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Notes on the Seasonal Dynamics of *Polyphylla turkmenoglui* Petrovitz (Coleoptera: Scarabaeidae: Melolonthinae) in the vineyards of Manisa, western Anatolia

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ABSTRACT

Polyphylla turkmenoglui Petrovitz, 1965 is one of the the most important pests of vineyards in the Aegean Region of Turkey. Larvae of this species feed on the roots of vineyards and in general, the larvaes are found under the soil. For this reason, controlling this pest is very difficult. The adults mostly feed on pines foliage. In the study, the seasonal activity of the adult beetles of *P. turkmenoglui* was studied via two light traps between May and August in 2016 and 2017 in two vineyard locations in Alaşehir and Sarıgöl districts, Manisa province of Turkey. At the end of the study, 1.552 specimens of *P. turkmenoglui* were evaluated. Total 362 and 1.190 specimens were collected from the localities in Alaşehir and Sarıgöl, respectively. In spite of the small differences in trapping localities, the number of the specimens belonging to this species increased as of June, reached the highest level in mid-June and early July, and started to decrease after that date. No specimens were collected after the second half of July. In addition, the morphological features of this species, both male and female, were defined and illustrated.

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Manisa yöresi bağlarındaki *Polyphylla turkmenoglui* Petrovitz (Coleoptera: Scarabaeidae: Melolonthinae) türünün mevsimsel aktivitesi üzerine notlar

ÖZET

Polyphylla turkmenoglui Petrovitz, 1965 türü Ege Bölgesi bağlarında bulunan en önemli zararlılardan biridir. Zararlının toprakta yaşayan larvası bitki kökleri ile beslenir. Bu nedenle kontrolü çok zordur. Erginleri çoğunlukla çam yaprakları ile beslenmektedir. Bu çalışmada, 2016-2017 yıllarında Mayıs-Ağustos tarihleri arasında Manisa'nın Alaşehir ve Sarıgöl ilçelerinde bulunan iki bağ alanına kurulan ikişer tane ışık tuzağı aracılığı ile ergin *P. turkmenoglui* türünün mevsimsel aktivitesi incelenmiştir. Çalışma sonucunda, toplam 1.552 örnek değerlendirilmiş olup bu örneklerin 362'si Alaşehir, 1.190'ı ise Sarıgöl bağ alanlarından toplanmıştır. Tuzak lokaliteleri arasında küçük farklılıklara rağmen, bu türe ait örnek sayısı Haziran ayından itibaren artmaya başlamış, Haziran ayının ortası ve Temmuz ayının başında en yüksek populasyon yoğunluğuna ulaşmış ve bu tarihten sonra düşmeye başlamıştır.Temmuz ayının ikinci yarısından sonra ise hiç örnek toplanamamıştır. Ek olarak, bu türün dişi ve erkeğine ait morfolojik bilgiler ve şekillere de çalışmada yer verilmiştir.

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INTRODUCTION

Turkey hosts a large number and variety of agricultural products thanks to its climatic and geographical characteristics. Viticulture has an important place among these products. Turkey ranks the sixth in grape production in the world and

viticulture provides the livelihood of many farmers (Bashimov, 2017). In 2018, 3.9 million tons of grapes were produced on a total area of 4.8 million decares in Turkey (Anonymous, 2021a). At the same time, table grapes and raisins have a very important place in Turkey's exports of agricultural products. Especially in the production of seedless raisins, Manisa in western Turkey, and Alaşehir and Sarıgöl districts of Manisa stand out. The most important economic activity in both districts is vine growing. According to 2015 data, 495 thousand tons of grapes were produced in an area of 200 thousand decares in Alaşehir. In Sarıgöl district, approximately 238,000 tons of grapes were obtained from an area of 90,000 decares (Anonymous, 2021a).

The genus *Polyphylla* Harris, 1841 is divided into 7 subgenera and it contains 33 species in the Palaearctic region (Löbl and Smetana, 2006). A total of five species of the genus are known from Turkey, which are *Polyphylla fullo* (Linnaeus, 1758), *P. boryi* Brullé, 1832, *P. olivieri* (Laporte, 1840), *P. adspersa* Motschulsky, 1854 and *P. turkmenoglui* Petrovitz, 1965 (Löbl and Smetana, 2006). Among these species, *P. fullo* has a wide distribution in whole Europe and Turkey. *P. boryi* is known from Bulgaria, Greece, Croatia and Turkey; *P. olivieri* is known from Greece, Turkey, the Caucasus, Iran, Syria, and Israel. *P. adspersa* is dispersed over Turkey, Iran, the Caucasus and the Middle East. Lastly, *P. turkmenoglui* is only known from Turkey. The larvae of *Polyphylla* species may damage almost all types of fruit saplings and vineyards. The main harm of this species is that they gnaw and pierce plant roots.

P. turkmenoglui is described by Petrovitz in 1965 as *Polyphylla fullo turkmenoglui* from the Menemen district of Izmir (Petrovitz, 1965) and was later raised to the species level (Löbl and Smetana, 2006). Very few studies have been done so far regarding the phenology, biology and the damage caused by this species. Among these, Türkmenoğlu (1967) has included important information about this species in his publication. In summary, it has been reported in this study that this species damages different cultivars in the Aegean Region but specifically vineyards. In addition, he gave information about the ways of damage and economic importance, morphological features, phenologies and struggle against *P. turkmenoglui* species. Accordingly, the biggest damage of the larvae of this species is observed in the roots of vine. Especially the third, i.e. last-stage larvae cause significant damage by gnawing vines erected on sandy soils. The damage is very high especially in newly established vineyards. It may sometimes rise to an extent of 50-80%. In the same publication, it was also reported that this species preferred sandy, fine sandy and alluvial soils and that it caused economic damage at the roots of the cultivated plants grown there. In addition, Türkmenoğlu (1967) reported that this species is found in Nazilli (Aydın), Denizli Central District, Edremit (Balıkesir), Manisa Central District, Akhisar, Alaşehir, Sarıgöl, Saruhanlı, Turgutlu (Manisa) and Köyceğiz (Muğla) in the Aegean Region. In another study, according to Önuçar and Ulu (1987), this species is one of the most important pests for cherries, peach and potatos and some other fruits and crops.

