Zoological and Entomological Letters

E-ISSN: 2788-8428
P-ISSN: 2788-8436
ZEL 2022; 2(1): 01-03
Received: 13-10-2021
Accepted: 02-12-2021

İnanç Özgen
Fırat University, Engineering Faculty, Bioengineering Department, Elazığ, Turkey

Yunus Güral
Fırat University, Statistic Department, Elazığ, Turkey

Tuba Aslan
Fırat University, Engineering Faculty, Bioengineering Department, Elazığ, Turkey

Correspondence Author:
İnanç Özgen
Fırat University, Engineering Faculty, Bioengineering Department, Elazığ, Turkey

The determination of the relationships between yield parameters and number of larvae of almond saw fly (*Cimbex quadrimaculata* Müller, 1766, Hymenoptera: Cımbıcıdae) on different almond varieties in Turkey

İnanç Özgen, Yunus Güral and Tuba Aslan

Abstract
This study was carried out between 2020-2021 to determine the relationships between the number of larvae and yield parameters of *Cimbex quadrimaculata* Müller, 1766 (Hymenoptera: Cimbicidae) in wild and cultivated almond cultivars in Diyarbakır and Elazığ provinces. It has been determined that the pest has a higher population in wild almonds than cultivated almonds, and the yield of almond trees decreases as the number of pests increases. However, it has been determined that this change is different according to tree age and crown projection. When the damage degrees of the pest were examined among the locations, it was determined that the yield of wild almond trees in Keban location in 2020 was less affected by the number of pests than other locations. It was determined that the number of larvae affected the yield parameters more than the other varieties in the cultivated almonds in the Keban location in 2021. It is thought that the pest affects the yield parameters in all locations, regardless of species, and this study will form the basis for model studies on the Economic Damage Threshold (EZE) of this pest.

Keywords: Almond, *Cimbex quadrimaculata*, yield parameters, EZE model, Turkey

Introduction
Approximately 25% of the almond production in our country is made in the Eastern and Southeastern Anatolia Regions. Diseases and pests have an important place among the factors affecting the yield and quality in almond production areas. Global warming and climate change bring along important problems not only in terms of the plant's need for water, but also in terms of harmful and disease factors. Especially the water stress that will occur in the plants affects the plant quality, the development and damage of the insect (Özgen and Karsavuran, 2009). There are insect species that cause economic damage to almond trees. In a study conducted in the almond fields of Diyarbakır, Elazığ and Mardin; A total of 205 species belonging to 11 orders and 56 families were determined (Bolu et al., 2005) [1]. Among these species; almond leaf wasp *Cimbex quadrimaculata* Müller, 1766 (Hymenoptera: Cimbicidae); It was among the dominant species with a rate of 51%. In view of damage, recent years, it has caused significant damage to all almond orchards where it has been hazardous (Bolu, 2016) [2]. *C. quadrimaculata* caused significant damage to almond plantations, especially in Elazig and Diyarbakir provinces. The pest; It has been determined that this species, which causes significant damage especially in the end shoots, varies according to the tree crown projections and the type of damage (Özgen et al., 2021). This study was carried out between the years 2020-2021 in order to determine the relationships between the number of larvae and yield parameters in wild and cultivated almond varieties in Diyarbakır and Elazığ provinces. The results of the study will form the basis for the determination of the Economic (EZE) Damage Threshold of the pest.

Materıal and Method
In this study was carried out in Diyarbakır Eğil and Elazığ Province Keban districts between 2020-2021. Samples were made on 5 randomly selected wild almonds (*Prunus dulcis*) and 5 grafted cultivated almonds (*Prunus amygdali*) (Ferragnez variety) in each orchard. A total of 20 trees were marked for two years, 5 of each variety. The trees were selected in the same crown projection and age as almond trees. The impact method was used in larval sampling.

