

Determined of Important Pests in Different Phonological Periods in Adiyaman Province of wheat fields

MahmutIslamoglu¹

^{*1}Faculty of Agriculture, Department of Plant Protection, Adiyaman University, Turkey

Corresponding Author: furberk@hotmail.com

Abstract

Adiyaman province has an important place in the South-eastern Anatolia Region in terms of grain cultivation area and production. There are many harmful insects that are harmful to wheat in this province. *Eurygasterintegriceps* Put., (Hemiptera: Scutelleridae), *Zabrus* spp. (Coleoptera: Carabidae), *Phorbia* sp., (Diptera, Anthomyiidae), *Pachytychiushordei* Brulle. (Coleoptera: Curculionidae), *Haplothripstritici* Kurdj. (Thysanoptera: Thripidae), *veSyringopaistemperatella* Led. (Lepidoptera: Scythrididae), *Cephus* sp. (Hymenoptera: Cephidae), and *Sitobionavenae* (F.) and *Myzuspersicae* (Hemiptera: Aphididae) were found among these pests. These pests are present in different phenological stages of wheat and cause damage. Accordingly, in the first development period of wheat in Adiyaman province, *Phorbiasp* and *Zabrus* spp., in tillering period, *S. avenae* and *M. persicae*, in the steam extension, *E. integriceps*. the grain filling period; *Cephus* sp., *P. hordei*, *H. tritici*, *S. temperatella*, *P. major* pests were detected.

Keywords: Adiyaman, *Eurygasterintegriceps*, Harmful Insects, Phenological periods, Wheat

Date of Submission: 15-11-2022

Date of acceptance: 30-11-2022

I. INTRODUCTION

Wheat is one of the most widely grown crops in the world and in our country. Thanks to its great adaptability, it has the advantage of being grown in all kinds of climates and regions. Wheat provides approximately 20% of the total calories provided to the world population from plant-based foods and 53% in our country. Wheat is used in many food and industrial sectors, especially in bakery products [1].

In 2020, world production of wheat was 761 million tonnes, making it the second most-produced cereal after maize [2, 3]. Global demand for wheat is increasing due to the unique viscoelastic and adhesive properties of gluten proteins, which facilitate the production of processed foods, whose consumption is increasing as a result of the worldwide industrialization process and the westernization of the diet [1, 2].

The most important biotic factors that cause yield and quality loss in wheat are leaf and root-knuckle diseases caused by fungal factors. It is necessary to pay attention to the fight against these plant diseases that cause yield and product loss [4]. In addition to plant diseases, there are important harmful insects seen in wheat [5, 6, 7, 8]. Among these pests, *Eurygaster* spp. (Hemiptera: Scutelleridae), *Aelia* spp. (Hemiptera: Pentatomidae), *Zabrus* spp. (Coleoptera: Carabidae), and *Pachytychiushordei* (Coleoptera: Curculionidae). Most of these pests in our country are also found in Adiyaman and cause significant losses [6, 7, 8].

It is known that wheat, as a culture plant, is attacked by some pests in different development periods from planting in the field. In this study, it was aimed to determine the harmful insect species, damage and distribution areas in different phonological periods in wheat cultivation areas in Adiyaman province. The results of the research will help to develop wheat Integrated Control programs going forward. Thus, it is thought that in the future, the unconscious use of pesticides in wheat will be prevented and the environment and human health will be protected and it will contribute to the national economy [7, 8].

II. MATERIAL AND METHOD

The study, which was carried out to determine the pests in the wheat cultivation areas of Adiyaman province, was carried out in the wheat fields of Adiyaman Center, BesniKahta and Samsat districts in 2020 and 2021. The surveys were carried out in the wheat field determined in each district, during the first development, tillering, staking, earing and grain filling periods. The surveys were made by taking one decare as the sampling area for each thousand decare of wheat area (based on at least 1% of the wheat grown area) [9].