There are many pests in the vine plant, as in every agricultural product. One of the important pests of the Aegean Region vineyards is *P. turkmenoglui.* This insect, known as "Halkalı Şeker" among the people in Alaşehir and Sarıgöl region, tends to grow in sandy and loosely structured soils in the region. It is also more common in fertilized and organic soils and in vineyards where weeds are abundant. This species, commonly found in Alaşehir and Sarıgöl vineyards, causes significant damage, damaging the root of the vine and causing the plant to weaken and to completely dry out . However, integrated combat methods are often not successful or at least the desired result is not fully achieved. The presence of the larvae of the species in the depths of the soil reduces the effectiveness of chemical control.

It is possible to collect and examine *Polyphylla* species by means of light traps because they exhibit light-directed behavior. No specific studies regarding the seasonal activities of *P. turkmenoglui*'s mature individuals located in Turkey vineyards have been conducted until now. In this study, *P. turkmenoglui* found in Alaşehir and Sarıgöl vineyards were collected by light traps for the first time in Turkey. It has been sought to demonstrate seasonal activities of the species by determining its seasonal densities. Thus, it was aimed to obtain the information which may be useful for the struggle against this species.

MATERIAL and METHOD

Light trap method was used to collect samples of *P. turkmenoglui* species in this study. In this method, two light trap assemblies were set up in each vineyard area selected in Alaşehir and Sarıgöl districts of Manisa, covering May-August periods of 2016 and 2017. The study in 2016 was made within the scope of the master's thesis of the second author, and the study in 2017 was an independent study. In the master's thesis, this species was identified as *P. fullo*, but later on it was found out that the species was in fact *P. turkmenoglui.*

Some preliminary studies were carried out in the selected areas before the study was established. In this framework, the presence of this insect's activity was determined through observations on visits to selected areas in advance. In addition, a short-term light trap was established in 2015 in the same

vineyards for study purposes. It was investigated whether there were larvae in the soil on visits to both study areas. The vineyard with a light trap in Sarıgöl has a total of 9 decares of land and a 3-year-old "Thompson seedless" grape variety. The planting frequncy is 3.00 X 1.8 m and the vineyard is established with an open pergola trellis system. The vineyard with a light trap in Alaşehir has a total of 5 decares of land and a 13-year-old "Red Globe" grape variety. The planting frequncy is 3.00 X 2 m and the vineyard is established with an open pergola trellis system. All cultural practices in the vineyard have been carried out under farmer conditions.

Soil analyzes of the studied localities were also conducted. For this purpose, soil samples were taken from the depths of 0-30 cm and 30-60 cm in the test plots. In soil samples, grain size distribution was determined by using hydrometer method, soil reaction (pH) was determined in sature soil paste with glass electrode pH-meter, salinity was determined in sature soil paste with EC-meter, organic matter was determined through wet burning with potassium dichromate ($K_2Cr_2O_7$), lime ($CaCO_3$ %) was determined with Scheibler calcimeter by volumetric method, Total-N was determined with modified macro kjeldahl method, extractable K, Na, Ca, Mg 1, and N were determined through NH_4OAc (pH 7) extraction, extractable phosphor was determined through NaHCO3 extraction, extractable Fe, Cu, Zn, Mn were determined by extraction method with DTPA+$CaCl_2$+TEA solution (Kacar, 2016). The results of the analysis were evaluated according to Müftüoğlu et al. (2014).

Light traps were established in the coordinates of 38°19'50.35"N 28°36'31.36"E and 38°19'50.36"N 28°36'30.95"E in Alaşehir and 38°14'18.93"N, 28°42'25.35"E and 38°14'19.57"N 28°42'29.38"E in Sarıgöl (Figure 1). A 125 watt Philips energy saver white day light bulb was used at each trap and traps were cleared at weekly intervals.

