Important Insect Pests in Madicago sativa L. in Bulgaria

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Author’s contribution

The sole author designed, analyzed, interpreted and prepared the manuscript.

ABSTRACT

This paper describes common insect pests in forage alfalfa in Bulgaria and their seasonal dynamics. The method of sweeping with the entomological net was used. The degree of infestation (attack) of Otiorrhynchus ligustici was established by taking soil monoliths. The most common insect pests of alfalfa from order Coleoptera are Hypera postica, Sitona spp., Apion seniculus, and Otiorrhynchus ligustici. The next species belongs to orders Hemiptera and Thysanoptera. Therioaphis maculata was the main harmful specie, followed by Acyrthosiphon pisum from Aphidodea, as well Adelphocoris lineolatus and Lygus rugulipennis (Hemiptera – Heteroptera). Economic importance species from Hemiptera: Fulgorormorpha and Cicadomorpha were Empoasca pteridis and Agallia ribauti, as well Thrips tabaci and T. atratus (order Thysanoptera). Apion seniculus is reported for the first time in our country as harmful species in alfalfa. The main insect pests, depending on the order to which they belong, were found in high numbers through the different regrowth of alfalfa vegetation period. The determination of the population dynamics of economically important pest species in the alfalfa grown for forage, helps determine the most appropriate time for control and management.

Keywords: Alfalfa; insect pest; seasonal dynamic; Bulgaria.
1. INTRODUCTION

Alfalfa is the most frequently grown legume forage crop worldwide, primarily because of its high feed value. Its longevity promotes a temporal stability rarely seen in other agricultural systems and provides the opportunity for the development of a diverse arthropod community structure [1]. In fact, alfalfa fields are important contributors to the biodiversity of agricultural systems [2].

It is well adapted to cold winters and hot dry summers. Because a stand of alfalfa can be productive for up to 30 years, it provides a stable environment for many species of arthropods, both phytophagous and entomophagous. Alfalfa is an important honey-producing crop and serves as a source of nectar and pollen for many arthropods.

In countries where alfalfa occupies large areas, the diversity of species is too great, so Alsuhaibani [3] describes it as “amazing.” According to the author, the entomofauna is represented by a large number of arthropods, some of which are pests, but many of them have no influence on alfalfa. In the United States have reported at least 1,000 species, of which perhaps 100-150 cause damage to plants. However, few of them can be described as main pests, while others have only local importance or their occurrence is sporadic or accidental occurring in alfalfa agroecosystems [4].

Insects are important components of forage production systems as direct competitors for forage resources and as pollinators essential for propagation of Medicago species. The most important pests are plant bugs, alfalfa weevil, aphids, and potato leafhopper in Iran [5]. Some additional pests may occasionally cause economic losses [6]. In the Washington State are found 591 insect species of which one of the most important pests of economic importance are species of the genus Lygus, Acrhythosiphon pisum Kalt, Hypera postica Brug and Sitona hispidula Fabr. [7]. As a result of a multi-year field study in central China has determined the composition and structure of insect communities in alfalfa crops. Dominant, of economic importance, are Acrhythosiphon pisum, Sitona lineatus L. and Adelphocoris lineolatus Goeze [8]. Al-Ghamdi [9] has conducted an intensive, multi-year study related to insect pest alfalfa in Saudi Arabia, and found eleven important pests, including 5 key species: Aphis craccivora Koch., Therioaphis trifolii (Monell), Empoasca lyrba (de Berg), Empoasca discipiens Poali and Thrips tabaci (Lind). Common pests that can cause serious damage to alfalfa grown for the seeds and forage in Romania are Hypera postica, Subcoccinella 24 punctata, Hypera variabilis Herbst., Sitona spp. and Otiorrhynchus ligustici [10].

