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Seed Beetle (Chrysomelidae: Bruchinae) Species, Occurrence Rate and Damage in Vetch Cultivation Areas of Eleşkirt (Ağrı) District

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ABSTRACT
This study was carried out to determine the seed beetle species in vetch cultivating areas their infestation rates, and weight loss in vetch seeds in the 17 villages of Eleşkirt district of Ağrı province in 2019-2020. Seed beetle adults were collected from common vetch (*Vicia sativa* L.) and Hungarian vetch (*Vicia pannonica* Crantz.) by sweeping net. In addition, they were obtained by culturing the vetch seeds harvested from the fields. As a result of the study, 10 species belonging to the genera *Bruchidius* Schilsky, 1905 (1 species), *Bruchus* Linnaeus, 1767 (6 species), and *Spermophagus* Schoenherr, 1833 (3 species) of subfamily Bruchinae (Coleoptera: Chrysomelidae) were identified. *Bruchus affinis* J. A. Frölich 1799 and *Spermophagus calystegiae* (Lukjanovitch & Ter-Minassian 1957) are first found in the Eleşkirt district. Among the 5.887 adult individuals collected, the most dominant species were *Bruchus brachialis* Fåhraeus 1839 (52.03%) and *Bruchus rufimanus* Boheman 1833 (43.49%). The infestation rate and weight loss in vetch seeds were found as 1.03% and 0.51%, respectively.

Entomoloji

Araştırma Makalesi

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Anahtar Kelimeler
Chrysomelidae
Bruchinae
Eleşkirt
Seed beetle
Vetch

Eleşkirt (Ağrı) İlçesinin Fiğ Ekim Alanlarındaki Tohum Böceği (Chrysomelidae: Bruchinae) Türleri, Bulunma Oranı ve Zararları

ÖZET
Bu çalışma fiğ ekim alanlarındaki tohum böceği türleri, bulunuş oranları, bulaşıklık oranları ve ağırlık kayıplarının tespit edilmesi amacıyla Ağrı iline bağlı Eleşkirt ilçesinin merkezi ve ilçeye bağlı 17 köyünde, 2019-2020 yıllarında yürütülmüştür. Tohum böceği erginleri, adi fiğ (*Vicia sativa* L.) ve Macar fiği (*Vicia pannonica* Crantz.) bitkileri üzerinden atrap ile toplanarak, ayrıca tarlalardan hasat edilen fiğ tohumlarının kültüre alınmasıyla elde edilmiştir. Çalışmanın sonucunda, Bruchinae (Coleoptera: Chrysomelidae) altfamilyasından *Bruchidius* (1 tür), *Bruchus* (6 tür) ve *Spermophagus* (3 tür) cinslerine bağlı 10 tür tespit edilmiştir. *Bruchus affinis* J. A. Frölich 1799 and *Spermophagus calystegiae* (Lukjanovitch & Ter-Minassian 1957) türleri Eleşkirt ilçesinden ilk kez tespittir. Toplanan 5.887 ergin birey arasından dominantlığı en yüksek türler, *Bruchus brachialis* (%52.03) ve *Bruchus rufimanus* (%43.49) olmuştur. Eleşkirt ilçesinde tohum böceklerinin fiğ tohumlarında bulaşıklık oranı ve fiğ tohumlarındaki ağırlık kaybı sırasıyla %1.03 ve %0.51 olarak tespit edilmiştir.

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INTRODUCTION
Family Fabaceae (Leguminosae), called legumes, is one of the largest families in the world. Of the 250 thousand flowering plant species considered to exist, 12 thousand are legumes and distributed within approximately 600 genera. Legumes have been one of the important food sources of humankind since ancient times. The presence of

legume seeds in the Egyptian pyramids and in grave excavations in our country is a clear indicator of this (Serin & Tan, 2008). It is stated that vetch, legume forage plant, has approximately 140-150 species worldwide. Vetch is especially known as a native plant of Asian, European, and Mediterranean countries (Avcıoğlu et al., 2009). Important vetch species in Turkey: *Vicia sativa* L., *V. villosa* Roth, *V. pannonica* Crantz., *V. narbonensis* L. and *V. ervilia* (L.) Willd. (Ekiz et al., 2011).

Vetch is a fodder plant that is not selective in terms of soil requirements. It can be grown for grass production, grain production, and grazing or as a green manure plant. Its green and dry grass is high quality and nutritious. Since its grains contain a high amount of crude protein, it can be used extensively in animal nutrition (Elçi, 2005; Ertekin & Çakmakçı, 2020). There is a high crude protein content of 14.0-14.9% in vetch dry grass, depending on harvesting time and vetch type, and 20.2-27.7% in its grains. The remaining vetch straw after grain production also contains digestible crude protein approximately 2.0-3.5% (Çetin, 2016).