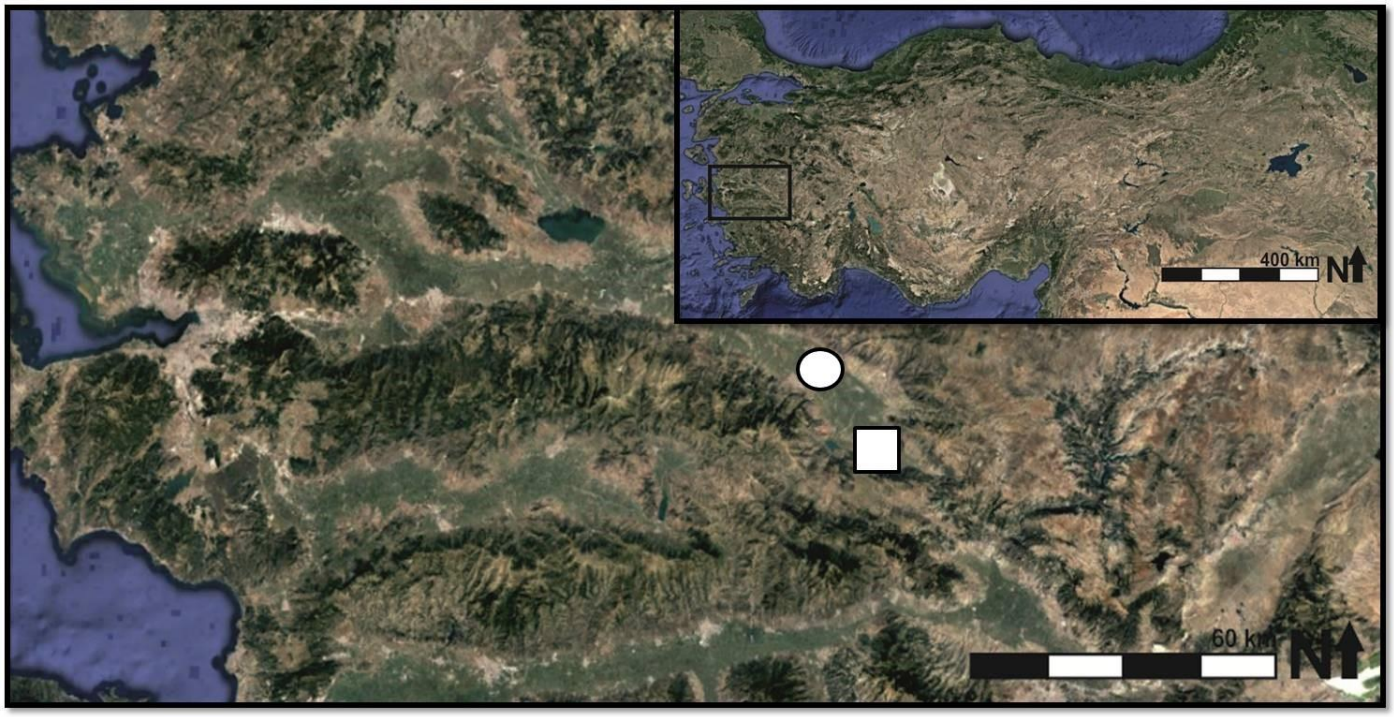

Figure 1. The locality of light trapping study area in Alaşehir (circle) and Sarıgöl (square), Manisa, western Anatolia, Turkey.

Şekil 1. Batı Anadolu'da (Türkiye) bulunan Manisa'daki çalışma yapılan Alaşehir (daire) ve Sarıgöl (kare) ışık tuzağı lokaliteleri.

All specimens falling into the chamber of the light trap was brought to the laboratory by taking them in the field into jars containing 70 % ethanol. Labels containing the name and date of the vineyard where the study was set up were placed in the jars in which the specimens collected in the field were put. The jars which were brought to the laboratory and which contained insect specimens were first poured into a large white area in the form of a tray. Since many specimens belonging to other groups were collected with the light trap, the samples of the target species, namely *Polyphylla turkmenoglui,* were separated and then counted, and labeled in different jars. The separated specimens were cleaned from various dust and substances adhering to them with a soft painting brush. After that, all samples were examined morphologically under a microscope. The identified specimens were dried and pinned. Locality and identified labels were also added to these specimens.

The morphological studies were conducted using a Stemi 508 microscope (Zeiss, Germany). Photographs of the studied specimens were taken with a digital camera (Zeiss Axiocam ERC5s). All photographs were edited with the Helicon Focus v. 6, and Coreldraw X5 software. The map (Figure 1) was made using the software Google Earth Pro (2019). The materials were identified by the third author and were deposited in the Alaşehir Zoological Museum, Manisa, Turkey (AZMM).

RESULTS

Morphology of P. *turkmenoglui* Petrovitz, 1965 (Figures 2-4)

Diagnosis. Female body 3.0-3.6 cm in length. General coloration: head dark brown; pronotum, elitra, antenna and legs reddish brown in dorsal view (Figure 2A); the whole body brown in ventral view (Figure 2B).

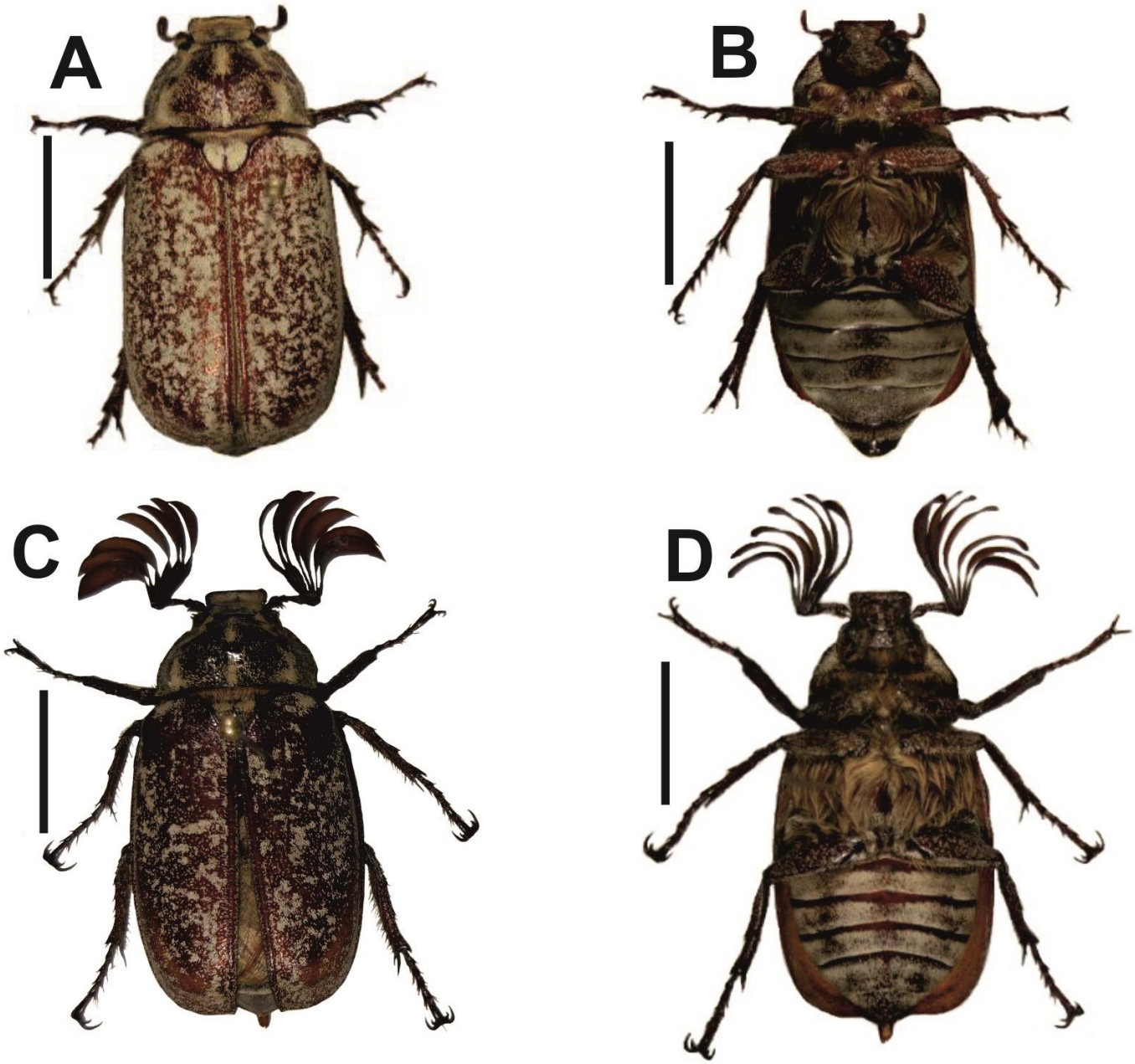

Figure 2. Habitus of *P. turkmenoglui* Petrovitz, 1965. A) female in dorsal view; B) female in ventral view; C) male in dorsal view; D) male in ventral view. Scale bars: 1 cm (A-D).

