

INVENTORY OF PESTS IN TUZLA CANTON

Dr.sc. Isat Skenderović¹, dr.sc. Elvira Hadžiahmetović Jurida¹, dr.sc. Besim Salkić², Ahmed Salkić²

¹ Faculty of Natural Sciences and Mathematics, University of Tuzla, Tuzla, Bosnia and Herzegovina,

² Faculty of Technology, University of Tuzla, Bosnia and Herzegovina,

isat.skenderovic@untz.ba

***Abstract:** This scientific work provides an overview of the inventory of pests in Tuzla Canton. The research was conducted in 2018 at several locations in the City of Tuzla and 12 municipalities. Based on the inventory, a percentage representation was determined for the most frequent orders and species in the total sample taken for the purposes of this study. The research has established the presence of 52 types of pests, distributed differently in different locations by research sites. The most biological diversity was observed in the representatives of the class Insecta with dominant participation of the representatives of the orders Lepidoptera and Coleoptera, while the presence of other representatives in the examined area was slightly smaller. Six types of pests of the order Acariphormes belonging to the Acarina group have been presented in this work. For each determined pest species, data were provided on their biology, location found and hosts.*

Key words: Inventory, pests, Tuzla Canton, Insecta

1. INTRODUCTION

Tuzla Canton is located in the Northeastern part of Bosnia and Herzegovina, and constitutes 10.1% of the total territory of the Federation of Bosnia and Herzegovina. It occupies an area of 2,649 km². Tuzla Canton includes the City of Tuzla and 12 municipalities: Banovići, Čelić, Dobož-Istok, Gračanica, Gradačac, Kalesija, Kladanj, Lukavac, Sapna, Srebrenik, Teočak and Živinice. The economic, educational, cultural and social center of this region is the city of Tuzla, which is also the residence of this canton. The Tuzla region has a variety of natural resources: ores, minerals, land, forests and water. It should be noted that agricultural production in this area also participates in a high percentage of gross product production. In the future economic development of the Tuzla Canton, agriculture will remain one of the basic or additional activities and a very important generator of employment of the population, especially rural. [1] Tuzla Canton is characterized by a high degree of diversity in every sight. However, various negative pressures are present on the biodiversity of plant and animal components, such as: air and water pollution, waste disposal, groundwater abstraction, application of large quantities of mineral fertilizers and plant protection products, uncontrolled felling of forests, etc. Human activities have an impact on biodiversity and nature as a whole, causing different forms of change that are manifested through degradation, devastation and destruction of biodiversity. In addition to the listed abiotic factors, there are also biotic ones that also adversely affect the environment from which the presence of pests should be indicated. Examples of negative effects on plant health include biotic factors. Among the biotic factors are important influences that come from animal organisms. There are numerous pests that reduce agricultural production despite the implemented plant protection measures. Pests that attack agricultural crops and ornamental plants are classified into several groups: pets, worms, molluscs, arthropods, sparrows and a small number of Chordata. Pests of agricultural crops are found in the group Nematelminthes, Mollusca, Arthropoda and Chordata. The largest number of pests belongs to the type of Arthropoda class of Insect (Hexsapoda). The goal of a one-year research was to make an inventory of pests living in the Tuzla Canton area. The data presented in this paper may indicate the possibility of overstatement of recorded pests. Comprehensive research on the presence of pests in the Tuzla Canton area has never been carried out, and the data thus obtained can be used to improve the strategy of protecting agricultural crops from possible pests. The obtained data within the mentioned monitoring were compared with the data that Festić came from the end of the last century. [2]