Vetch is rich in nutritional value and has a positive effect on the soil in which they are grown. The importance of this plant is increasing today, as the air's free nitrogen bonding properties to the soil, environmentalism and the popularity of sustainable agriculture increase. *Rhizobium* bacteria, which live in common with legumes, enrich the soil layers where their roots spread by binding the nitrogen that is free in the air but cannot be directly used by living things to the environment in which they live (Şehirali, 1988). The vetch is also one of the best rotation plants because it fixes nitrogen into the soil (Kalkan & Avcı, 2020).

According to the data of 2023 in our country, the cultivation area of the plants used in animal nutrition is 19 044 837 decares and their production is 56 764 701 tons. Among the plants used in animal nutrition, vetch has a share of 14.90% with a cultivation area of 2 836 285 decares and 6.55% with its 3 717 866 tons of green grass production. The cultivation area of the fodder plants produced in the Eastern Anatolia Region in 2023 is 5 651 963 da and the production is 9 286 756 tons. Vetch cultivation is carried out in the area of 504 049 da and 438 944 tons of green grass are produced. In Ağrı province, the vetch cultivation area as green grass was 35.708 da and the production amount was 16.310 tons. In Ağrı provinces, the ratio is 8.91% of vetch cultivation area and 7.08% of green grass production in the Eastern Anatolia Region (Anonim, 2023).

Legume plants, which have such an important place in the agricultural structure of the country, are attacked by many pests during the field and storage periods. Among these pests, seed beetles feeding on legume grains have an important place due to the weight and germination losses they cause. Seed beetles, which started to be harmful to the crop during the field period, can continue their damage after harvest and cause a high amount of product losses. Because of these features, seed beetles are described as “Big Protein Consumers” (Yücel, 1985). Many researchers have carried out scientific studies on seed beetles in different habitats, but no study has been found on the species, distribution, and damage of seed beetles in the vetch in Eleşkirt district of Ağrı province. This study was carried out to identify seed beetle species in vetch cultivation areas and to contribute knowledge to the local farmers to be able to get higher yield and quality vetch production opportunities in Eleşkirt district.

MATERIAL and METHOD

Material

The main materials of the research are seeds of *Vicia sativa* L. and *V. pannonica* Crantz. The seed beetles were obtained by culturing vetch seeds and collected by sweeping net from vetch plants. Reared materials are used for the identification of seed beetle species.

Obtaining Species Belonging to the Subfamily Bruchinae

Field observation surveys were carried out to determine the species of seed beetles associated with vetch plants in the center of Eleşkirt district and 17 belonging villages. Three fields in different directions were determined to represent each village and study area. Values were calculated based on 54 fields at least twice during the vegetation season. The samples were taken for two consecutive years, in May, June, and July, during the flower and capsule binding periods of the plants. In the surveys, a sweeping net was used (30 cm diameter, 75 cm deep, conical shape, handle length 55 cm). At different points that can represent each field, the sweeping net circle was kept perpendicular to the ground and swung at an angle of 180°, once in two steps, as far as possible, on the part of the plant close to the soil. Accordingly, 50 sweeping at each point were shaken at four different points of the field, and the seed beetles entering the sweeping net were taken with an aspirator (beetle-sucking tube) and transferred to a killing bottle with potassium cyanide. The beetles taken from the killing bottle were labeled by putting them in beetle storage envelopes. After that, specimens were mounted on triangle cards by glue (Yücel, 1985). Storage surveys were carried out in village producer storages where field surveys were made. Vetch seed samples were collected from three randomly selected storage sites representing each village. Samples of 500 g were taken from the vetch seeds from different locations and depths of the vetchs that were bagged and stored in bulk.

For each sample, a survey record form containing information such as the district, village, storage owner, for what purpose it was stored, and the year of manufacture was filled in. The samples were brought to the laboratory by placing them in plastic bags together with the registration forms. In the laboratory, these samples were transferred into glass jars separately and the mouths of the jars were closed with the help of a thin tulle fabric in order to meet the oxygen need of the insects that will exit the seeds and prevents their escape. A label was affixed to the jar containing information such as the name of the place where the sample was taken, the date of its collection, from which field it was taken, and the product type. The jars were kept under room conditions for 3 months to determine the weight loss (%) and beetle infestation rates (%) in the grains. Adults obtained from the samples, which were checked daily, were collected with the help of an aspirator, and the number of insects, the date of collection, and information of the village and storage where the insects from the jar belonged were recorded (Yücel, 1985; Kaynaş, 2014). Species collected in the field and reared under storage conditions were identified by a third author [Dr. Melek GÜÇLÜ (Atatürk University, Department of Plant Protection)]. For identification of the specimens, the presence of the single or double denticles on the apical side of the middle tibia, the structure of the segments on the antenna, the denticles status on the lateral side of the pronotum, the patterns formed by the feathers on the elytra, the carina, and apical spines status on the hind tibia were taken into consideration.