Şekil 2. P. turkmenoglui Petrovitz, 1965 türünün vücut şekli. A) dişi, dorsal görünüş; B) dişi, ventral görünüş; C) erkek, dorsal görünüş; D) erkek, ventral görünüş. Ölçek çubukları: 1 cm (A-D).

Male body 2.9-3.3 cm in length.

General coloration: All body darker than the female in dorsal and ventral view (Figures 2C-D).

In female; dorsal surface of head covered with flakes of color ranging from white to golden yellow; flakes more frequent on the front and back of the head and less frequent at the lateral, these structures in the front resembling thick hair growth rather than flakes (Figure 3A). Clypeus elongated forward with sharp corners, light brown hairs on the indented structures on the sides of the head. The antenna 10 segments, the tip knobed with five lamellas, the colour varying from dark brown to reddish; frequently whitish yellowish hairs on the sides of the first segment of the antenna, these structures gradually changing as they go towards the ends of the antenna. Eyes small, yellowish structures on the upper part of the eyes in the form of eyelashes.

In male; head brown to blackish and covered with yellowish-whitish flakes, these flakes more intense on the lateral of the head and the margins of the eyes (Figure 3B). Clypeus elongating anterior and its corners more roundish than the female. Antennae strikingly seven-leaf / lamellar fan-shaped, with sparse pubesences on these fans, antennomere I with dense and light brown pubesences. Eyes small and lash-shaped golden yellow flakes present on the upper part, more frequent and evident towards the antennae.

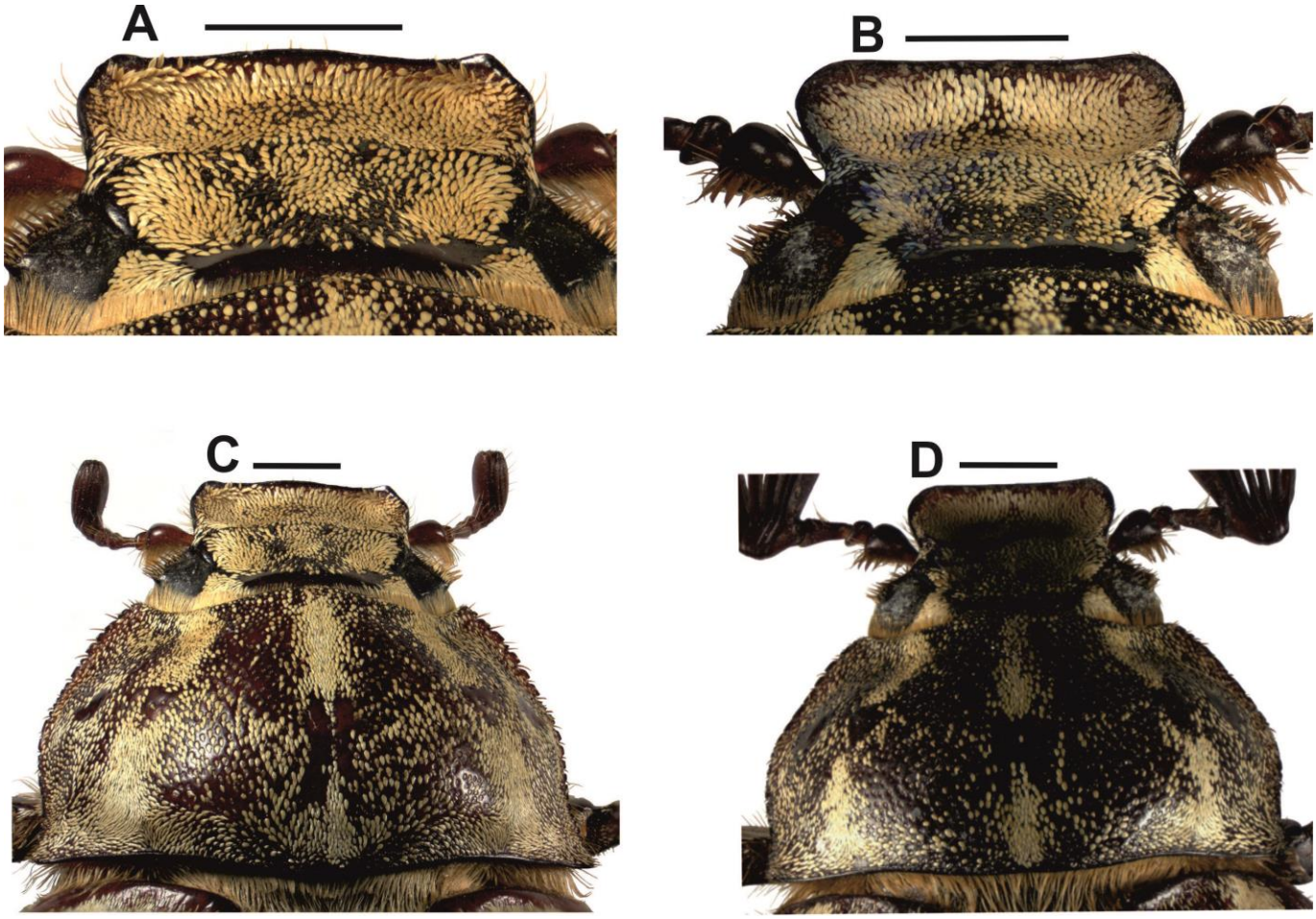

Figure 3. In *P. turkmenoglui* Petrovitz. A) female head; B) male head; C) female pronotum; D) male pronotum. Scale bars: 2 mm (a-d).