2. MATERIAL AND METHODS

The presence of pests was monitored in the wider area of the City of Tuzla (Tz) as well as in several locations in all municipalities of Tuzla Canton (Doboj Istok (DI), Kladanj (K), Teočak (T), Banovići (B), Živinice (Ž), Lukavac L), Gradačac (G), Srebrenik (S), Čelić (Č), Sapna (Sa), Gračanica (Gr) and Kalesija (Ka). A pheromone trap was used to monitor the appearance of pests in some orchards in the Tuzla Canton. The work is based on the method of visual inspection, with the recorded species recorded. The frequency of occurrence of certain pests was evaluated without the extermination and killing of individual specimens, while the data from the Tuzla Agricultural Institute for 2018 were also used. In the period from March to October 2018. The collection of material was done with the entomological network of a smaller number of species. In this paper, the determination was carried out to the level of the species. When determination is done we use literature, 1971; [3] Lelo, 2008; [4] Maceljiski, 1999; [5] Stouts and Winter, 2000; [6] Tomiczek et al., 2000), [7]

In order to reduce losses and the degree of damage to plants, it is necessary to carry out the inventory of the pests of the area. In order to get a true picture of the harmfulness of plant pests in the area of TK, species, stages of development and damage have been recorded.

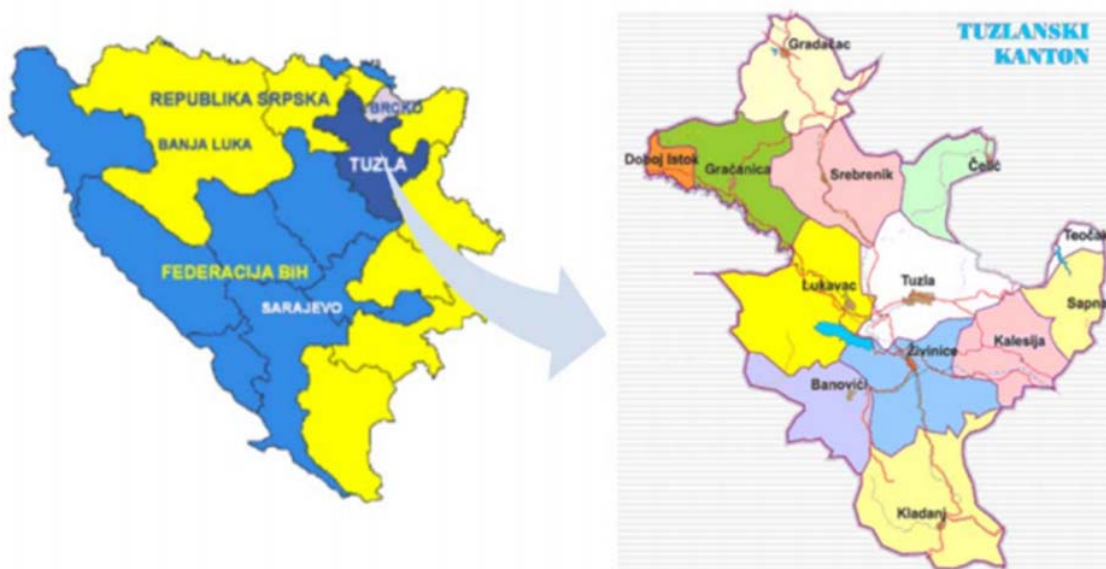


Figure 1. Canton of Tuzla

3. RESULTS AND DISCUSSION

The results of the research of the present pests in the Tuzla Canton area have shown that the damage they cause is diverse. Determined pests significantly affect the proper growth of plants, weakening of the physiological and mechanical plants, which ultimately results in a decrease in the yield of agricultural crops. Several groups of pests in the investigated area have been investigated. Research has shown the dominant presence of pests from the Insecta class, while the presence of other groups of pests is considerably less. The pests from class Insecta are represented with 6 phylum and the order of Acariphormes belonging to the Acarina group (ticks and mites). An overview of the pests in the Tuzla Canton municipalities is given in Table 1 and 2. Research has shown the presence of 52 types of pests distributed in different locations.

Table 1. The presence of pests in the area of Tuzla Canton for the investigated period

Order	Number of species	%
Lepidoptera	19	36,5
Coleoptera	13	25
Homoptera	7	13,5
Hymenoptera	3	5,7
Diptera	3	5,7
Thysanoptera	1	1,9
Acariphormes	6	11,5

Studies have shown that Lepidoptera representation is highest, 36.5% in the total sample of the investigated area. With 13 species and 25% of the share, the order of Coleoptera is next, followed by the order of Homoptera with 13.5% and Acariphormes with 11.5%. The representation of other established orders is smaller such as shown in Figure 2.