Determination of Insect Pest Infestation Rate and Weight Loss in Seeds

Vetch seeds (500 g) in the jars were checked daily. The seed beetles that emerged were collected from the jars with the help of an aspirator. After the completion of insect emergence at the end of 3 months, the intact and perforated seeds in the jars were separated individually, counted, and recorded. The number of perforated seeds was used to determine the infestation rate, and their weights were used to determine the weight loss caused by the seed beetles. The infestation density in seeds was calculated using the following formula (in Equality 1) given by Seçkin (Seçkin, 1981).

$$Infestation\ rate = \frac{N1}{N2} \quad (1)$$

Inequality 1, N1 indicates the number of damaged grains, and N2 indicates the number of grains in the sample.

Undamaged and damaged grains collected from the jars were weighed separately with an electronic scale, and their weights were recorded. The obtained data were used to calculate the weight loss (%). The weight loss in seeds was calculated using the following formula (in Equality 2) given by Yücel (Yücel, 1985).

$$Weight\ Loss\ (\%) = \frac{(U\ x\ Nd)-(D\ x\ Nu)}{U(Nd+Nu)}\ x\ 100 \quad (2)$$

Inequality 2, U is the weight of undamaged grains, Nu is the number of undamaged grains, D is the weight of damaged grains, and Nd is the number of damaged grains. The status of seed beetles in the village was determined by taking the average of the infestation rates and weight loss values obtained from samples collected from three storage sites in each village. The status of the district was determined by averaging the values of all villages.

RESULTS

Seed Beetle Species Detected in Vetches in Eleşkirt District

In this study, a total of 10 seed beetle species (Bruchinae) were determined belonging to six species *Bruchus*, one species *Bruchidius* and three species *Spermophagus*. These species are *Bruchus affinis* J. A. Frölich 1799, *Bruchus brachialis* Fåhraeus 1839, *Bruchus ervi* J. A. Frölich 1799, *Bruchus hamatus* Miller 1881, *Bruchus rufimanus* Boheman 1833, *Bruchus viciae* Olivier 1795, *Bruchidius lutescens* (Blanchard 1844), *Spermophagus calystegiae* (Lukjanovitch & Ter-Minassian 1957), *Spermophagus kuesteri* Schilsky 1905 and *Spermophagus sericeus* (Geoffroy 1785). Totally, 3026 female and 2790 male individuals belonging to the genus *Bruchus,* 29 female and 31 male individuals belonging to the genus *Spermophagu*s, and 2 female and 4 male individuals belonging to the genus *Bruchidius* were collected. In this study, seed beetles belonging to the genera *Bruchidius* and *Spermophagus* were not found in the cultivated seeds. These species were only observed in the flowers of vetch plants in the field surveys. However, species belonging to the genus *Bruchus* were found both in the field and under storage conditions. Locality information, collection and emergence dates and male and female numbers of the detected species are given in Table 1.

Occurrence Rate of Seed Beetle Species Detected in Vetches in Eleşkirt District

Among the 5,887 adult individuals obtained, the most dominant species were *Bruchus brachialis* (Vetch seed beetle) with 3.063 individuals and 52.03% occurrence rate, and *B. rufimanus* (Broad bean seed beetle) with 2.560 individuals and 43.49% occurrence rate. The least common species was *B. Viciae,* with one individual and occurrence rate of 0.02%. The occurrence rates and the numbers of species are listed in Table 2.

Table 1. Detected seed beetle species and their locality, collecting and emergence dates and male and female numbers in Eleşkirt district in 2019-2020.

Çizelge 1. 2019-2020 yıllarında Eleşkirt İlçesi'nden tespit edilen tohum böceği türleri ve bunların lokaliteleri, toplanma ve çıkış tarihleri ile erkek ve dişi sayıları