Şekil *3. P. turkmenoglui Petrovitz türünde, A) dişi, baş; B) erkek, baş; C) dişi, pronotum; D) erkek, pronotum. Ölçek çubukları: 2 mm (A-D).*

In female; pronotum with single sclerits, the lateral margins indented similar to tooth; flakes less denser than that of head (Figure 3C).

In male; pronotum with single sclerits, and smaller number of indented structures on the margins compared to the female; flakes less denser than that of head (Figure 3D).

In female; elitra with colored flakes ranging from white to golden yellow on the reddish brown as small cubicles, flakes more frequent at the median area and less frequent along the sides. Legs long, the coxa with sparse yellowish pubesences, the femur of prothoracic

legs (the first pair of legs) with thick and rake-shaped toothed ridges, the last part of the tarsus with strong nails in the form of hooks (Figure 4A), these structures very small in the femoral part of mesothoracic legs (the second pair of legs) and metathoracic legs (the third pair of legs) compared to the prothoracic legs (Figures 4B-C).

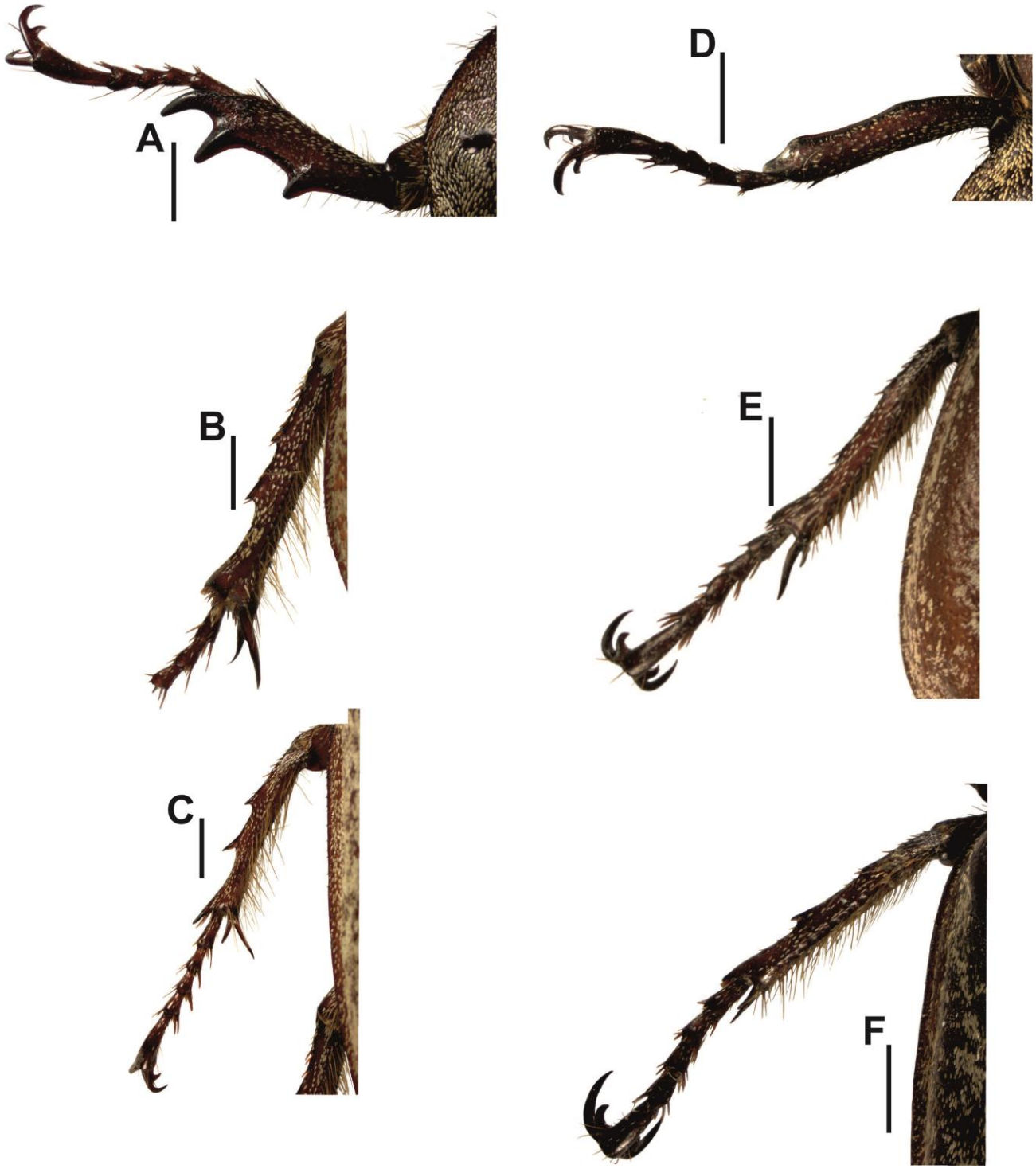

Figure 4. In *P. turkmenoglui* Petrovitz A) female prothoracic legs; B) female mesothoracic legs; C) female metathoracic legs; D) male prothoracic legs; E) male mesothoracic legs; F) male metathoracic legs; Scale bars: 1 mm (A-F).

Şekil *4. P. turkmenoglui Petrovitz türünde, A) dişi prothorasik bacaklar; B) dişi mesothorasik bacaklar; C) dişi metathorasik bacaklar; D) erkek prothorasik bacaklar; E) erkek mesothorasik bacaklar; F) erkek metathorasik bacaklar; Ölçek çubukları: 1 mm (A-F).*

In male; elitra with dense flakes ranging from white to golden yellow on a dark brown background. Legs less developed than the female, dark brown coloration and gradually darkening and turning into black towards tarsus; femur yellowish and dense pubesences; a single spine at the end of the femur of the prothoracic legs (Figure 4D), and curved structures in the form of hooks at the end of the tarsus of the legs (Figures 4D-F).

In female and male; abdomen with visible six segments in ventral view, with white pubesences, and very dense between mesothoracic and metathoracic legs.

Characteristics of the Vineyard Soils in the Study Areas

Some physicochemical properties of the soils in the two study areas are shown in Table 1.