At present, Medicago sativa occupies about 921 520 hectares in Bulgaria. In general, the crop is grown in Northern and Southeastern Bulgaria (74% of total alfalfa areas). To a lesser extent, it is grown in the Southwest and Southern Central Bulgaria (26% of alfalfa areas) [11]. The main alfalfa pests are widespread, mainly in the above-mentioned regions, where the crop occupies the largest areas. Important pest is Hypera postica, Sitona spp., Otiorrhynchus ligustici, Therioaphis maculata, Adelphocoris lineolatus, Lygus rugulipennis, Thrips tabaci and some cicadas [12]. Thus, respectively the damage from them, reduce the forage yield, seed production, and their quality. The negative effects of pests depend on the population density of the species. The identification of key alfalfa pests in a certain area, as well as their seasonal dynamics, is necessary to implement successful control and management of economically important insect pests.

This paper describes common insect pests in forage alfalfa in Bulgaria and their seasonal dynamics in order to successfully pest control.

2. MATERIALS AND METHODS

Studies were carried out in the period 2014-2017 in the first experimental field of the Institute of Forage Crops – Pleven, Bulgaria a natural background of soil supply with the major nutrients (N43°243,312; E2°42°34,856; altitude - 230 m) - Photo 1. The area size was 300 cm2 with a natural background of soil supply with the major nutrients.

The soil type was a leached chernozem with pH (KCl) – 5.49 and content of total N – 34.30 mg/1000 g soil, P2O5 – 3.72 mg/100 g soil and K2O – 37.50 mg/100 g soil. The insect density (weevils, leaf aphids, plant bugs, cicadas, thrips, caterpillars) was recorded once per week over the all vegetation season. The method of sweeping with the entomological net was used.
The net was 20 times swept per each selected day at each site. After the insects from each replication were caught, they were moved in a small dark glass bottle with 70% alcohol and killed. In the laboratory, every sample was transferred to glass dishes (150/25 cm) and thrips were counted using a stereomicroscope. The harvest of the regrowth was made in the flowering stage.

It was established the degree of infestation (attack) of *Otiorrhynchus ligustici* L. by taking soil monoliths 20х200х40 cm (width/length/depth) from eight different locations every year. The natural population density of alfalfa snout beetle was from 0.2 to 0.6 imago m$^{-2}$ for 2015–2017 periods. It was measured by the following indicators: number, length, and width of the gnawed furrows/root. The surface of the damage was calculated based on the length and width of gnawed furrows.

### 3. RESULTS AND DISCUSSION

About 10 insect species limit alfalfa production in Bulgaria. The first four species discussed in the following case studies are the most common insect pests of alfalfa in the order Coleoptera. The next species belongs to orders Hemiptera and Thysanoptera.

The most predominant in the total population of insect pests at the earliest and most critical stages of plant development are nodule-feeding weevils of *Sitona* genus, *Phytodecta fomicata* Brügg and *Opatrum sabulosum* L., which attacked the alfalfa seedlings, roots, and young plants [13]. Important and permanent insect pests causing damage from Coleoptera in the next stages from alfalfa development are *Hydera postica* Gyllenhal, species of *Sitona* genus, *Apion seniculus* Kirby, and *Otiorrhynchus ligustici* L., which belong to family Curculionidae.

*Hydera postica* is one of the most important pests in alfalfa and according to Metcalf and Luckman [14], is the most destructive alfalfa pest in the world. It is distributed in Europe, South Central Asia, Northern Africa and the United States. The result of the pest’s harmful activity is a considerable reduction in plant stem height and dry weight, yield, and forage quality, mainly on the first cutting of alfalfa [15]. Godfrey and Yeargan [16] reported that the forage yield decreased by 56.1% in the presence of three larvae per stem, while according to Moradi-Vajargah et al. [17], if there are more than 50 larvae of different ages/m$^2$ in alfalfa, the foliage will be destroyed and the whole stand will acquire a visually white appearance.

*Hydera postica* is dominant and most important species in alfalfa, which occupies 69.6% on average of the total population density of species of the order. The weevil goes through only one generation per year and overwinters as an adult under the crop residues, in the soil or old fields in Bulgaria. Alfalfa weevil larvae defoliate plants and their feeding reduce yield, quality, and stand health. Weevil damage is typically concentrated in the first cutting of alfalfa, but the
impact of weevils on the first cutting can negatively influence vigor of the second cutting.

Weevil seasonal dynamics are characterized by a high participation in spring, which coincides with the development of the first cutting of alfalfa (Fig. 1).