Species	Locality	Collecting and Emergence Dates	Number of Female and Male
Bruchus affinis J. A. Frölich 1799	Alagün	01.VI.2019	5♀, 3♂
	Dolutaş	23.V.2020	4♀, 5♂
	Düzyayla	16.VI.2019	4♀, 7♂
	Esentepe	22.V.2020	10♀, 5♂
	Goncalı	07.VI.2019	4♀, 3♂
	Haydaroğlu	02.VI.2019	2♀, 4♂
	İkizgeçe	16.V.2020	5♀, 6♂
	Kanatgeren	08.VI.2019	7♀, 3♂
	Mollasüleyman	03.VI.2019	11♀, 8♂
	Palakçayırı	21.V.2020	9♀, 6♂
	Pirabat	14.VI.2019	7♀, 7♂
	Toprakkale	24.V.2020	6♀, 10♂
	Yanıkdere	10.VI.2019	4♀, 2♂
	Yayladüzü	04.VI.2019	5♀, 2♂
	Yelkesen	15.0VI.2019	7♀, 5♂,
	Yücekapı	19.V.2020	9♀, 2♂
Bruchus brachialis Fåhraeus 1839	Alagün	01.VI.2019	11♀, 6♂
		03.I.2020	42♀, 50♂
		04.I.2020	37♀, 27♂
		05.I.2020	53♀, 25♂
		06.I.2020	40♀, 51♂
		07.I.2020	64♀, 29♂
	Dolutaş	23.V.2020	6♀, 8♂
		24.IX.2020	14♀, 16♂
		25.IX.2020	16♀, 21♂
		26.IX.2020	12♀, 19♂
	Esentepe	13.VI.2019	19♀, 9♂
		13.XII.2019	51♀, 33♂,
		14.XII.2019	67♀, 41♂,
		15.XII.2019	59♀, 29♂
		16.XII.2019	43♀, 32♂
	Goncalı	07.VI.2019	-, 5♂
	Haydaroğlu	02.VI.2019	1♀, -
		08.VI.2019	5♀, 17♂
		07.XII.2019	36♀, 42♂
		08.XII.2019	31♀, 57♂
	Kanatgeren	09.XII.2019	73♀, 53♂
		10.XII.2019	62♀, 39♂
		11.XII.2019	40♀, 75♂
		30.V.2020	9♀, 10♂
		21.V.2020	10♀, 5♂
	Palakçayırı	28.IX.2020	38♀, 41♂
		29.IX.2020	50♀, 21♂
		14.VI.2019	1♀, 3♂
	Pirabat	27.XII.2019	64♀, 28♂
		28.XII.2019	30♀, 47♂
	Süzgeçli	18.VI.2019	60♀, 32♂
	Yanıkdere	10.VI.2019	2♀, 2♂
		01.XII.2019	47♀, 71♂
	Yayladüzü	02.XII.2019	46♀, 53♂
		03.XII.2019	44♀, 36♂

		04.XII.2019	67♀, 54♂
		05.XII.2019	63♀, 29♂
		06.XII.2019	43♀, 48♂
		18.XII.2019	30♀, 35♂
		19.XII.2019	37♀, 51♂
	Yelkesen	20.XII.2019	42♀, 40♂
		21.XII.2019	36♀, 53♂
		22.XII.2019	27♀, 52♂
		23.XII.2019	9♀, 23♂
	Yücekapı	24.XII.2019	16♀, 31♂
		25.XII.2019	10♀, 17♂
		26.XII.2019	11♀, 23♂
Bruchus ervi J. A. Frölich 1799	Goncalı	07.VI.2019	5♀, 7♂
Bruchus hamatus Miller 1881	Değirmengeçidi	06.VI.2019	-, 1♂
	Dolutaş	23.V.2020	-, 1♂
	Düzyayla	16.VI.2019	-, 1♂
	Alagün	01.VI.2019	27♀, 38♂
		15.V.2020	22♀, 18♂
		06.VI.2019	36♀, 23♂,
	Değirmengeçidi	27.V.2020	20♀, 12♂,
		20.IX.2020	31♀, 20♂
		21.IX.2020	43♀, 28♂
		23.V.2020	13♀, 31♂
	Dolutaş	24.IX.2020	30♀, 17♂
		25.IX.2020	36♀, 23♂
		26.IX.2020	51♀, 24♂,
		16.VI.2019	28♀, 33♂
	Düzyayla	26.V.2020	13♀, 23♂
		22.IX.2020	33♀, 30♂
	Esentepe	13.VI.2019	19♀, 14♂
		22.V.2020	22♀, 14♂
	Goncalı	07.VI.2019	16♀, 22♂
		28.V.2020	33♀, 17♂
		02.VI.2019	27♀, 15♂
	Haydaroğlu	01.I.2020	59♀, 41♂
		31.V.2020	36♀, 21♂
Bruchus rufimanus Boheman 1833		17.VI.2019	9♀, 14♂
	İkizgeçe	29.XII.2019	54♀, 35♂
		30.XII.2019	51♀, 36♂
		16.V.2020	14♀, 22♂
	Kanatgeren	08.VI.2019	15♀, 6♂
		03.VI.2019	16♀, 29♂
	Mollasüleyman	25.V.2020	48♀, 25♂
		27.IX.2020	38♀, 24♂
	Palakçayırı	11.VI.2019	21♀, 33♂
		21.V.2020	30♀, 16♂
	Pirabat	14.VI.2019	26♀, 32♂
		17.V.2020	15♀, 14♂
	Süzgeçli	18.VI.2019	11♀, 13♂
	Toprakkale	09.VI.2019	26♀, 32♂
		24.V.2020	38♀, 18♂
		10.VI.2019	21♀, 41♂
	Yanıkdere	08.I.2020	26♀, 54♂,
		09.I.2020	32♀, 42♂
	Yayladüzü	04.VI.2019	44♀, 20♂
	Yelkesen	15.VI.2019	52♀, 33♂
		20.V.2020	49♀, 50♂