The soil of the vineyard, which is located in Sarıgöl locality, is classified as sandy-loam at a depth of 0-30 cm, and as loamy-sand at a depth of 30-60 cm. While the sand amount increases at 30-60 cm depth compared to 0-30 cm depth, silt rate decreases. The soil reaction is alkaline. The soil is classified as slightly lime in terms of lime and there is no salinity. The organic matter is very low, total nitrogen is low, extractable P is high, and extractable Ca K, Mg, Fe, Zn, Mn and Cu are sufficient (Table 1).

Table 1. Some physicochemical properties of the study area soils in Sarıgöl and Alaşehir.
Çizelge 1. Sarıgöl ve Alaşehirdeki araştırma alanı toprağının bazı fizikokimyasal özelikleri.

Region	Sarıgöl		Alaşehir	
Soil Properties/ Soil depth	0-30cm	30-60cm	0-30cm	30-60cm
pH	8,09	8,13	7,94	7,98
Electrical Conductivity (µS cm^{-1})	274	170	201	204
Lime ($CaCO_3$) %	3,28	2,96	0,80	1,08
Soil Texture	Sandy Loam	Loamy sand	Sandy Loam	Sandy Loam
Sand (%)	68,56	79,84	59,56	58,56
Silt (%)	23,28	14,00	31,28	29,28
Clay (%)	8,16	6,16	12,16	12,16
Soil Organic matter (%)	0,84	0,54	1,32	1,79
Total-N (%)	0,056	0,045	0,101	0,090
Available-P (mg kg^{-1})	40.82	30.53	35.29	27.48
Extractable-K (mg kg^{-1})	272,2	135,8	261,9	271,6
Extractable -Ca (mg kg^{-1})	2860	2761	2761	2663
Extractable -Mg (mg kg^{-1})	361	232	439	422
Available -Fe (mg kg^{-1})	9,01	9,93	7,83	6,29
Available –Zn (mg kg^{-1})	2,29	0,59	19,97	2,68
Available -Mn (mg kg^{-1})	3,96	4,67	13,92	12,50
Available -Cu (mg kg^{-1})	8,65	1,64	5,28	3,15

The soil of the vineyard, which is located in Alaşehir locality, is classified as sandy-loam at both depths. Soil reaction is alkaline. The soil is classified as less lime in terms of lime and there is no salinity. Organic matter is very low, total nitrogen is sufficient, extractable P is high, and extractable Ca K, Mg, Fe, Zn, Mn and Cu are sufficient (Table 1).

Seasonal Dynamics

In this study, four light traps were established in the vineyard areas determined in Sarıgöl and Alaşehir districts of Manisa between May and August in 2016 and 2017, and a total of 1.552 specimens belonging to *P. turkmenoglui* were collected. Accordingly, 362 of the collected specimens fell on the light traps which were set up in Alaşehir and 1.190 on the traps in Sarıgöl. When the distribution of sample numbers per year was examined, it was seen that a total of 792 samples were collected in 2016 and 760 samples were collected in 2017 (Figure 5, Table 2).

When the seasonal activities of the *P. turkmenoglui* in the study area in 2016 and 2017 were examined, it the data of both years were found to be similar. According to the study, the date when the adults of the species first appeared was between May 22 and May 29. However, only 4 examples fell into the traps in this period. Later, the number of specimens of the species started to increase and the number of the specimens was 30 between May 29 and June 5, and 240 between June 5 and June 12. After this date, that is between June 12 and June 19, the number of the collected specimens reached the highest with 543. Afterwards, the number of specimens decreased to 281 bewteen June 19 and June 26, and then increased again to 408 between June 26 and July 3. After this date, the number of specimens of the species

decreased rapidly to 41 between July 3 and July 10 and then to 5 between July 10 and July 17. After this date, no specimens could be collected with traps (Figure 5, Table 2).

Accordingly, when the seasonal activity of the *P. turkmenoglui* species was evaluated in general, it was found that the adults of this species first had begun to appear at the end of May. Later, it was observed that their numbers had increased since the beginning of June and reached the highest level in the middle of June and at the beginning of July. It was determined that the number of adults of this species had decreased since the beginning of July. Adult activity ended after the second half of July (Figure 5, Table 2).

