanical formulations were tested under laboratory conditions, using dipping method of 3 cm diameter almond leaves, which, were dipped five different doses and air dried before being offered to the first larval stages, including negative control using only water. Feeding and mortality rates of 240 larvae in total were followed up until the end of the pupal period and recorded. It was determined that the increased dose of the formulation containing mustard oil + allylisothiocyanate monoethanolamine dissolved in non-ionic surfactants was more effective than other botanical formulations. The results of this study are important for almond organic pest management.

Keywords: *Cimbex quadrimaculata, botanical formulations, increased dose, insecticidal effects.*

ÜÇ HARDAL YAĞI VE İKİ ÇAY AĞACI YAĞI FORMÜLASYONLARININ ARTTIRILMIŞ DOZLARININ *CİMBEX QUADRİMACULATA'YA* ETKİSİ

Özet

Orijinal bilimsel makale

Dişi badem yaprak arısı sineği, ilkbahar ve yaz döneminde, bitki dokusu içinde ve üzerinde yumurta bırakır, yumurtadan çıktıktan sonra genç larvalar badem yapraklarıyla beslenmeye başlar ve popülasyon seviyelerine bağlı olarak ağaçların yaprak dökülmesine neden olur. Bu çalışmada, badem böcek zararlısı *Cimbex quadrimaculata* (Müller, 1766) (*Hymenoptera: Cimbicidae*)'nin larva evrelerine karşı kullanılan üç hardal yağı ve iki çay ağacı yağı formülasyonunun etkilerinin değerlendirilmesi amaçlanmaktadır. Beş botanik formülasyon, laboratuvar koşullarında, sadece su kullanılarak negatif kontrol de dahil olmak üzere ilk larva aşamalarına sunulmadan önce beş farklı dozda daldırılan ve havayla kurutulan 3 cm çapında badem yaprakları daldırma yöntemi kullanılarak test edildi. Toplam 240 larvanın beslenme ve ölüm oranları pupa döneminin sonuna kadar takip edilerek kayıt altına alındı. İyonik olmayan sürfaktanlarda çözünmüş hardal yağı + allylisothiocyanate monoethanolamine içeren formülasyonun artan dozunun diğer botanik formülasyonlara göre daha etkili olduğu belirlendi. Bu çalışmanın sonuçları badem organik zararlı yönetimi için önemlidir.

Anahtar Kelimeler: *Cimbex quadrimaculata, botanik formülasyonlar, artan doz, böcek öldürücü etkiler.*

1 Introduction

Almond production mostly is centered in Aegean, Mediterranean, Marmara, Southeast and Eastern Anatolia regions. There are major insect pests that affect yield and quality in almond orchards. Among these species, *C. quadrimaculata* was established as the major species causing about 51% damage to almond orchards (Figure 1). This polyphagous species being damages cherry, apricot, peach, pear, and especially almonds in the region (Nizamlıoğlu, 1961; Maçan, 1986; Russo et al., 1994). The larval stages chew the young leave margins first of the host plants, before feeding the other parts causing defoliation of the almond trees (Bolu et al., 2005; Bolu, 2016). There were yield differences between wild almond and cultivated almond varieties in eastern and southeastern Anatolia region (Özgen et al., 2021). The larvae given the same amount of fresh almond leaves for their daily diet changed their larval stage according to the effects of the initial doses of the herbal extract. As the

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Received 17 March 2022; Received in revised form 27 September 2022; Accepted 03 October 2022

Doi: https://doi.org/10.46460/ijiea.1081953

larval stages develop further, the damage increases. It causes extensive damage to trees and effectively defoliates the trees in high populations (Bolu, 2016). Due to defoliation, unfortunately the next year's fruit buds do not develop and the damage is directly reflected on the next years' yield. Therefore, it can cause significant economic damage. Studies on pest control so far are limited. In controlling the pest, it is important to develop alternative methods to chemical control, especially to contribute to organic almond cultivation. For this purpose, the effectiveness studies of different formulations developed by BioAust and obtained from mustard oil and Australian tea trees were tested within the scope of The Scientific and Technological (TUBITAK) Research Project No: 118O124, and the results of this study are in the evaluation stage. To contribute to these studies, it is aimed to reveal what kind of change these formulations provide between pest nutrition and mortality parameters when mixed with each other. The results of the study are important in terms of almond integrated pest management studies. Due to botanical insecticides, do not affect the insect pests' parasitoids and their predators. Therefore, these formulations are easily can be used in IPM systems.