		05.VI.2019	9♀, 25♂
		23.XII.2019	17♀, 24♂
	Yücekapı	24.XII.2019	20♀, 39♂
		25.XII.2019	33♀, 18♂
		26.XII.2019	37♀, 54♂
Bruchus viciae Olivier 1795	Alagün	01.VI.2019	1♀, -
Bruchidius lutescens (Blanchard 1844)	Toprakkale	09.VI.2019	2♀, 4♂
	Esentepe	13.VI.2019	1♀, -
	Goncalı	28.V.2020	-, 1♂
	İkizgeçe	16.V.202	-, 2♂
	Kanatgeren	08.VI.2019	1♀, 1♂
Spermophagus calystegiae (Lukjanovitch & Ter-Minassian 1957)	Mollasüleyman	03.VI.2019	2♀, -
	Palakçayırı	21.V.2020	-, 2♂
	Toprakkale	24.V.2020	1♀, 1♂
	Yayladüzü	04.VI.2019	-, 1♂
	Yelkesen	15.VI.2019	2♀, -
	Yücekapı	05.VI.2019	1♀, 1♂
	Esentepe	13.VI.2019	1♀, -
	Goncalı	28.V.2020	-, 1♂
Spermophagus kuesteri Schilsky 1905	Haydaroğlu	02.VI.2019	-, 1♂
	İkizgeçe	16.V.2020	1♀, -
	Toprakkale	24.V.2020	1♀, -
	Yelkesen	15.VI.2019	-, 1♂
	Değirmengeçidi	27.V.2020	-, 2♂
	Dolutaş	23.V.2020	1♀, 2♂
	Düzyayla	16.VI.2019	-, 2♂
	Esentepe	13.VI.2019	2♀, 2♂
	Goncalı	07.VI.2019	1♀, -
	Haydaroğlu	31.V.2020	-, 1♂
	İkizgeçe	17.VI.2019	-, 2♂
Spermophagus sericeus (Geoffroy 1785)	Kanatgeren	30.V.2020	3♀, -
	Mollasüleyman	03.VI.2019	2♀, -
	Palakçayırı	11.VI.2019	2♀, -
	Pirabat	17.V.2020	1♀, 2♂
	Toprakkale	09.VI.2019	2♀, 1♂
	Yanıkdere	10.VI.2019	-, 1♂
	Yayladüzü	04.VI.2019	-, 2♂
	Yücekapı	05.VI.2019	1♀, -
			3057♀, 2825♂

Table 2. Occurrence rate of seed beetle species detected in vetch cultivation areas of Eleşkirt district in 2019-2020.
Çizelge 2. 2019-2020 yıllarında Eleşkirt İlçesi'nin fiğ ekim alanlarından tespit edilen tohum böceği türlerinin görülme oranı

Species	Number of Seed Beetle	Frequency in Samples (%)
Bruchus affinis J. A. Frölich 1799	187	3.18
Bruchus brachialis Fahraeus 1839	3.063	52.03
Bruchus ervi J. A. Frölich 1799	12	0.20
Bruchus hamatus Miller 1881	3	0.05
Bruchus rufimanus Boheman 1833	2.560	43.49
Bruchus viciae Oliver 1795	1	0.02
Bruchidius lutescens Blanchard 1844	6	0.10
Spermophagus calystegiae Luk. & Ter-Min.1957	17	0.29
Spermophagus kuesteri Schilsky 1905	6	0.10
Spermophagus sericeus Geoffroy 1785	32	0.54
Total	**5.887**	**100.00**

Infestation Rate of Seed Beetles in Vetch Seeds in Eleşkirt District in 2019-2020

The infestation rates of seed beetles in the vetch seeds are shown in Table 3. The highest infestation was detected

in sample number 3 in Yücekapı (2.19%), followed by sample number 2 in Yayladüzü (2.18%), and sample number 3 in Yayladüzü (1.87%). The lowest infestation was detected in sample number 1 in Mollasüleyman village (0.23%), followed by sample number 2 in Düzyayla village (0.24%), and sample number 2 in Mollasüleyman village (0.29%). The highest infestation mean on village/basis were 1.97%, 1.82%, and 1.56% in Yayladüzü, Yücekapı, and Alagün, respectively. The lowest average infestation rates were found in Mollasüleyman and Düzyayla (0.33%), followed by Palakçayırı (0.44%). In the Eleşkirt district, the seed beetle infestation rate of vetch seeds was determined to be 1.03%.