Overwintering weevils appear in alfalfa in the second decade of March into the first ten-day period of April, when the plants are in the stem development stage. The earliest occurrence of the weevil in the alfalfa stand is established in years with higher average daily temperatures during March (above 9°C), which activates adult insects earlier, like 2016. A lower average daily temperature in March (under 70°C) is related to the occurrence of insects (like 2017). The adults of H. postica reached the maximum of numerical dynamics in early April. Depending on the weather conditions over the years, the peak values range from 13.3 to 27.5 number adult individual /100 mowing. After harvesting the first growth, the weevil numbers suddenly decreased in the range of 0.1 - 5.9 number adult individual /100 mowing. Adults of the new generation are established in June in the stage button - beginning of flowering.

The larvae appearance is observed at the end of March. Their density increases in the third ten-day period of April and the first ten-day period of May, when the alfalfa is in the button stage. The maximum value of larvae is recorded at the beginning of flowering before the first harvest, which ranged from 178.2 to 976.3 number larvae individual /100 mowing over the years.

Comparing H. postica quantitative participation over the years, a significant increase was found in pest density in the third and fourth year of alfalfa grown for forage and the alfalfa weevil occupies 80.7% of the total population density of Coleoptera species.

![Graph showing seasonal dynamics of Hypera postica Gyllenhal in alfalfa](image)

**Fig. 1. Seasonal dynamics of Hypera postica Gyllenhal in alfalfa**

*Legend: SF - Stem formation, B – Button stage, B – F - Button and flower stages*
**Sitona genus** constantly present in alfalfa agroecosystem as they found in significantly high density [18,19]. The larvae cause more serious damage as destroys bacterial nodules and gnaw small holes in the roots, which favors infection by pathogenic fungi present in the soil or on the root system [20]. The result of nutrition is also a reduction in nitrogen-fixing activity, as plants become users of soil nitrogen [21]. *Sitona* cause permanent damage to the plants as the damages by larvae remain invisible, which prevent an early diagnosis and conducting control [22,23].

*Sitona spp.* is permanent subdominant insect pests in alfalfa biosynthesis. They occupy 5.7% of the total amount of Coleoptera order. The predominant species from them is *Sitona lineatus*. It is distributed throughout Europe, Asia, Africa and North America and it has recently become an established pest in the Canadian prairies [24]. Adults overwinter in alfalfa or other perennial legumes and emerge in the spring primarily by flying or walking short distances. It goes through only one generation per year in Bulgaria. Overwintering adult weevils appear early in the spring, usually the second ten-day period of March (Fig. 2). Gradually, their number increased and peaked in the first growth in the first half of April (from 14 to 59 number adult individual /100 mowing), while in May and the beginning of June, they die. Adult weevils from new generation begin to appear in a higher density from the second half of June to the first ten-day period of July, which numbers vary in the range 2.5 - 7.5 number adult individual /100 mowing depending on weather conditions in the particular year.

*Apion* species are important pests in alfalfa and clover, as high density led to considerable losses in the forage yield in the first cutting of *Medicago sativa* [25]. *Apion seniculus* is announced as a clover insect pest in Bulgaria by Popov and others [26], while in foreign literature species were reported as an alfalfa pest [27,25]. It is distributed all over Europe.

*Apion seniculus* is reported for the first time in our country as harmful species in alfalfa. The attack by the pest is found when harvesting the first cut. The species develops one generation and wintering as an adult weevil in the surface soil layer and under plant residues. Weevils damage alfalfa leaves as gnaw small holes, which have no practical importance. After copulation, female individuals lay the eggs at the base of the stem of the plants by gnawing dents in them. Generally damage is caused by larvae that develop and feed inside the stem by the gnawing of a thin oblong tunnel in the stem along its length. The tunnels are clean and there are no excrements. As a result of the damage done to the plants, they break and lodge. A similar picture of the damage caused by this injurious insect was also reported by Rokantan [28] in clover. When the weevil is dominant and has a high density, according to Kullaj et al. [29], causes late "awakening" of plants in the spring.

Overwintered weevils appear in alfalfa early in the spring in the first half of March (Fig. 3).