Accordingly, the survey areas constituting approximately 94% of the wheat cultivation areas of our province and the average number of fields corresponding to these areas (number of sampled fields) are given in

Table 1. The surveys started from the first development period of the plants on the routes determined according to the simple random sampling method and continued until the grain formation period.

Insects in different developmental stages (eggs, larvae, nymphs, pupae) were brought to the laboratory and cultured in 20 x 30 x 25 cm plastic jars at 26°C temperature, 60% proportional humidity, 16/8 hours lighting/dark conditions. In addition, root and root collars of succumbed, cut and yellowed plants that can be seen in the sampling sites were also investigated. Root and root collars of the plants were examined for the determination of underground pests. In addition, root and root collars of succumbed, cut and yellowed plants that can be seen in the sampling sites were also investigated [10].

Table 1,Adiyaman province's wheat fields, surveyed areas and the number of sampled fields.

Province/District Village	Approximate Planting Area (decare)	Average area to be surveyed (decare)	Number of Fields Sampled
Adiyaman (Lokman and Bağpınar)	245.000	3500	2
Besni (Şambayat)	135.000	2000	1
Kahta (Dut and Ortanca)	210.000	2750	2
Samsat (Taşkuyu)	125.000	1000	1

The living specimens collected as a result of the survey were brought to the laboratory, killed with the help of ethyl acetate or a killing bottle, and the specimens that were stabbed and in a condition not to be pricked were preserved in 70% alcohol. These samples were identified after being labelled with the place of collection, date and host [10].

III. RESEARCH RESULTS AND DISCUSSION

Pests Found During Development Period

The development period is the period when the wheat plant enters and exits the winter, before the plant enters the tillering period [11]. During this period, two harmful pests were detected on wheat plants in Adiyaman province. Pests seen in tillering period are given in Table 1.

One of the pests seen in the first development period of the wheat plant, *Phorbia* spp. (Diptera: Anthomyiidae) has been identified as one of the rare pests that do not reach the economic damage threshold in Adiyaman province. In the studies carried out in 2020, it was detected in the village of Lokman in the centre of Adiyaman and in the village of Taşkuyu in the district of Samsat. In 2021, it was detected only in Lokman and Taşkuyu villages, as in 2020. *Phorbiaspp.* It has been reported that it is seen in the early and tillering period of the wheat plant, especially in the early sown cereals [12]. Larva usually enters from 5 cm above the main stem, causing the main stem to dry out, and this damage is called "belly dry". In our country, it was determined that damage was done in Edirne, Kırklareli and Tekirdağ in the Thrace Region [13].

Table 2. Pests detected in the first development period of wheat.

Ordo	Family	Species	District	Village	Situation	
					2020	2021
Diptera	Anthomyiidae	<i>Phorbia</i> spp.	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	-	-
			Kahta	Dut Ortanca	-	-
			Samsat	Taşkuyu	+	+
Coleoptera	Carabidae	<i>Zabrus</i> spp	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+

*Zabru*spp. is one of the underground pests in cereals, causing damage to both its larvae and adults. They become harmful by eating leaves and shoots in early spring. When there is a large number of larvae, they cause a significant loss of yield due to succumbed parts, open grain rows and gaps in the fields [13, 14].

This pest was present in 4 of the 6 fields made in early March in both years in Adiyaman wheat fields. The highest population was detected in Taşkuyu village of Samsat district both in 2020 and 2021, followed by Merkez and Kahta districts. The density in Şambayat town of Besni district is lower than other districts is detected. However, as a result of the censuses, it was determined that there was no need for chemical control since no spraying density was reached in any of the surveyed fields. It has been reported that seed spraying is used for an average of 400 tons of *Zabru*spp throughout Adiyaman province, where producers regularly spray seeds in infested areas [13, 15]. Producers who do not spray seeds do surface spraying, but it has been reported that they did not get the expected result in the fight against pests. [13].