Table 3. Infestation rate (%) of seed beetles in vetch seeds in Eleşkirt district in 2019-2020.
Çizelge 3. 2019-2020 yıllarında Eleşkirt İlçesi'ndeki fiğ tohumlarının tohum böcekleriyle bulaşıklık oranı.

Villages	Storage Number and Infestation Rate (%)			Infestation Mean (%)
	1	2	3	
Alagün	1.79	1.49	1.39	1.56
Değirmengeçidi	0.38	1.10	0.47	0.65
Dolutaş	1.29	1.54	1.39	1.41
Düzyayla	0.33	0.24	0.43	0.33
Center	1.47	1.27	1.09	1.28
Haydaroğlu	0.66	0.44	0.52	0.54
İkizgeçe	1.18	0.76	0.85	0.93
Kanatgeren	1.56	1.50	1.34	1.47
Mollasüleyman	0.23	0.29	0.48	0.33
Palakçayırı	0.45	0.55	0.33	0.44
Pirabat	0.46	0.48	0.40	0.45
Yanıkdere	0.89	0.81	0.76	0.82
Yayladüzü	1.86	2.18	1.87	1.97
Yelkesen	1.26	1.46	1.67	1.46
Yücekapı	1.54	1.73	2.19	1.82
District Mean (%)				**1.03**

Weight Loss Caused by Seed Beetle in Vetch Seeds in Eleşkirt District in 2019-2020

As a result of feeding of seed beetle larvae on vetch seeds, weight losses in vetch seeds are shown in Table 4. The highest weight loss in vetch was detected in sample number 3 in Yücekapı (1.14%), followed by sample number 1 in Alagün (%1.00 and sample 3 (0.99%). The lowest weight loss was detected in sample 2 in Düzyayla (0.12%), followed by sample number 2 in Mollasüleyman 0.13% and sample number 3 in Palakçayırı by 0.14%. The highest weight loss on a village basis was 0.96%, 0.88%, and 0.81% in Yücekapı, Yelkesen and Alagün, respectively. The lowest weight losses were 0.17%, 0.18%, and 0.20% in Düzyayla, Mollasüleyman, and Pirabat, respectively. In Eleşkirt district, the weight loss in vetches was determined to be 0.51%.

Table 4. Weight loss (%) caused by seed beetles in vetch seed samples in 2019-2020 in Eleşkirt district.
Çizelge 4. 2019-2020 yıllarında Eleşkirt ilçesinde fiğ tohumu örneklerinde tohum böceklerinin neden olduğu ağırlık kaybı (%)

Villages	Storage Number and Weight Loss (%)			Weight Loss Mean (%)
	1	2	3	
Alagün	1.00	0.81	0.63	0.81
Değirmengeçidi	0.19	0.52	0.24	0.32
Dolutaş	0.51	0.77	0.73	0.67
Düzyayla	0.17	0.12	0.23	0.17
Center	0.77	0.67	0.52	0.65
Haydaroğlu	0.32	0.24	0.26	0.27
İkizgeçe	0.60	0.40	0.39	0.46
Kanatgeren	0.90	0.83	0.57	0.77
Mollasüleyman	0.13	0.15	0.27	0.18
Palakçayırı	0.22	0.28	0.14	0.21
Pirabat	0.17	0.24	0.19	0.20
Yanıkdere	0.45	0.36	0.40	0.40
Yayladüzü	0.65	0.69	0.73	0.69
Yelkesen	0.74	0.90	0.99	0.88
Yücekapı	0.80	0.93	1.14	0.96
District Mean (%)				**0.51**

Type of Damage Caused by Seed Beetles on Vetch Seeds

Adult seed beetles, which were overwintered in the field or the stored vetch seeds, appeared in the vetch fields in the first week of May, which is the beginning of flowering and capsular attachment of the vetch plant. The adults feed on the flowers, nectar, and pollen of the vetch plant before mating. Adult beetles that feed on the flowers of the vetch plant mate, and females lay their eggs on the vetch capsules. The hatching larva opens a thin gallery in the vetch capsule, enters the vetch seed, feeds in the seed, changes its coat, and completes the pupal stage. It completes its development in the seed and the adult beetles emerge from the seed (Figure 1). After the adults emerged, the damaged seeds perforated as shown in Figure 2.