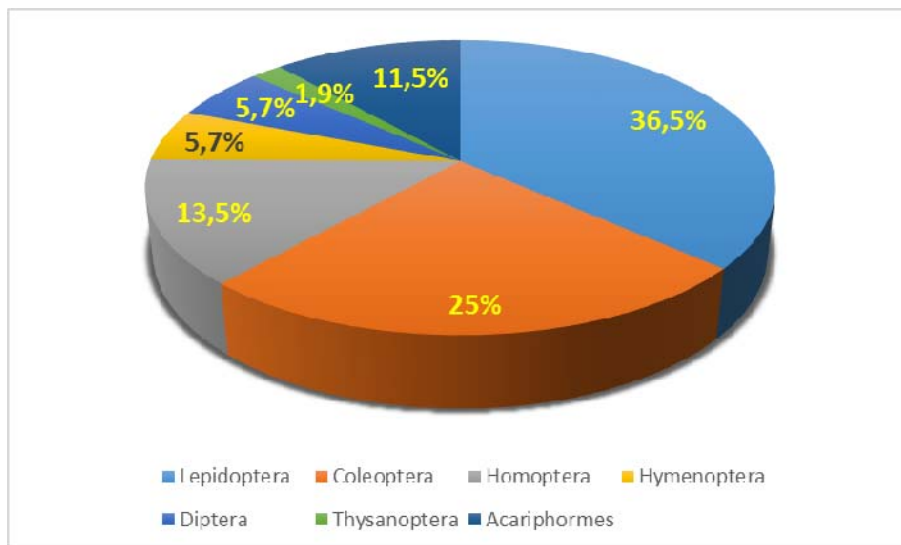


Figure 2. The frequency of pests in the total sample

According to the biodiversity of established pests, the area of the municipality of Srebrenik with 43 determined species is singled out, which is expected as the research was carried out in several locations. A smaller biodiversity was established in the municipalities of Gračanica, Gradačac and Čelić in which fruit growing and other agricultural branches have been developed. The number of taxon established in other Tuzla Canton municipalities is somewhat smaller (Table 2).

Table 2. Qualitative composition of pests by research sites

Type of pests	Municipality												
	Tz	DI	K	T	B	Ž	L	G	S	Č	Sa	Gr	Ka
Lepidoptera													
<i>Cydia pomonella</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Capua reticulana</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Cossus cossus</i>	+					+	+		+				
<i>Grapholita funebrana</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Leucoptera malifoliella</i>		+	+					+	+			+	
<i>Lyonetia clerkella</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Lithocolletis corylifoliella</i>					+	+			+			+	
<i>Stigmella /Nepticula/ matella</i>	+							+	+			+	
<i>Yponomeuta malinellus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Argyresthia conjugella</i>			+						+				
<i>Blastodacna atra</i>								+	+				
<i>Synanthedon myopaeformis</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Operophtera / Cheimatobia/ brumata</i>	+	+	+			+	+	+	+	+		+	
<i>Penthophtera /Hypogymna/ morio</i>								+	+		+		
<i>Loxostege sticticalis</i>								+	+	+			
<i>Vanessa polychloros</i>	+		+		+					+	+		+
<i>Inachis io</i>	+			+			+						
<i>Pieris brassicae</i>	+	+				+	+	+			+	+	+
<i>Pieris rapae</i>	+		+				+		+	+		+	
Coleoptera													
<i>Scolytus rugulosus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Scolytus mali</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Phyllobius oblongus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Anthonomus pomorum</i>	+	+	+	+	+	+	+	+	+	+	+	+	+