Pests Found in Tillering Period

Tillering in wheat is the occurrence of more than one stem from a single seed. Depending on the climatic conditions in Adiyaman, the average is the end of March and the beginning of spring [11]. Pests seen during tillering period in Adiyaman wheat fields are given in Table 2.

Adults and nymphs of aphids form large colonies on leaves and spikes in wheat and cause damage by sucking plant sap. As a result of sucking, the plant weakens, development stops, it has been reported that the ripening of the grain is prevented and it causes wrinkling and drying [13, 14, 15]. The yield of the product decreases, its quality deteriorates and the plant dries up [16, 17, 18].

During the tillering period, two types of aphids, *Sitobionavenae* and *Myzuspersicae*(Hemiptera: Aphididae), were detected in the surveyed areas in Adiyaman. Although the vegetation is quite young, it has begun to be seen as harmful. Both pests were detected in all surveyed areas in 2020. In both years, the population density of *S. avenae* reached the highest value in Samsat district, and it was observed in the counted fields in Merkez, Kahta and Besni districts. In the surveys conducted during this period, the population of *S. avenae* was observed to be slightly higher than that of *M. persicae*. Although the pest was first seen in this period, its population continued to increase in all other periods of wheat. Since the chemicals used in the fight against other pests are effective in this pest, a separate spraying program has not been organized for the pest.

Pests Found in Steam Extension Period

Steam Extension is the period when the plants take root immediately after the rosette period with the warming of the weather [11]. The pests seen in this period are given in Table 2.

Table 3. Pests detected during tillering period of wheat

Ordo	Family	Species	District	Village	Situation	
					2020	2021
Hemiptera	Aphididae	<i>Sitobionavenae</i>	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+
Hemiptera	Aphididae	<i>Myzuspersicae</i>	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+

E. integriceps is an earth-colored, flat-bodied insect about 1 cm long. It is found in almost every region of our country and our province, and it causes important epidemics in some years. *E. integriceps* is an important pest of our cereals. *E. integriceps* has a stinging-sucking mouth structure [17]. *E. integriceps* prevents the formation of spikes in the grain by inserting the stem of the wheat in the early period and later periods, "white kernel" damage occurs as a result of stinging and sucking. In case of white kernel damage, the spike takes on a lighter and whiter color than the ears that are not damaged [17, 19]

Table 4. Pests detected in wheat stalking period in Adıyaman province

Ordo	Family	Species	District	Village	Situation	
					2020	2021
Hemiptera	Scutelleridae	<i>Eurygasterintegriceps</i>	Merkez,	Lokman Bađpınar	+	+
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+

Adults descending from the winter to the plains mate after feeding. The adult female lays her eggs in 2 or 3 rows under wheat leaves or weeds. Overwintered adults die after spawning. 1st period nymphs emerge from the eggs that hatch after about 1 week. Nymphs change their shirts for the 5th time and form a new generation of adults. New generation adults gorge on wheat to store their energy for the winter. New generation nymphs are harmful directly on the grain of the wheat ear. They cause quality losses due to the secretions they secrete during insertion and sucking, as well as causing yield losses in the grain. They secrete an enzyme that breaks down the protein of the wheat grain. They disrupt the chemical structure of gluten in wheat. Such wheat cannot be used as bread. Highly contaminated wheat cannot be used even as a feed.

E. integriceps is the main pest of wheat in Adıyaman. In the surveys, when the number of new generation nymphs and adults is 10 or more per m², chemical control is decided [13, 20].

E. integriceps is not only the most important pest of our country, but also the most important pest of our city. *E. integriceps* control is applied on an average of 400,000 – 500,000 decare of land every year in Adıyaman. This pest was found in all the villages surveyed in 2020 and 2021, and it was determined that its density was above the economic damage threshold in the controls. For this reason, chemical control was carried out in these areas.