Figure 1. Vetch seeds infested by seed beetles
Şekil 1. Tohum böcekleriyle bulaşık fiğ tohumları

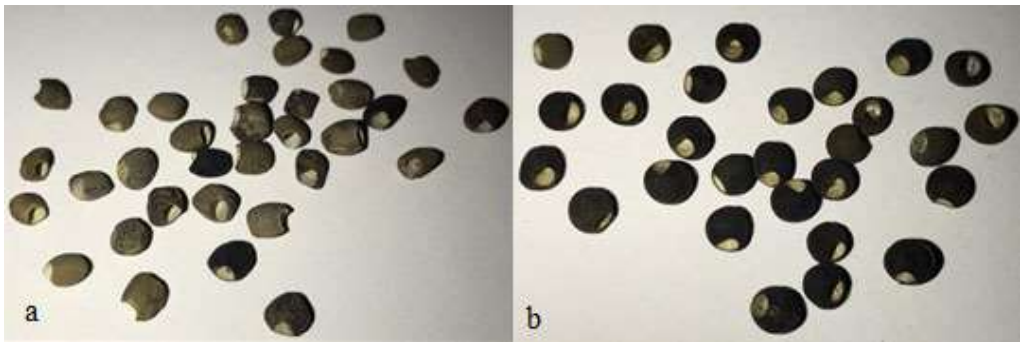

Figure 2. Vetch seeds damaged by seed beetle larvae, *a: Vicia sativa L., b: Vicia pannonica Crantz.*
Şekil 2. Tohum böceği larvaları tarafından zarar gören fiğ tohumları, a: Vicia sativa L., b: Vicia pannonica Crantz.

DISCUSSION

This study was conducted in the center of the Eleşkirt district of Ağrı province and 17 villages in the district. Totally, ten species were determined from the vetch cultivation fields of the Eleşkirt district. All the seed beetle species detected in this study were previously detected in Turkey. Additionally, *Bruchus affinis* and *Spermophagus calystegiae* were detected for the first time in the Eleşkirt district. In addition, the weight losses caused by seed beetles and the infestation rate in the seeds were investigated in vetch cultivation areas.

Bruchus affinis, which was detected in Eleşkirt district of Ağrı province was collected on flowers of *Vicia sativa* and *V. pannonica*. Lodos (1998), stated that *B. affinis* has a rich host list; its main host is *Lathyrus* species, and it also damages plant seeds of genera such as *Lotus*, *Vicia*, *Pisum,* and *Ulex*. Güdek (2020), reported that this species was found in *V. cracca.*

Bruchus rufimanus was collected from the flowers and reared from the seeds of *V. sativa* and *V. pannonica*. It has been found extensively in the seeds of *V. sativa*. Özer (1961), reported that this species is polyphagous and harmful to vetch, lentils, beans, and broad beans. Alkan (1966) stated that it causes damage to chickpeas and vetches. Seçkin (1981), stated that it is only found in bean and black lentil seeds and that this insect causes severe damage to black lentils. Lodos (1998), reported that its main host is a broad bean belonging to the genus *Vicia*, which is found in peas, some *Lathyrus* species, and rarely in beans. György and Merkl (2005) reported that it was found in *V. pannonica*. Güdek (2020) reported that it is found on the flowers of *V. sativa* and *V. pannonica*. In addition to these researchers, this species was detected on *Lathyrus laxiflorus* (Desf.) O. Kuntze, *L. venetus* (Mill.) Woh., *L. cicera* L., *L. vernus* (L.) Bernh., *Pisum sativum* L., *V. bithynica* L., *V. hybrida* L., *V. lutea* L., *V. panonica* Crantz.,

V. peregrina L., *V. faba* L., *V. hirsuta* (L.) Gray., *V. loiseulerii* (M. Bieb.) Litv., *V. narbonensis* L., *Onobrychoides* L. (Delobel and Delobel 2007; Delobel, 2014).

Bruchus ervi and *B. viciae* were collected from flowers of common vetch while, *B. hamatus* was reared from seeds of Hungarian vetch. *B. ervi* was found *Lathyrus* spp., *Lens culinaris* Medik., *Vicia* spp., *V. pannonica* , (Borowiec & Anton, 1993; Decelle & Lodos 1989; Kaynaş, 2014). *Bruchus vicae* was found on *Vicia teneufolia* Roth., *V. sepium* L., *V. angustifolia* L., *Lathyrus sphaericus* Retz., *L. pratensis* L., *L. miniatus* L. *Lens culinaris* (Hoffmann, 1945; Parker, 1957; Decelle & Lodos, 1989). *Bruchus hamatus* was detected on *Vicia variablis* Freyn & Sint., *Lathyrus* spp. (Lukjanovitch & Ter- Minassian 1957). Researchers stated that these seed beetles are harmful to *Vicia* species, so these studies support this study.

Bruchidius lutescens was also collected from the common vetch plant. In the studies, *B. lutescens* was detected on *Onobrychis sativa* L., *O. caput-galli* (L.) Lam. (Abdul-Rassoul et al. 1986; Decelle & Lodos 1989). Güdek (2020) stated that this species was collected from *Onobrychis sativa* (Sainfoin) flowers and obtained from *O. viciifolia* Scop. seed. Sainfoin is one of the forage crops commonly cultivated by producers in Eleşkirt district. It is thought that *B. lutescens* may have flown from sainfon fields to neighboring vetch fields.