<i>Anthonomus cinctus</i>	+				+		+					+	
<i>Melolontha melolontha</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Xyleborus /Anisandrus / dispar</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Rhynchites betulae</i>								+	+	+		+	
<i>Caenorhinus aequatus</i>		+	+		+		+		+	+		+	
<i>Diabrotica virgifera virgifera</i>		+		+			+	+	+			+	+
<i>Leptinotarsa decemlineata</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Oulema melanopus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Gonioctena fornicata</i>		+						+				+	
Homoptera													
<i>Typhlocyba rosae</i>	+	+		+	+				+	+			
<i>Psylla mali</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Aphis pomi</i>		+	+			+	+	+	+				
<i>Aphis forbesi</i>						+	+	+	+				
<i>Lecanium corni</i>							+		+			+	
<i>Eriosoma /Schizoneum/ lanigerum</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Lepidosaphes ulmi</i>		+			+			+	+				
Hymenoptera													
<i>Hoplocampa testudinea</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Hoplacampa minuta</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Hoplacampa flava</i>	+	+				+				+	+		+
Diptera													
<i>Dasineura pyri</i>		+		+	+				+	+			
<i>Lasioptera rubi</i>			+			+			+				
<i>Ceratitis capitata</i>							+	+	+			+	
Thysanoptera													
<i>Frankliniella occidentalis</i>							+		+				
Acariphormes													
<i>Panonychus ulmi</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Tetranychus urticae</i>	+	+	+	+	+	+	+	+	+	+	+	+	+
<i>Tetranychus viennensis</i>									+	+	+		+
<i>Bryobia rubrioculus</i>			+						+	+		+	
<i>Eriophyes avellanae</i>								+		+			
<i>Rhizoglyphus echinopus</i>			+			+		+		+		+	
Ukupno													

3.1. Order Lepidoptera

Cydia / Laspeyresia, Carpocapsa, Grapholita / pomonella L. is one of the most important pests of apples and pears plantations and other plantations. In addition to these fruits, the caterpillars of codling moth attack walnuts and quince, and rarely other species. The listed pest damage exclusively fruits and the damaged fruit falls. At the explored sites, they were spotted at the end of April.

Adoxophyes (Capua) reticulana Hb. (Summer fruit tortricid) most often attacks pears and apples, and can significantly damage the other fruits. In April, it first attacks the buds of plants and then the young leaves. Caterpillars of this butterfly attack the hull of fruit.

Cossus cossus L. (Goat moth) is widespread in Europe. Attack of fruit (apple, pear, cherry and walnut) and forest deciduous species (willow, poplar, beech, oak and birch). The presence of butterflies at the end of June was confirmed at sites within the area of distribution.

Cydia / Laspeyresia, Grapholita funebrana TrJ. (plum fruit moth) is an important pest of plum, whose caterpillars burst into fruit, feeding mostly on flesh along hull. Butterflies occur during May and June. It attacks the plum, peach, apricot, cherry and blackthorn. [2]

Leucoptera malifoliella Zell. (apple leaf miner) attacks the pear and apple. On the face of the leaves of fruit trees from the explored sites (Table 2), the concentric circles formed by the activity of the caterpillars of this butterfly

Lyonetia clerkella L. most often attacks apples, pears and cherries. The caterpillars are drilled into a leaf and making curve up to 10 cm.

Phyllonorycter / Lithocolletis corylifoliella Hb. (leaf miner moth), presence on a small number of apples and pears of the investigated sites was noted.

Stigmella / Nepticula / malella Stt. (moth miner) is present more often than the previous species. The caterpillar makes a short mine that is visible from the top of the leaf. [5]

Yponomeuta malinellus Zell. (apple moth) is a pest whose caterpillars begin to attack buds and leaves in early spring. They live the most commonly in ternary nests that sometimes grab whole branches. Butterflies occur during June and July.

Argyresthia conjugella Zell. (small apple moth), the presence of this pest in the Kladanj and Čelić area was established.

Blastodacna atra Zell. (Apple pith moth) is a rare pest of apples. The presence of butterflies in the area of Srebrenik and Čelić was noted.

Synanthedon myopaeiformis Borch (apple clearwing moth) most often attacked plantations of apples, and rarely quince, plum and other fruits. The caterpillar of the apple clearwing moth makes shallow wells under the cortex, and fed with the juice of the plants. Butterflies were recorded in June at locations within the already established area.