Pests Found During Grain Filling Period

The grain filling period or milk production period is the period when protein accumulates in the epidermis cells in the grain and a honeycomb network is formed, and this period lasts for 20-25 days [11].

One of the important pests of wheat in Adıyaman is *Cephus* sp. Adult emergence of *Cephus* sp. is generally observed during the stalking and earing periods of the grains. Adult females mating for a while after hatching lay eggs in the grain stalk. The damage of *Cephus* sp. is done by the larvae feeding in the stem and they cause damage by destroying the vascular tissues as a result of feeding and disrupting the carbohydrate and water transmission system in the plant. As a result, it has been observed that the grains develop less and cause grain loss, and the grains obtained from the contaminated ears are lighter than the healthy ones. In addition, the stems cut by the larvae break before forming and fall and cause losses. It has been reported that the most important form of damage is the weight reduction in the grain. [21].

In the survey studies carried out in 2020, the pest was found in the surveys carried out in MerkezLokman and Bađpınar villages, but in the studies carried out in 2021, it could not be obtained in the Bađpınar village. In the studies carried out in the village of Besni, in the village of Şambayat, it was determined that *Cephus* sp. was detected in 2020, but it could not be detected in the surveys carried out in 2021. In the studies conducted in Kahta district, it was determined that the pest was found in both Dut village and Ortanca village in 2020, while it was detected only in Dut village in 2021. It could not be detected in Ortanca village. In the studies carried out in Samsat district, pests were found in both years. Studies have shown that the pest population is generally low compared to other provinces[12, 13, 21].

It has been reported that *P. hordeis* spends the winter in the soil in the adult period, the total rainfall in our country has increased over 10 mm since the second half of March in general, and the adults emerge from the soil when the soil temperature rises above 9°C[13, 15, 22]. Adults start to mate 5-7 days after they emerge from the soil and spawn 20-25 days after mating, and the spawning period continues until the milk production period. In addition, the female individual lays her eggs in the spikelet through the hole she opens with her proboscis, the larvae that emerge from the egg feed in the grain, then throw them into the soil to become pupae, and they give 1 offspring per year [13, 22].

As a result of feeding of *P. hordei* adults on the leaves, 2-3 rows of feeding holes appear, and it has been reported that the adults form brown holes as a result of feeding on the stems. In spikes, it is usually in the form of stinging and feeding the middle and bottom parts of the husks [13]. As a result of feeding the adults in the ears, the number and weight of the grains decrease. The main damage is the larvae; They are made into husks by emptying the grains in the milk and yellow ripening period [13, 22].

P. hordeiis one of the main pests of wheat in Adiyaman. For this reason, it was determined that it was found in all fields surveyed in both 2020 and 2022 during the surveys. It was determined that it is especially dense in AdiyamanDut, SamsatTaşkuyu and BesniŞambayat villages. For this reason, it is recommended to carry out chemical struggle in these areas.

*Haplothripstritici*Kurdj. (Thysanoptera: Thripidae) feed on the leaves and stems of the plants while the grain is still in the uprooting stage, and cause whitish or silvery spots as a result of feeding [13, 23]. Particularly, as a result of feeding of wheat in the grains in the period of milk formation, it causes wrinkling and various deformations in the grains, and the quality and quantitative properties of the damaged grains are lower. [13, 14, 23].In the surveys, this pest was found in KahtaOrtanca and BesniŞambayat villages in 2020, while it was found only in BesniŞambayat village in 2021.

The main damage of *Syringopaistempratella* Led. (Lepidoptera: Scythrididae)is done by the larvae, the larvae that become active in the soil after the first rains in autumn pass to the young cereals with 2-3 leaves, and the larvae eat the green tissue between the cereal leaves and cause the leaves to dry from the ends [13, 24]. Also, a heavily damaged field will have discoloration and it has been reported that it looks like it has hit the north wind from afar [24]. In the surveys, this pest was found in AdiyamanBağpınar and BesniŞambayat villages in 2020, while it was found only in AdiyamanBağpınar village in 2021.