Figure 1. The Habitus of *Cimbex quadrimaculata* Müller,1766.

2 Material and Method

The studies were established with first larval stages collected from the non-sprayed almond orchards. Studies were carried out in a climate cabinet with 65% humidity and 25C ± 2°C and 30C ± 2°C temperature conditions, 16:8 lighting periods. These trials were carried out in the climate room of the Bioengineering Department between 01.09.2018 – 01.09.2021. The formulations used in the study and their codes are shown in Figure 2 and Table 1.

Figure 2. Plant extracts used in trials.

Table 1. F-Formulation Extracts used against *C. Quadrimaculata.*

Herbal Extract Code	Substance
F4	Mustard oil + monoethanolamine solubilized in nonionic surfactants
F7	Mustard oil + allylisothiocyanate monoethanolamine solubilized in nonionic surfactants
F8	Mustard oil+morpholene amid solubilized in nonionic surfactants
F9	Australian tea tree oil extracts + allylisothiocyanate + morpholene amid solubilized in nonionic surfactants
F10	Australian tea tree oil extracts + allothiocyante + monoethanolamine solubilized nonionic surfactants

In the study, leaf discs with a diameter of 3 cm were immersed in extract dilutions for 30 seconds and dried for 1-2 hours in a fume hood and placed on a filter paper (moist) in a plastic container (7 cm in diameter and 3 cm in height) in order not to dry the leaf. The extracts were obtained by mixing 6 different formulations at a certain rate. In the increase, the system in Table 2. was applied. 1 ml of each F insecticide was taken. Different formulations were obtained by increasing 1 ml in each formulation, and the differences of the mixture, which is prominent in the effectiveness of the drugs, compared to other formulations were revealed. Each formulation was mixed with 1 liter of distilled water and the solutions and times in which the leaves were soaked were adjusted equally. Leaf feeding areas were divided by the total area, and data on the percentage of the leaf on which the pest was fed were recorded. Five replications were used for each formulation. 10 1st instar *C. quadrimaculata* larvae were used in each replication and 10 controls were used for each formulation. Feeding and mortality rates of 240 larvae in total were followed up until the end of the pupal period and recorded.

Table 2. Increased formulation codes and doses.

Code	Dose
1	F9+F8+F7+F10+F4 (All of 1 ml)
2	F9 (2 ml), others 1 ml
3	F8 (2 ml), others1 ml
4	F7 (2 ml), others1 ml
5	F10 (2 ml), others 1 ml
6	F4 (2 ml), others 1 ml

3 Results and Discussion

It was shown that differences between formulations in Table 3. This is the first study on this pest. Therefore, the findings will contribute to the literature. The effects of the applied botanical formulations on the feeding behavior of *C. quadrimaculata* were investigated with the Kruskal-Wallis test. When Table 2. is examined, the statistical effect of botanical formulations on feeding behavior is significant ($p<0.05$). The 4th formulation was statistically significantly higher than the 1st, 3rd, 5th, and 6th formulations ($p<0.05$). The 2nd formulation was statistically significantly higher than the 5th formulation ($p<0.05$).

Table 3. Kruskal-Wallis Test and Pairwise comparisons of formulation Grup.

Formulations	Mean ± sd	N	Mean Rank	Test Statistic	p	Pairwise Comparisons	
						Sample 1- Sample 2	p
1	0.5±0.00	10	23,50	47,778	,000	1-4	**,000[a]**
2	0.63±0.13	10	33,25			2-5	**,000[a]**
3	0.5±0.00	10	23,50			3-4	**,000[a]**
4	1±0.00	9	50,00			4-5	**,000[a]**
5	0.13±0.05	6	3,50			4-6	**,001[a]**
6	0.5±0.00	9	23,50				

a. Significance values have been adjusted by the Bonferroni correction for multiple tests. The significant level is .05

Acknowledgements

The study of Dr. İnanç Özgen and his collaboration friends was performed in the framework of "The Scientific and Technological (TÜBİTAK) Research Project No: 118O124. We thank TÜBİTAK for the study grant.

Declaration

Ethics committee approval is not required.

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