Operophtera / *Cheimatobia* / *brumata* L. (winter moth) is a common pest of orchards near the forest. In spring, caterpillars attack taps, leaves causing "naked branches". On the cherry fruit they eating fruit meat to a seed. In October, the presence of *Operophtera Brumat* at explored sites was noted.

Penthophtera / *Hypogymna* / *morio* L. during the April and May caterpillars feed on grass. The caterpillars are characteristic in appearance, easily recognizable by long dark hair and orange papulas.

Loxostega sticticalis L. (beet webworm) is a typical periodic pest. During May, butterflies of the first generation occurs, when they are noticed in the municipalities of Srebrenik, Sapna and Čelić. Second-generation butterflies appear at the end of June, and the third generation in August. It is a polyfag species that most often attacks planted plants (sugar beet, sunflower, clover and others).

Nymphalis / *Vanessa polychloros* L. (blackleg tortoiseshell) occurs occasionally in our region. Adult individuals of this type were noticed in April at the research sites (Table 2). During May and June, caterpillars live together and eat leaves and can cause "naked branches".

Vanessa / *Inachis io* L. (peacock butterfly) found in the area of Tuzla, Teočak and Lukavac. According to earlier research Skenderovic and sar. *Inachis io* is widely spread in BiH and in the area of Tuzla Canton. The caterpillars cause damage to the hay as well as some weeds plants.

Pieris brassicae L. (cabbage butterfly) in Bosnia and Herzegovina is present almost everywhere. The cabbage butterfly is cabbage pest and related species of the Brassicaceae family as well as numerous weed brooms. The first generation of butterflies appeared at the end of April and the other at the beginning of July when the presence of this species was established.

Pieris rapae L. (a small cabbage butterfly) attacks the same plant as the cabbage butterfly. It has the same distribution as *Pieris brassicae*.

3.2. Order Coleoptera

Scolytus rugulosus Ratz (shothole borer) attacks all kinds of fruits most often during the dry season. The female lays eggs under the cortex where the larva that pierce the passage develop. In summer there is a second generation of larva that winteries.

Scolytus mali Becht. (big shothole borer) is a secondary pest attacking plums, apples, pears, cherries and quinces. He also attacks blackthorn, elm, service tree, etc.

Phyllobius oblongus L. (European snout beetle) is the most common fruit pest, it occurs during leafing. Most often attacks plum, apple, pear, cherry and other fruit trees.

Anthonomus pomorum L. (apple blossom weevil) apple pest. Larva attack the bud and flower that then dry and fall. In early June young adult forms appear.

Anthonomus cinctus Redt. (pear blossom weevil) pear pest.

Melolontha melolontha L. (white grub cockchafer) adult individuals feed with leaves of fruit trees, and other leaves. *Melolontha* that living in the soil are damaging the roots of plants. It causes great damage to vegetables, strawberries and berry fruits.

Xyleborus / *Anisandrus* / *dispar* F. (pear blight beetle) attacks all kinds of fruits as well as decorative trees. Adults appear in the spring. Women after copulation go into the appropriate tree, attacked trees are less developed, leaves fade and falls off.

Rhynchites betulae L. (leaf roller) pests of vines leaves and pears, and less common plums, other fruit trees and forest trees.

Caenorhinus aequatus L. (apple fruit weevil) was noted during April on apples, plums and pears. It also causes damage to peaches, quinces, apricots and other fruit trees.

Diabrotica virgifera virgifera LeConte (corn rootworm), larva of this species damage the corn root. In Bosnia and Herzegovina it was first discovered in 1996. [5]

Leptinotarsa decemlineata Say (Colorado potato beetle) is the most significant potato pest in Europe and North America. Depending on climatic conditions, we have 1 to 3 generations per year. A female lays eggs into groups during May and June. The larva feed on the leaf that browse. In the beginning of August, the second generation of imago has emerged.

Oulema melanopus L. (cereal leaf beetle) most commonly attacks stern cereals, has recently caused serious damage on the corn. The larva in appearance looks like a slug. During May, when temperatures above 15 0C are imago from the soil, they go to the leaves of cereals they feed. Larvas are also feeding on leaves of stern cereals.