Table 5. Pests detected in the grain filling period of wheat

Ordo	Family	Species	District	Village	Situation	
					2020	2021
Hymenoptera	Cephusidae	<i>Cephus sp.</i>	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	+	-
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+
Coleoptera	Curculionidae	<i>Pachytychiushordei</i>	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	+	+
			Samsat	Taşkuyu	+	+
Thysanoptera	Phloeothripidae	<i>Haplothripstritici</i>	Merkez,	Lokman Bağpınar	-	-
			Besni	Şambayat	+	+
			Kahta	Dut Ortanca	-	-
			Samsat	Taşkuyu	-	-
Lepidoptera	Scythrididae	<i>Syringopaistempratella</i>	Merkez,	Lokman Bağpınar	-	-
			Besni	Şambayat	+	-
			Kahta	Dut Ortanca	-	-
			Samsat	Taşkuyu	-	-
Acarina	Eupodidae	<i>Penthaleus major</i>	Merkez,	Lokman Bağpınar	+	+
			Besni	Şambayat	-	-
			Kahta	Dut Ortanca	-	-
			Samsat	Taşkuyu	-	-

Penthaleus major (Acarina:Eupodidae) damages the plant by absorbing the sap, and in the years when the winter and spring are cool and humid, the damage is very high if the density is not high. [13]. In addition, it has been determined that besides the whitening of the leaves, it causes deformities in the plant and generally causes more damage to young cereal plants [6, 13]. In the damaged plant, turning brown of the leaf tips, stunting, stagnation of development, shrinkage of grains and a decrease in yield are observed [13]. In the surveys conducted, it was determined that this pest was found in AdiyamanLokman and KahtaOrtanca villages in 2020, while it was found only in AdiyamanLokman village in 2021.

IV. CONCLUSION

It has been determined that there are many harmful species that negatively affect production in the cereal fields in Adiyaman province. However, it is a fact that there are beneficial species in the wheat ecosystem as well as harmful species. Particular attention should be paid to the protection of these beneficial in the fight against pests. For this purpose, economic damage thresholds should be taken into account in chemical control studies and chemical control should be carried out in the period when beneficial insects will be least damaged. In this context, in the fight against pests, the principles of integrated control should be followed.

Pests determined in different phonological periods in Adiyaman province and their natural enemies are an indicator of the biological richness of this region. In general, the abundance of species diversity, the fact that most of the species are general phytophagous species and the abundance of predators and parasitoids from natural enemies show that the natural balance elements are partially established in these areas. In a study conducted in Van in 2017, insect species found in wheat fields were determined. At the end of the study, 66 species belonging to 7 orders and 39 families were found in 165 different locations. Distribution of species 26 species from 12 families in Coleoptera, 19 species from 10 families in Hemiptera, 9 species from 8 families in Diptera, 6 species from 5 families in Hymenoptera, 2 species from 2 families in Orthoptera, 2 species from 1 family in Neuroptera and It was recorded as 1 species belonging to the order Thysanoptera[25]. In a similar study conducted by Altınayar (1975) in Central Anatolia, 76 species were identified [26]. 109 species were identified by Sayan (2010) in Adana wheat agro-ecosystem [27].

As a result; in the first development period of wheat in Adiyaman province, *Phorbiasp* and *Zabrus* spp., in tillering period, *S. avenae* and *M. persicae*, in the beginning flowering, *E. integriceps*. the grain filling period; *Cephus*, *P. hordei*, *H. tritici*, *S. temperatella*, *P. major* pests were detected.