Spermophagus calystegiae, *S. kuesteri,* and *S. sericeus* were found on flowers of common vetch and Hungarian vetch plants. These species were found on *Calystegia sepium* L., *C. soldanella* (L.) R.Br., *Convolvulus arvensis* L., *C. althaeoides* L., *C. cantabrica* L., *Medicago sativa* L., *Pimpinella anisum* L., *Carduus* L., *Centaurea* L. and *Vicia sativa* L. (Hoffman 1945; Lukjanovitch & Ter Minassian 1957; Decelle & Lodos 1989; Anton et al. 1997; Güdek, 2020). Studies indicated that the main hosts of these insects is *Convolvulus* and *Calsytegia* species. Weed control is not very common in the agriculture fields of Eleşkirt district, so weeds such as *Convolvulus arvensis* are always seen in the fields. For this reason, it has been observed that *Spermophagus* species, which are found in vetch fields also feed on the flowers of the vetch plant.

The infestation rate and weight loss of seed beetles on vetch seeds were found to be 1.03%, and 0.51%, respectively. Kaynaş (2014) reported that the infestation rate and weight loss were 0.45% and 0.24% for vetch seeds. On the other hand, Yücel (1985), determined that the weight loss in vetch was 2.77%.

Among the 5,887 adult individuals collected, the most dominant species were *B. brachialis* (52.03%) and *B. rufimanus* (43.49%). The least common species were *B. hamatus* (0.05%) and *B. viciae* (0.02%). When the relative occurrence of seed beetles in vetch seeds was examined, the vetch plant which is grown in Eleşkirt district is the main host of *B. brachialis* and *B. rufimanus*.

The highest infestation of seed beetles was detected in Yayladüzü town at 1.97%, followed by Yücekapı town at 1.82% and Alagün village at 1.56%. The lowest infestation was found in Mollasüleyman village and Düzyayla village by 0.33%, followed by Palakçayırı village by 0.44%. The infestation rate of vetch seeds was 1.03% in a total of 45 vetch samples taken from the Eleşkirt district.

The highest weight losses occurred of seed beetle larvae on vetch seeds were determined as 0.96%, 0.88% and 0.81% in Yücekapı town, Yelkesen, and Alagün villages, respectively. The lowest weight losses were found as 0.17%, 0.18%, and 0.20% in Düzyayla, Mollasüleyman, and Pirabat villages, respectively. The weight loss mean was found to be 0.51% for 45 vetch samples taken from Eleşkirt district.

CONCLUSION

According to the obtained results, all vetch cultivation fields of Eleşkirt district are infested by these mentioned seed beetles. Likewise, these pests were found in all storages. Ten species were detected on vetch plants in Eleşkirt district. Among of detected species, *Bruchus* species are found in vetch fields and the seeds in storage. Especially, *Bruchus brachialis* and *B. rufimanus* are common species both on vetch flowers and in vetch seeds in storage. In addition, these species have caused serious damage to vetch seeds in storage. The highest infestation rate was determined as 2.19% in Yücekapı, and the lowest infestation rate was determined as 0.23% in Mollasüleyman village. The most weight loss was found at 1.14% in vetch in Yücekapı, and the lowest weight loss was found at 0.12 in Düzyayla village. It is not considered that these two *Bruchus* species will be significantly harmful to vetch plants grown as green parts for animals in the district. However, it should be taken into account that pest populations can increase based on temperatures and incorrect chemical control applications, and there needs to be monitoring of the populations of these pests. It is estimated that it will cause serious damage if used as a seed in storage. In this context, for the product to be stored against these pests, to prevent increasing the population of the pests and reaching other places must be taken precautions.

As a precaution: the harvest should not be delayed too much, spraying the vetch seeds before they are brought to the storage, cleaning and spraying the empty storage (if the storage is contaminated with the stored product pest) and if pests are detected during the storage period of the vetch seeds, fumigation application can be recommended.

The rate of pest infestation in the field is much lower in late-planted vetches than in early-planted ones. Therefore, late planting is recommended in heavily damaged areas for farmers. It shouldn't be left in heaps in the field for a long time after harvesting. After harvest, the residues left in the field should be buried deeply with a plough and burned. Clean seeds should be used. Infested products, bags or materials shouldn't be placed in the storage. In addition, seeds should be fumigated to prevent contamination of the field from products used as seeds. It is recommended to apply pesticide when the storage is empty, approximately two weeks before placing the product.

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Researchers' Contribution Rate Statement Summary

The authors declare that they have contributed equally to the article.

Conflict of Interest Statement

The article's authors declare that they do not have any conflict of interest.

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