The period of a mass do out of the pests from wintering places is in the third ten-day period of March and in the first ten-day period of April. The beginning of the egg-laying coincides with the period of stem formation in the first alfalfa growth and continues until the second or third ten-day period of June. A maximum in the number of *A. seniculus* is found in a first growth in the stages of stem and button formation (in the third ten-day period of May and the first ten-day period of June) when massively appear weevils from the new generation. The percentage of plants damaged by *A. seniculus* varied from 8.7 to 23.3% on average.

The weevil density varies from 27.6 to 30.6 number adult individuals /100 mowing depending on weather conditions over the years, after that, it decreases and in the second regrowth are established single adult individuals. The attack of *A. seniculus* was found primarily in the first harvesting of alfalfa. In the second harvest year of alfalfa, weevils damaged an average of 15.1% of the stems and in the third harvest year, it was 23.3%. The degree of damaged plants is gradually increasing and it is the highest in the third harvest year.

*Otiorrhynchus ligustici* is widespread across Europe, including Bulgaria, Asia Minor, introduced to North America. The species is polyphagous and causes serious damages on not only alfalfa but also red clover, sainfoin, sugar beet, pea, vetch, vine [30,31], Shebl et al. [32]. The high population density disturbs strongly the density of alfalfa stands (occurs thinning) which impose their early plowing. Strongly attacked stands can be destroyed for one-two years and at a moderate infestation, the permanence of alfalfa reduces to two-three years.
The potential problems for host plants arising from a root attack by insects include drought stress to the plant caused by pruning of the root system, loss of reproductive output and an increase in the plant’s susceptibility to infection by soil-borne pathogens [34]. Further, root-feeding by insects may directly reduce food reserves such as carbohydrates [35], synthesis of numerous growth hormones and plant stability, resulting in lodging [36].

Fig. 2. Seasonal dynamics of Sitona lineatus in alfalfa

Fig. 3. Seasonal dynamics of Apion seniculus Kirby in alfalfa
Otiorrhynchus ligustici (snout beetle) develops one generation per year and winters as imago and larva at a depth of 30-40 cm in Bulgaria. Overwintered imagos gnawed leaves, buds and top parts of plants. These damages had no economic importance. The main damage was caused by the larvae, which gnawed deep longitudinal furrows on alfalfa roots and hindered its growth and development (Photo 2). In the year of the establishment of the stand (2014), there were no damages found on the root system of plants from O. ligustici, only single furrows are established in the autumn regrowth. In the study period, the percentage of damaged plants by pest increased on average from 23.9% in 2015 to 79.8% in 2017.

The considered parameter was not enough precision to determine the degree of infestation by O. ligustici. It determined what part of plants had a damaged root system but it did not reflect the degree of damage.

The main sign for determination of the degree of larva infestation by O. ligustici on the root system of plants was the surface of caused damage. The values of the studied parameter increased consistently over the years on average from 5.6 to 42.1 cm² as during the last year of alfalfa growing the surface of damage increased almost eight times in compare with 2015 when the surface of damage was slightly expressed and because of low population density of pest (Fig. 4). Significantly, higher values were observed in 2016 as the larva damage increased nearly four times compared to the previous year. The largest surface and twofold increase of that parameter were found in the last year from the growth of stands.

During the years of study, the populations of O. ligustici were in the relations among themselves and were in relation to the age of alfalfa determined from the biology of culture. Otiorrhynchus ligustici wintered as an adult and larva in the stands and with the aging of the stands, it’s number increased respectively the surface of the damage. Gnaws on the root system of plants in the spring regrowth were by overwintered larvae of O. ligustici which activated in the spring and feed to the moment of turning into a pupa (the second half of May and the first half of June). In the next regrowths, the damages caused by the larvae were in significantly higher degree and due to the individuals of a new generation. The surface of damage increased in ascending order from the spring regrowth to the autumn one on average by 130.6%. The most active was the feeding activity of larvae in the summer regrowth when the surface of damage increased on average by 95.2% to the spring regrowth. At the autumn regrowth, the value of analyzed parameter increased in less degree – average by 20.5% to summer regrowth.
Another important parameter complementary to the surface of damage was the number of gnawed furrows on the root system. In different years, it increased on average from 4.5 to 28.2 number/10 roots and during the study period, it increased six times (Fig. 4). The most expressed increase from the spring regrowth to the autumn one was observed in 2015 (nearly eight times) followed by two times increase in 2016 and one time in 2017. The degree of increase of the density of furrows decreased as simultaneously as the degree of increase of their length rose with the development of stands during different years.