REFERENCES

- [1]. Akkaya, A. (1994). Buğday yetiştiriciliği. Kahramanmaraş Sütçü İmam Üniversitesi. Ziraat Fakültesi Genel Yayın No: 1. Ders Kitapları Yayın No: 1, Kahramanmaraş, 225 s..
- [2]. Godfray, H.C.; Beddington, J. R.; Crute, I. R.; Haddad, L.; Lawrence, D.; Muir, J. F.; Pretty, J.; Robinson, S.; Thomas, S. M.; Toulmin, C (2010). "Food security: The challenge of feeding 9 billion people". Science. **327** (5967): 812
- [3]. Day L, Augustin MA, Batey IL, Wrigley CW (2006). "Wheat-gluten uses and industry needs". Trends in Food Science & Technology (Review). **17** (2): 82–90. doi:10.1016/j.tifs.2005.10.003
- [4]. Różewicz, M.; Wyżłomski, M.; Grabowski, J. The Most Important Fungal Diseases of Cereals— Problems and Possible Solutions. Agronomy 2021, 11, 714. https://doi.org/10.3390/agronomy11040714
- [5]. Lodos, N., 1986. Türkiye Entomolojisi -II-. Genel Uygulamalı ve Faunistik. Ege Üniversitesi Bitki Koruma Bölümü, Ege Üni. Matbaası, İzmir, 580 s.
- [6]. Anonymous, 1995. Zirai Mücadele Teknik Talimatları, Koruma ve Kontrol Genel Müdürlüğü, Ankara, Cilt 1, 291 s.
- [7]. Brown, E. S. and M. Eralp. 1962. The Distribution of the Species of *Eurygaster* spp. (Hemiptera, Scutelleridae) in Middle East Countries. Ann. Mag. Nat. Hist., 13 (5): 65- 81.
- [8]. Lodos N., F. Önder, E. Pehlivan ve R. Atalay. 1978. Ege ve Marmara Bölgesinin Zararlı Böcek Faunasının Tespiti Üzerinde Çalışmalar. Zir. Müc. Zir. Kar. Gn. Md. Yay., Ankara, 301s.
- [9]. Bora, T. ve Karaca, İ. 1970. Kültür bitkilerinde hastalığın ve zararının önlenmesi. Ege Üniversitesi Yardımcı Ders Kitabı, Yayın No: 167, E.Ü. Mat., Bornova-İzmir, 8s.
- [10]. Zümreoğlu, S., ve Akbulut, N., 1984. Ege Bölgesi İkinci Ürün Ekim Alanlarında Görülen Hastalık, Zararlı Yabancı Ot Larve Bunların Doğal Düşmanları Üzerinde Araştırmalar. Zir. Müc. Ar. Yıll., 20: 92-93.
- [11]. Ünsal Eren, N., Türker, M.H. & Akkaya, G. (2018). Bazı durum buğday çeşitlerinin kurağamukavemetyönündentoprakaltiveüstüorganlarının incelenmesi. Harran Tarım ve Gıda Bilimleri Dergisi, 22(4): 551-559. DOI: 10.29050/harranziraat.3414 16
- [12]. Hatchett, J. H., Starks, K. J., & Webster, J. A. (1987). Insect and Mite Pests of Wheat. Ed: E. G. Heyne, Agronomy Monographs, https://doi.org/10.2134/agronmonogr13.2ed.c34.
- [13]. Anonymous (2008). Zirai Mücadele Teknik Talimatları, Cilt 1. T.C. Gıda Tarım ve Hayvancılık Bakanlığı, Tarımsal Araştırmalar ve Politikalar Genel Müdürlüğü Bitki Sağlığı Araştırmaları Daire Başkanlığı, Ankara.
- [14]. Lodos, N., 1973. "Wheat pests and their importance in Turkey". Panel on Pest and Diseases of Wheat. Central Treaty Organization for Scientific Education on Research, Cento Scientific Coordinating Board, Iran, 28-44.
- [15]. Lodos N. & F. Önder, 1983. Süne (*Eurygaster integriceps* Put.)'nin Türkiye'deyayılışızüzerindedüşünceler. Bitki Koruma Bülteni, 23 (2): 53-60.
- [16]. Lodos N., F. Önder, E. Pehlivan, R. Atalay, E. Erkin, Y. Karsavuran, S. Tezcan & S. Aksoy, 1998. Faunistic Studies on Pentatomidae (Plataspidae, Acanthosomatidae, Cydnidae, Scutelleridae, Pentatomidae) of Western Black Sea, Central Anatolia and Mediterranean Regions of Turkey. E. Ü. Basımevi, Bornova-İzmir, 75 pp.
- [17]. Popov, C., A. Barbulescu, I. Vonica and I. Rosca. 1998. New Approaches Regarding Integrated Sunn Pest (*Eurygaster integriceps* Put.) Management. Proceedings of International Symposium on Integrated Protection of Field Crops, 137-145, Vrnjaka Banja, Yugoslavia, on 25th September 1998.
- [18]. Tayat, E., & Özder, N. (2016). Edirne ilinde buğday tarlalarında görülen yaprak bitileri (Hemiptera: Aphididae) üzerine araştırmalar. Türkiye Entomoloji Bülteni, 6(1), 53-60.
- [19]. Mohaghegh, J. 2004. Life History and Reproductive Table of *Eurygaster maura* L. (Het.: Scutelleridae) in the Laboratory. 22. Proceedings of the Second International Conference on Sunn Pest, July 19-22, 2004, Aleppo-Syria.
- [20]. Yüksel, M. 1968. Güney ve Güneydoğu Anadolu'da Süne *Eurygaster integriceps* Put.'un Yayılışı, Biyolojisi, Ekoloji, Epidemiyolojisi ve Zararı Üzerinde Araştırmalar. Zir. Müc. Zir. Kar. Gn. Md. Yay., No:46, Ankara, 255s.
- [21]. Tayakası, İ. (1971). Buğdayda Zararlı Olan Ekin Saparı (Cephus spp.'nın Antalya ve Maraş illerinde Kıymetlendirme Sürveyi. Adana Bölge Zirai Araştırma Enstitüsü, Adana.
- [22]. Koyuncu, N. (1975). Burdur ilinde buğday hortumluböceği (*Pachytychius hordei* Brulle)'nin yayılışı, morfolojisi, biyokolojisi ve sebepolduğürün kayıplarına ve savaşızüzerinde araştırmalar. Ankara Z.M.A.E., 40, 112