Gonioctena / Phytodecta / fornicata Brugg. (broad-shouldered leaf beetle) is very harmful to lucerne, significantly reducing the yield and quality of the stem. The presence of this species on the sites within the fortified area has been determined.

3.3. Order Homoptera

Typhlocyba rosae L. (white cicada) is a common pest of roses and other species of the Rosaceae family. Larvae and they have the ability to feed the juice from the leaf, and in the end they also cause clutter. On the back of the list, white linens appear from the coating of larva where they live and larvae and adult cycads. Larvae appear at the end of April and will last at the end of May. [8]

Psylla Small Schm. (leaf aphid apples), larvae appear at the end of March, on buds fed and then leaves. The damaged leaves are blighted, dried and fallen, as well as flowers and the fruits are deformed. Adult flies occur in late May.

Aphis pomi De Geer (green moth of apple trees), apart from apples, attacks pears, quince, rowan, medlar and black thorn. It attacks the buds, the flower, the leaf and the fruit. Winged individuals were observed during May in nurseries and young plantations of Lukavac, Gradacac, Srebrenik and Celic.

Aphis forbesi Weed (green ears of strawberry) is present in all areas where strawberries are grown. *Lecanium corni* Bouche (shields) along the plum of attacking vines, hawthorn, acacia, lime and others. After massive attacks on the trees of the plants, these pests cause the trees to freeze due to exhaustion.

Eriosoma / Schizoneum / lanigerum Hausm. (bloody moth) attacks apple, pear, quince, ossushushu and hawg. On the bark of the attacked trees there is a cancer of the wound, the infected branches and the trees are dried. It is best developed in wet and shaded areas. [9]

Lepidosaphes ulmi Hnd. has a pin-shaped shield. It is also present in our country, attacking various types of fruits (apples, pears, plums, walnut, hazelnuts, raspberries), vines as well as trees of forest ecosystems. In September, the first generation images were noticed.

3.4. Order Hymenoptera

Hoplocampa testudinea Klug. (apple wasp) is one of the more important apple pests. It has one generation per year, it was established at the beginning of April at the time of blooming apple. A female lays eggs in a flower, squeezed larvae burst into fruit. [10]

Hoplacampa Christ (black wasp of plum) is present in all plums of the explored sites. In unprotected plantations, plums cause great damage. A woman lays eggs in a flower cup, after larva transformation, they burst into newly formed plum fruits, damaging the seed and surrounding tissue of the fetus.

Hoplacampa flava L. (yellow wasp of plum) is less represented in the Tuzla Canton of *Hoplacampa minuta*.

3.5. Order Diptera

Dasineura pyri Bouche is a common pest pest. They always attack the top leaves from which the juice is sucked, causing little damage.

Lasioptera ruby Hegeer attacks raspberry and blackberries. The larva live in the group at the place where they are located formed thickening and causing the drying and breaking of the stem. It is monitored visually from May to August.

Ceratitis capitata Wied polyphagous pests that damage the fruits of a large number of fruits. Attacking mature fruits, larva are found in large numbers near the surface of the fruit. It belongs to the group of the most harmful insects, it occurs in several generations. [11]

3.6. Order Thysanoptera

Frankliniella occidentalis Pergande (Californian trips) is a newer species that has been present in our country since the 20th century. According to the data of the Tuzla Agricultural Institute, this pest has been recorded in a protected area at several localities in the municipalities of Srebrenik and Lukavac. The pest attack a large number of cultural plants (vegetables, ornamental plants). The most attacked are tomatoes and peppers i greenhouse, causing deformation of leaves and fruits with necrotic spots. The highest number of trips was recorded in May.