The length and number of furrows were complementary to each other’s parameters which influenced the complexity of the degree of damage, but between them there was not always a directly observed proportional dependence.

*Leaf aphids* occupy a special place as alfalfa pests. They appear annually in high density and can quickly cover large areas. Leaf aphids have developed very specific parts of the oral apparatus called stilettos, which pass through the cuticula, epidermis, and mesophiles to form the feeding site in the phloem [37]. Nutrition act is related to shifting mainly sugars as well as other substances formed through the photosynthesis process to the roots. That prevents the use of photosynthetic products for plant growth and can cause leaf chlorosis, wilting, stopping growth, suppressing flowering and seed formation, as well as the death of wintering plants [38]. In addition to the direct damage that causes on plants (sucking plant juice, cause strongly deformations, drying and falling of leaves), they are infected with dangerous viral diseases. This increases their harmfulness and necessity to control them even if species are in low density [39].

Order Hemiptera-Aphididae in alfalfa was represented by one family and four species, as spotted alfalfa aphid, *Therioaphis maculata* Buckt. was with the highest participation to the total population density of aphids - 64.4%. These are the main harmful species. A considerable part had pea aphid, *Acyrthosiphon pisum* Kalt - 29.2%. Black aphid, *Aphis fabae* Scop. occupied a smaller proportion and belongs to the subdominant species. * Macrosiphon avenae* F was an accidental species, which participation was insignificant.

*Therioaphis maculata* is widespread across Europe, China, India, Pakistan, Australia, South Africa, North American region. It overwinters as an egg on plant residues and develops 12 generations per year, which overlap. The aphids had the highest density in the first year (total 7918 number/100 sweeps) and second year (total 7768 number/100 sweeps) from the growing of alfalfa compared to the third year.

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**Fig. 4. The surface of damage and density of furrows on root system by Otiorrhynchus ligustici L. in alfalfa**

Legend: 1- spring regrowth; 2-summer regrowth; 3-autumn regrowth; 4-average

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The species of the order Heteroptera in Bulgaria in alfalfa crops were represented by 39 species of bugs, including 28 phytophagous and 11 predatory. Phytophagous species belong to 8 families and 21 genera, and predators - to 5 families and 6 genera. Serious and dominant pests were *Adelphocoris lineolatus* Goeze (29.7%) and *Lygus rugulipennis* Poppius (19.1%), and subdominant species was *Piezodorus lituratus* Fabr (5.2%).

*Adelphocoris lineolatus* lives in Western Europe, Northern Africa, Middle East, Afghanistan, Pakistan, Mongolia, China, Japan, and Western Asia. It is the main pest of alfalfa and develops two generations per year. Imago individuals are found in alfalfa at the beginning of May at the beginning of the flowering stage of the first regrowth. The second generation was found in crops in the second half of March, much earlier than alfalfa bug. His numbers were negligible from March to May in the first regrowth and at the stage of the vegetative stem of the second regrowth. The maximum density of the first generation was observed during the second decade of June in the flowering stage of the second regrowth (from 1.9 to 52.5 number individual /100 mowing). The second peak in numbers was found in the second generation in the second half of May in the third regrowth (from 0.5 to 57.5/100 mowing) and the values were similar to those of the first maximum. The bugs were detected in higher numbers in the fourth regrowth at the end of button stage and at the beginning of flowering in 2016. *Piezodorus lituratus* appeared in alfalfa in the start of buttoning stage in the second half of April. The bug was observed in higher numbers in the second decade of May and June in flowering stage respectively of the first and second regrowth. The pronounced maximum was found in the second half of July, in the stage of the end of a button and at the beginning of flowering in third regrowth (from 3.0 to 9.4 number individual /100 mowing). Then the density remained insignificant.
Fig. 5. Population dynamics of *Therioaphis maculata* Buckt. in alfalfa
For the environmental conditions of Bulgaria, the most important harmful bugs in alfalfa belong to the family Miridae and Pentatomidae as in general harmful bugs were found in the highest number in the flowering stage of second and third regrowth respectively in the second decade of June and the second half of July.