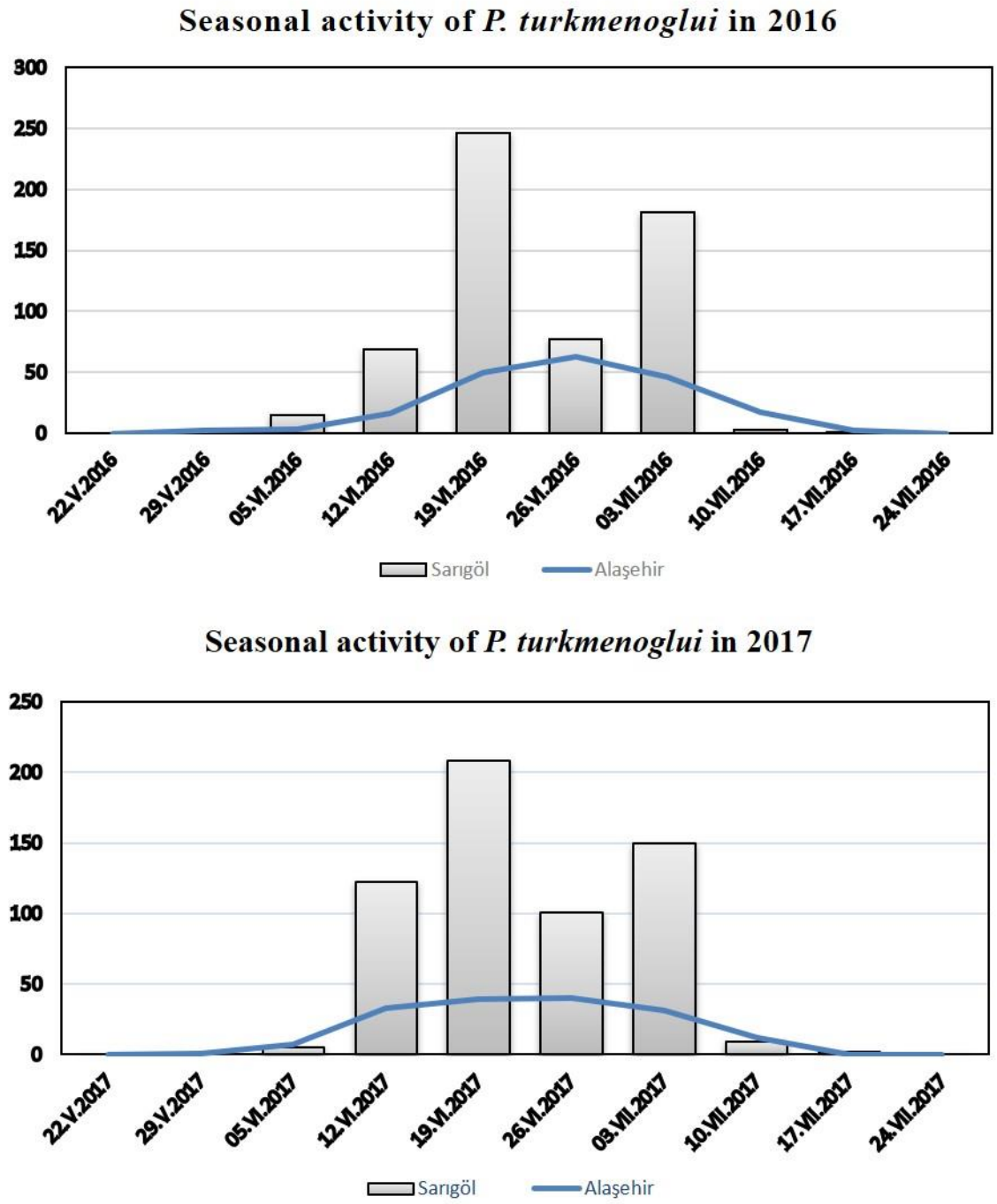

Figure 5. Seasonal activity of *P. turkmenoglui* in 2016 and 2107 in Sarıgöl and Alaşehir localities.
Şekil 5. P. turkmenoglui türünün Sarıgöl ve Alaşehir lokalitelerindeki 2016-2017 yıllarındaki mevsimsel aktivitesi.

Ecological Observations

Observations were made in the localities where light traps were established in order to obtain additional ecological data. According to these observations, *P.*

turkmenoglui individuals were observed to fly mostly between 20:30 and 21:30 with their heads toward the light. It was also observed that the specified time range and flight density varied depending on the weather's being windy, rainy and cool. According to this, rainy weather prevented the flights completely, while cool and windy weather reduced the density of the flying population of the species. It was determined that individuals belonging to the species entered the soil again after mating. After that, it was observed that the mating female individuals laid their eggs 10-20 cm below the soil in groups of 20-28, and that their ovulation periods reached a week. It was found that their eggs hatched in the last week of July.

Table 2. Numbers of specimens by date and localities.
Çizelge 2. Lokalite ve tarihlere göre örnek sayıları.

Collecting date	Year	Alaşehir	Sarıgöl	Total
22 May	2016	-	-	-
	2017	-	-	-
29 May	2016	2	1	3
	2017	1		1
5 June	2016	3	15	18
	2017	7	5	12
12 June	2016	16	69	85
	2017	33	122	155
19 June	2016	50	246	296
	2017	39	208	247
26 June	2016	63	77	140
	2017	40	101	141
3 July	2016	46	181	227
	2017	31	150	181
10 July	2016	17	3	20
	2017	12	9	21
17 July	2016	2	1	3
	2017	-	2	2
24 July	2016	-	-	-
	2017	-	-	-
22 May-24 July	2016	199	593	792
	2017	163	597	760
Total	**2016-2017**	**362**	**1.190**	**1.552**

Besides, some adult beetles were observed to hide among the surrounding weeds after flight and mating. When the adults were disturbed in their areas, they moved away from their environment by making a characteristic sound. In addition, due to the fact that the study established in Alaşehir was close to the residential area, this insect was also observed to hover around the lamps which lit up in front of various houses in the evening. Since the stations in Sarıgöl were further from the residential area than those in Alaşehir, the night flights of the insect took place only around the traps.

According to the observations made during the research, it was determined that *Corvus cornix* Linnaeus, 1758 and *C. monedula* Linnaeus, 1758 were predators of *P. turkmenoglui*. In addition, *Megascolia maculata maculata* (Drury, 1773) and *Scolia hirta* (Schrank, 1781) species of the family Scoliidae (Hymenoptera), which are thought to be parasitoids of *P. turkmenoglui*, were also observed to be flying in vineyards.

DISCUSSION

This study on the seasonal activity of the adults of *P. turkmenoglui species*, which damaged the vineyards identified in Alaşehir and Sarıgöl districts between 2016 and 2017, serves as the first study conducted in this respect.

However, according to the literature research conducted, there are some observational studies on the activity of this species. According to one of them, Türkmenoğlu (1967), adult appearance of the species continues from mid-June to the end of the first week of July, and the number of adults reached the highest level on June 20. According to our findings, however, adult appearance of the species occurs as of the end of May. Nevertheless, the highest number of samples that fell in our traps was 543 in the period between June 12 and 19. The number of samples decreased in the following week. Then, again, an increase was observed between June 26 and July 03. In the same study, according to Türkmenoğlu (1967), it was stated that the adults of the species appeared from the soil 40 minutes after sunset on average, and flew and

mated for 40 minutes on average again, and then they got into the soil again. According to our observations in the vineyards where the study was carried out, the adults of the species started to fly maximum half an hour after sunset. It was also observed that adults of the species flew, though rarely, until late at night.

Another study on *P. turkmenoglui* was carried out by Önuçar and Ulu (1987) in a peach orchard in the province of Manisa between the end of May and the beginning of July between 1984 and 1987. According to this study, this species was observed every five minutes between 20.40 and 21.00 between the same two peach trees in the orchard. In the same study, it was stated that the flight of the species started 10-20 minutes after sunset and varied depending on the climatic conditions. At the same time, predation of this species by *Caprimulgus europaeus* Linnaeus, 1758 was observed. In the observations made in this study, it was found that *C. cornix* and *C. monedula* species were predators of *P. turkmenoglui*.