- [23]. Karman, M., Kaya, O., & Kavut, H. (1971). Ege bölgesi Meksika orjinli veyerlibuğdaylarında görülen buğday thrips'i (Haplothrips tritici) 'in zararlı olup olmadığına ilişkin araştırmaları (Aphis spp.) kesafeti, türleri ve mücadelelerine ekonomik olup olmadığına ilişkin araştırmaları. Proje E/105.633 Nihai Raporu.
- [24]. Adıgüzel N., 1978. Güneydoğu Anadolu Bölgesinde Ekinlerde Zarar Yapan Sap Tırtılları (Lepidoptera) Tanınmaları, Yayılışları, Kısa Biyolojileri ve Zararları Üzerinde Araştırmalar. Diyarbakır Bölge Ziraat Mücadele Araştırma Enstitüsü (Yayınlanmamış Uzmanlık Tezi).
- [25]. Özgökçe, M S, Kara, H, Baş, F H, Kına, E, 2022. Harmful and Beneficial Insect Species and Their Distributions in Wheat Areas in Van Province. Yuzuncu Yil University Journal of Agricultural Sciences, 32(1): 213-222.
- [26]. Altınayar, G. (1975). Ekin sap arıları [Cephus pygmaeus (L.) ve Trachelustabidus (F.) (Hymenoptera: Cephidae)]'nın Konyi ilinde biyo-ekolojileri, sebep oldukları ürün kayıplarını ve savas yolları üzerinde araştırmalar
- [27]. Sayan, M. (2010). Adana'da buğday agro-ekosistemindeki böcek türlerinin belirlenmesi. Adana.