*Cicadas* (Order Hemiptera, Auchenorrhyncha) are pests that can cause serious damage and losses in the cultivation of crops, including alfalfa.
Direct damages are related to eating by which cicadas suck juices from the tissues. That slows growth and development of plants. Common symptoms of damage include wilting on the top of young plants, foliar chlorosis (yellowing or browning of the leaves) followed by premature fall of the leaves and inhibition of plant growth [43]. The most important sign of reduced yield is the suppressed vegetative and reproductive growth and development. Cicadas cause mechanical damage by laying eggs. Some phytophagous are vectors of plant viruses and mycoplasmas and cause direct and indirect damages.

Order Hemiptera, Auchenorrhyncha was represented by 26 species that belong to 9 families and 22 genera. The most diverse composition was family Cicadellidae, containing 14 species and 12 genera. It had the highest part of the total population density of cicadas - 76.3%. Economic importance species for alfalfa were dominant and subdominant cicadas. Dominant species were Empoasca pteridis Dhlb. (22.0%) and Agallia ribauti Oss. (19.4%), subdominant species were Peragallia sinuata M. R. (13.6%), Philaenus spumarius L. (11.2%) and Paraphlepsius irratus Groton (10.4%).

The most significant expression of the negative impact of *Empoasca pteridis* is the reduction of the yield by 20-30% and reducing the forage quality and in particular the crude protein content and the reserve of carbohydrates in the root, as well as suppression of the development of the following regrowth [44]. Cicadas reproduce sexually. The female inserts the eggs singly into plant tissues with its ovipositor, sometimes on stems, but mostly on the undersides of leaves near the veins. The larvae hatch after 1-4 weeks. Metamorphosis is incomplete, so the five nymphal instars resemble adults, but they lack wings until the fourth instar. The green leafhopper is widespread in central and southern Europe, the Middle East, central Asia and North Africa. In Bulgaria, the adults are able to overwinter on wintergreen plants and develop 2-3 generations per year.

Imago of *Empoasca pteridis* appeared in the second half of March at the beginning of the vegetation period. A considerable increase in density was observed in the second regrowth from button stage to the flowering stage. Maximum density was observed in the second ten-day period of August at the stage of stem formation and the beginning of the button in the fourth regrowth. It reached 40.6 number individual /100 mowing, and then sharply decreased. Larvae of the species were found in the second half of May to mid-June in buttonging and flowering stages of the second regrowth (Fig. 7).

*Agallia ribauti* is widespread all over Europe. Cicadas develop two generations per year and winter as adults. Cicadas have incomplete metamorphosis and 5 nymphal instars. Eggs usually laid inside plant tissue. *Agallia ribauti* was found in all regrowth at the vegetation period of alfalfa with a pronounced maximum in the second decade of June in the flowering stage of a second regrowth. The numbers of cicada in this stage depending on weather conditions over the years ranged from 15.3 to 58.8 number individual /100 mowing. Relatively high numbers were observed in the buttoning stage. The density of cicada in other regrowths had been substantially lower and relatively high values were established at the end of June at the stage of stem formation in the third regrowth (3.8-15.0 number individual /100 mowing).

In conclusion, common cicada fauna of alfalfa was significantly high participation in April, June, July, and August, which was determined by the number of dominant and subdominant species when alfalfa grown for forage was most vulnerable to damage. *Paraphlepsius irratus* was reported as a new harmful species, which cause damage in alfalfa.

Thrips (Thysanoptera) have piercing-sucking mouthparts through which they inject enzymes in plant parts and generate biochemical changes. Following thrips suck plant juices. The result of damage inflicted is deformation and wrinkling of the leaves, due to irregular growth around the area of damage. When nutrition is especially close to the central node, leaves turned and looked like a half-open funnel [45]. Thrips damage induces not only reduce productivity, but they are vectors of virus diseases in plants. Due to the rapid reproduction, high mobility and instinctive characteristics thrips become increasingly important over the years [46].