3.7. Order Acariphormes

Panonychus ulmi Koch (Fruits black spider) found at all sites of research in the Tuzla Canton area. It is present in whole Bosnia and Herzegovina, especially during warm and dry years. It attacks most plums and apples, as well as other types of fruits and some forest species. They are wintering in the stage of winter eggs, larva appear in April, they go to the leaf from which from the juice is sucked with the previous split of the net. With stronger attacks, the leaves collapse and fall in late July and early August. [12]

Tetranychus urticae Koch (garden mites) is a very important pest of vegetables and ornamental plants in a protected area. Polifag species, most damages the hops, soybeans, alfalfa, sunflower, sugar beet and peas. Damages on the leaves are made by larva and imago, which first deform and then fall.

Tetranychus viennensis Zacher the presence of this pest in the municipalities of Kalesija, Sapna, Celic and Srebrenik is visually asserted. Adult shapes on the back of the leaf spin out a lot of spider web, causing characteristic wrinkles.

Bryobia rubrioculus Schteut (brown mites) attacks apple, pear, cherry, plum and other fruit trees. Larva feed on sucking vegetable juice, adult individuals do not produce a spider web.

Eriophyes avellanae Nal lives in the hives of hazelnuts. Damaged buds fall off, leaving the branches bare. It has more generations per year. The presence of this species was established in the area of Gradačac and Čelić.

Rhizoglyphus echinopus F. (Onions mites) attacks the underground trees of white and red onions and other bulbs in the field and warehouse.

4. CONCLUSION

Several-months long research in 2018, monitoring and collection of pests at research sites showed the presence of 46 potentially harmful insect species and 6 species of acarines. In the Tuzla Canton area, the dominant pests are from the Lepidoptera order with 36.5% share, followed by representatives of the Coleoptera order with a 25% share. In addition to the above pests, the presence of Homoptera, Hymenoptera, Diptera, Thysanoptera and Acariphormes has been established. The majority of the species identified are polyphagous according to the regime and diet, while a smaller number is monophagous or oligophagous. The results of the research can be used to identify potential pests on the cultural plants (hosts). All these results indicate that it is necessary to introduce permanent monitoring in order to monitor the number and type of pests in the Tuzla Canton area. It is necessary to intensify the research, in addition to the cultural plants, to include plants of forest ecosystems in order to spot pests in a timely manner with the aim of applying preventive measures and preventing them from being overpopulated.

REFERENCES

- [1] Strategija razvoja poljoprivrede u Tuzlanskom kantonu za period 2009.-2013. godin (15- 22)
- [2] Festić H. Poljoprivredna entomologija. Sarajevo: IP „Svjetlost“ D:D: Zavod za udžbenike i nastavna sredstva; 1996.
- [3] Peters S. Insekten auf Feld und Wiese in Farben. Denmark and Germany; 1971: 27 -28
- [4] Lelo S. Dnevni leptiri Bosne i Hercegovine. Sarajevo: Prirodnomatematički fakultet Univerziteta u Sarajevu; 2008.
- [5] Maceljčki M. Poljoprivredna entomologija. Zagreb: Zrinski Čakovec; 1999.
- [6] Stouts R. G., Winter T. G. Diagnosis of ill-health in trees. Forestry Comission; 2000.
- [7] Hacker H., Ronkay L., Hreblay M. Hadeninae I. Noctuidae Europaeae 4, Entomological Press, 2002: 419 p., Sorø.
- [8] Kereši T., Sekulić R., Popović A. Bolesti i štetočine u hortikulturi. Novi Sad: Poljoprivtrdni fakultet Univerziteta u Novom Sadu; 2016.
- [9] Rodriguez Manuel Marino. Lexicon of plant pests and diseases. Amsterdam, London, New York: Elsevier publishing company; 1966.
- [10] Paradis R. O. L'Hoplocampe des pommes, *Hoplocampa testudinea* (Klug) (Hymenoptera: Tenthredinidae), au Québec. Phytoprotection, 61, 1980: 26 – 29.
- [11] Christenson L. D. and Foote R. H. Biology of Fruit Flies. Ann. Rev. Entomol. 5, 1960: 171-192.
- [12] Goonewardene H.F., Williams E.B., Kwolek W.F. and McCabe L.D. Resistance to European red mite, *Panonychus ulmi* (Koch), in apple. *Journal of the American Society for Horticultural Science* 101, 1976: 532-537.