The number of larvae falling on the Japanese umbrella was counted by blowing on four different sides of the trees. The counted larvae were released back to the tree. Tree heights of wild almonds are approximately 3,5 m and their crown projection is approximately 2-2,5 m. The age of the trees is between 7-15 years. Grafted almonds are selected from 3-year-old ferrragnes almond trees, their height is about 2 m and their crown projection is approximately 1-1,5 meters. The larvae of the pest were counted weekly, and the total number of larvae and yield values during the harvest period were compared. No insecticide was applied to these trees, including the pest *C. quadrimaculata*. In addition, it was thought that the factors affecting the other diseases, pests and yield parameters in the counted trees equally affected the tree yields. For the statistical analysis of the values; Almond yield per larva was obtained by dividing the almond yield by the number of larvae.

Research and Dıscussıon

Table 1 shows the total number of *C. quadrimaculata* larvae per five tree and total almond yield (kg) in wild and cultivated almonds in Diyarbakir (Egil) and Elazig (Keban) locality. When Table 1 is examined; It has been observed that the number of pests is numerically higher in wild almonds than in cultivated almonds, and the yield decreases as the number of pests increases. However, it was determined that this change was different according to the age of the tree. It was determined that the yield increased when the obtained ratio increased, and the yield decreased when it decreased. In Table 1, it is seen that the average yield rate of wild almond trees in Keban district is high in 2020.

Table 1: Index of *Cimbex quadrimaculata* Müller, 1766 (Hymenoptera: Cimbicidae) total larvae number and total almond yield (kg) per tree (5 trees) and average yield ratio.

LOC.-Vary.- Year	Total Larvae (number)	Total Yield (Kg)	Average Yield Rate $\bar{x}$
Elazığ-Keban-wild almond-2020	252	116	0,4632
Elazığ-Keban-culture almond-2020	109	22	0,2099
Elazığ-Keban-wild almond-2021	323	91	0,2866
Elazığ-Keban-culture almond-2021	200	15	0,0750
Diyarbakır-Eğil-wild almond-2020	597	82	0,1383
Diyarbakır-Eğil-culture almond-2020	177	17	0,0959
Diyarbakır-Eğil-wild almond 2021	606	69	0,1207
Diyarbakır-Eğil-culture almond -2021	348	14	0,0399

Using the yield ratio; In wild and cultivated almond trees; One Way ANOVA analysis was used to determine whether there was a statistical difference between years and districts in Keban and Eğil districts. Tukey HSD multiple comparison test was used to determine the difference between which groups. Additionally; The independent sample t test was used to determine whether there was a statistical difference between wild and cultivated almond trees (Table 2).

Table 2: Comparison of the difference of wild and cultivated almonds in Keban and Eğil districts with ANOVA test.

Anova						
		Sum of Squares	df	Mean Square	F	Sig.
Wild Almond	Between Groups	,380	3	,127	47,830	,000
	Within Groups	,042	16	,003		
	Total	,422	19			
Culture almond	Between Groups	,081	3	,027	16,254	,000
	Within Groups	,027	16	,002		
	Total	,108	19			

When Table 2 is examined; There was a statistically significant difference between the groups in the yield ratio of wild almonds (P<0.05). According to Table 3; In wild almonds, the yield rate of Keban district in 2020 ($\bar{X}$=0.4632) is statistically different from the yield rates of Keban in 2021 ($\bar{X}$=0.2866), Egil in 2020 ($\bar{X}$=0.1383) and Egil ($\bar{X}$=0.12.07) in 2021. significantly higher (P<0.05). In addition, it was determined that the yield rate of Keban district in 2021 ($\bar{X}$=0.2866) was statistically significantly higher than the yield rates of Eğil in 2020 ($\bar{X}$=0.1383) and Egil ($\bar{X}$=0.12.07) in 2021 (P<0.05).). When Table 2 is examined, there is a statistically significant difference between the groups in the yield ratio of cultivated almonds (P<0.05). According to Table 3; In cultivated almonds, the yield rate of Keban district in 2020 ($\bar{X}$=0.2099) is statistically significant from the yield rate of Keban in 2021 ($\bar{X}$=0.075), Egil in 2020 ($\bar{X}$=0.0959) and Egil ($\bar{X}$=0.0399) in 2021. was determined to be higher (P<0.05).