Order Thysanoptera was presented by 13 species from 3 families and 9 genera. The harmful species occupied 54.0% of the total number of species, and predatory species – 44.0%. Main pests were dominant species Thrips tabaci L. with 37.4% participation, followed by subdominant species *T. atratus* Haliday - 9.7%.
Empoasca pteridis Dhlb.

Agallia ribauti Oss.

Fig. 7. Population dynamics of some cicadas in alfalfa forage

Legend: VS - Vegetative stem; BS - Bud stage; F - Flowering stage

Thrips tabaci is thought to have originated in the Mediterranean region but is now found on all continents except Antarctica [47]. Species overwinter as adults in the soil within winter wheat, alfalfa, and weedy vegetation and overwintering females are capable of ovipositing.
on these plants during the spring. The number of generations produces within a year is determined by climatic conditions and usually, three to five generations per year are possible.

The highest percentage participation had the harmful species, T. tabaci and depending on weather conditions during the study, it appeared in alfalfa crops in the second half of March to the end of September (during the entire growing season).

The highest density was found in second regrowth from the second half of May to the second half of June (Fig 8). A maximum value was recorded in the first ten-day period of June at the budding and the beginning of flowering stages (from 25.5 to 291.4 number of individuals per 100 sweepings), which was related to favorable weather conditions. In the third and fourth regrowth species occurred in considerably lower number. The high temperature in July and August, combined with small rainfall amount suppressed the development and abundance of onion thrips. It was observed slight density increase in the second half of July and the second half of August at the budding stage and the beginning of flowering. Tobacco trips had a minor participation at the end of September.

The population dynamics of species showed that the treatment against T. tabaci needs to be done at the end of May - the beginning of June at the budding stage in the second regrowth of the alfalfa (when the density exceeded the economic threshold level of pest populations).

Important pests of the order Lepidoptera are Agrotis segetum, Euxoa temera, Autographa gamma, Heliothis maritima, and Loxostege sticticalis. Depending on the species, their caterpillars cause substantial damage, gnaw the foliage and the generative parts of the plant. The presence of Heliothis maritima is more frequent in alfalfa grown for forage. Given that the caterpillars from the fourth age onwards feed on the generating parts of plants and seeds, and alfalfa is cutting for hay, the species do not endanger the plants.

Fig. 8. Population dynamics of *Thrips tabaci* L. in alfalfa forage

Legend: VS - Vegetative stem; BS-Bud stage; F-Flowering stage
4. CONCLUSIONS

- The most common insect pests of alfalfa in order Coleoptera were *Hypera postica*, species of *Sitona* genus, *Apion senicuslus*, and *Ototrynchus ligustici*.
- From order Hemiptera, Sternorrhyncha: Aphidodea *Theroaphis maculata* was the main harmful species, as considerable part had *Acyrthosiphon pisum*. As serious and dominant insect pests belong to the order Hemiptera – Heteroptera, were *Adelphocoris lineolatus* and *Lygus rugulipennis*, and subdominant species was *Piezodorus literatus*. Economic importance species from order Hemiptera: Fulgorormorpha и Cicadomorpha in alfalfa were dominant species *Empoasca pteridis* and *Agallia ribaudi*, and subdominant species - *Peragallia sinuata*, *Philaenus spurarius*, and *Paraphlepsius irratus*.
- The main pests from order Thysanoptera are dominant species *Thrips tabaci*, followed by subdominant species *T. atratus*. *Apion senicuslus* is reported for the first time in our country as harmful species in alfalfa.
- The common insect pests, depending on the order to which they belong, were found in high numbers through different regrowth of alfalfa vegetation period.

COMPETING INTERESTS

Author has declared that no competing interests exist.

REFERENCES

15. Willson HK, Quisenberry SS. Impact of feeding by alfalfa weevil larvae (Coleoptera: Curculionidae) and pea aphid


37. Will T, Komemann SR, Furch ACU, Tjallingii WF, van Bel AJE. Aphid watery saliva counteracts sieve-tube occlusion: A