Compared to the traps set up in Alaşehir, the traps set up in the Sarıgöl vineyard area had three times more samples. Among the reasons for this may be that the vineyard area in Sarıgöl consists of younger vines compared to the vineyard area in Alaşehir. *Polyphylla* spp. are especially harmful in young vineyards (Lodos, 1995). As a matter of fact, the larvae of this insect have better feeding opportunities with the roots of the young vine seedlings in Sarıgöl. According to our observations, in the vineyard areas of Sarıgöl, withederedness in the green parts and seedlings of the vine was detected. In addition, the fact that the study area in Sarıgöl district was farther from the residential area was interpreted as a reason for the higher density of the species. Besides, soil type is thought to have an effect. Among soil properties, soil structure is the most important feature which will affect the population of *Polyphylla* spp. Sand content of 0-30 cm depth of the test area soil in Sarıgöl region was determined as 68.56 % and sand content of 30-60 cm depth was determined as 79.84 %. Sand content of 0-30 cm and 30-60 cm depth of the soil of the test area in Alaşehir region was determined the same for both depths, as 58.56 %. As a result, one of the reasons why *P. turkmenoglui* was more abundant in Sarıgöl locality may be the higher sand content of the soil in Sarıgöl locality. In fact, Türkmenoğlu (1967) stated in his study that this species preferred sandy, fine sandy and alluvial soils. Besides, it was evaluated that other soil characteristics in the study areas were not different enough to affect the activity of the species.

In their studies, Vereecken and Carriere (2003) and Vuts et al. (2012) stated that Scoliidae species, which is a parasitic wasp family, is the ectoparasite of some Scarabaeidae species, and also mentioned *P. fullo* among these species. From this perspective, scoliid species are also thought to be ectoparasites of *P. turkmenoglui*, as well. It is known that species belonging to the family Scoliida are abudantly present in Turkey and in Manisa province (Anlaş and Çevik, 2004; Özbek and Anlaş, 2012). As a matter of fact, in the observations made during the study, some scoliid species were identified in the localities where light traps were established.

In conclusion, it will be useful to take the following measures in the fight against *P. turkmenoglui* species:

1) to clean vineyards off weeds especially in June and July since *P. turkmenoglui* species usually lay their eggs on weedy areas,

2) to reduce the population of larvae by making deep soil cultivation in the autumn period, when the larvae are active and by leaving the larvae to sunlight and the effect of predators,

3) to set up light traps in areas where the pest is densely found by taking the seasonal activity of *P. turkmenoglui* species into consideration, and, thereby to take the population of adults under control,

4) to plant flowering plants (e. g. *Vitex agnus-castus* L., *Rubus canescens* DC.) in the sides of the vineyards in order to enable scoliid wasps to combat the pest effectively.

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Statement of Conflict of Interest

Author has declared no conflict of interest.

Author's Contributions

The contribution of the authors is equal.

REFERENCES

Anlaş S, Çevik I E 2004. Manisa ilindeki Scoliidae (Hymenoptera) familyası türleri üzerine faunistik araştırmalar. Turkish Journal of Entomology, 28 (3): 221-228.

Anonymous 2021a. Kilis Üzüm Raporu 2019 İpek Yolu Kalkınma Ajansı, http://www.investinkilis.gov.tr/upload/yazilar/Kilis-Uzum-Raporu-195814.pdf (last access date: 27.06.2021).

Anonymous 2021b. Manisa Üzümü, https://manisa.tarimorman.gov.tr/Menu/32/Manisa

-Uzumulast access date: 27.06.2021).

Bashimov G 2017. Türkiye'de Üzüm Üretimi ve İhracat Performansı. Journal of Agricultural Faculty of Uludag University, 31 (2): 57-68.

Kacar B 2016. Bitki, toprak ve gübre analizleri 3: Fiziksel ve kimyasal toprak analizleri. Nobel Akademik Yayıncılık Eğitim Danışmanlık Tic. Ltd. Şti. 613 pp.

Lodos N 1995. Türkiye Entomolojisi IV. Ege Üniversitesi Ziraat Fakültesi Yayınları, 250 pp. İzmir.

Löbl I, Smetana A 2006. Catalogue of Palaearctic Coleoptera. Vol. 3, Scarabaeoidea, Scirtoidea, Dascilloidea, Buprestoidea, Byrrhoidea. Apollo Books, Stenstrup, 690 pp.

Müftüoğlu M, Türkmen C, Çıkılı Y 2014. Toprak ve bitkide verimlilik analizleri. Nobel Akademik Yayıncılık Eğitim Danışmanlık Tic. Ltd. Şti. Ankara. 216 pp.

Önuçar A, Ulu O 1987. Investigations on the adult flights of *Polyphylla turkmenoglui* Petr. (Coleoptera: Scarabaeidae) in peach orchards in Manisa Province. Türkiye I. Entomoloji Kongresi Bildirileri, 13-16 Ekim 1987, Ege Universitesi, Bornova, İzmir, pp. 89-98.

Özbek H, Anlaş S 2012. Distribution of Scoliidae (Hymenoptera: Aculeata) of Turkey with their zoogeographic characterization. Turkish Journal of Entomology, 35 (4): 627-639.

Petrovitz R 1965. Drei neue palaearktische Melolonthinae: Reichenbachia, Zeitschrift für taxonomische Entomologiedes Staatliches Museumfür Tierkunde in Dresden, 5 (21): 191-195.

Türkmenoğlu H 1967. Haziran Böceği *Polypylla fullo tuerkmenoglui* Petr. üzerinde araştırmalar. Bitki Koruma Bülteni, 7 (2): 67-77.

Vereecken N, Carriere J 2003. Contribution to the ethological study of the French scoliid wasp (scarab-hunterwasp) *Megascolia maculata flavifrons* (F., 1775) (Hymenoptera, Scoliidae) in the French Mediterranean area. Notesfauniques de Gembloux, 53: 71-80.

Vuts J, Razov J,. Kaydan M B, Toth M 2012. Visual and Olfactory Cues For Catching Parazitic Wasps (Hymenoptera: Scoliidae). Acta Zoologica Academiae Scientiarum Hungaricae, 58 (4): 351-359.