Table 3: Multiple Comparisons of Wild and Cultivated Almonds

Multiple Comparisons						
Tukey HSD	Grup 1(I)-Grup 2(J)	Mean Difference(I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Lower Bound
Wild	Keban 2020-Keban 2021	,17659*	,03254	,000	,0835	,2697
	Keban 2020- Eğil 2020	,32489*	,03254	,000	,2318	,4180
	Keban 2020- Eğil 2021	,34249*	,03254	,000	,2494	,4356
	Keban 2021- Eğil 2020	,14831*	,03254	,002	,0552	,2414
	Keban 2021- Eğil 2021	,16590*	,03254	,001	,0728	,2590

	Eğil 2020- Eğil 2021	,01759	,03254	,948	-,0755	,1107
Culture	Keban 2020-Keban 2021	,13490*	,02579	,000	,0611	,2087
	Keban 2020- Eğil 2020	,11397*	,02579	,002	,0402	,1878
	Keban 2020- Eğil 2021	,16994*	,02579	,000	,0962	,2437
	Keban 2021- Eğil 2020	-,02093	,02579	,848	-,0947	,0529
	Keban 2021- Eğil 2021	,03504	,02579	,541	-,0387	,1088
	Eğil 2020- Eğil 2021	,05598	,02579	,174	-,0178	,1298
*. The mean difference is significant at the 0.05 level.						

When Table 4 is examined, there is a significant difference between the yield rates of wild and cultivated almonds in 2020 and 2021 in Keban district (P<0.05). There is a significant difference between the yield rates of wild and cultivated almonds in Egil district in 2020 and 2021 (P<0.05).

Table 4. Comparison of the difference between wild and cultivated almonds with independent samples t-test

		Mean	Std. Deviation	t-test for Equality of Means				
				t	df	Sig.	Mean Difference	Std. Error Difference
Keban 2020	Wild	,4632	,05826	5,820	8	,000	,25332	,04353
	Culture	,2099	,07797					
Keban 2021	Wild	,2866	,07014	6,569	8	,000	,21164	,03222
	Culture	,0750	,01646					
Eğil 2020	Wild	,1383	,01499	4,624	8	,002	,04240	,00917
	Culture	,0959	,01399					
Eğil 2021	Wild	,1207	,04528	3,891	8	,005	,08078	,02076
	Culture	,0399	,01026					

As a result, it has been determined that the pest creates more population in wild almond trees with larger crown projection than the tree crown projection size. In addition, it is thought that there are yield differences between wild almond and cultivated almond varieties in both provinces, and this difference varies depending on the age of the tree. Despite the high number of larvae in wild almond trees in Keban location, it was observed that the yield was less affected by the larval population increase compared to other locations. It was determined that the number of larvae affected the yield more than the other varieties in the 2021 cultivated almonds in Keban district.

Acknowledgements

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

References

1. Bolu H, Özgen I, Çınar M. Dominancy of insect families and species recorded in almond orchards of Turkey. Acta Phytopathologica et Entomologica Hungarica. 2005;40(1-2):145-157.
2. Bolu H. Distrtibution, Life History and Biology of Almond Sawfly (*Cimbex quadrimaculata* (Müller, 1766), Hymenoptera: Cimbicidae). Scientific Papers. Series A. Agronomy. 2016;LIX:219-222.
3. Özgen İ, Topdemir A, ve MZ Efe. Population Change in *Cimbex quadrimaculata* Müller, 1766 (Hymenoptera: Cimbicidae). Journal of Research Science. In press. 2021.