PHYTOPHAGOUS ENTOMOFAUNA OCCURRING ON ONION PLANTATIONS IN POLAND IN YEARS 1919-2007

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Summary

In years 1919-2007 on domestic onion plantations 37 phytophagous species taxons belonging to 7 insect orders: *Thysanoptera*, *Homoptera*, *Heteroptera*, *Lepidoptera*, *Coleoptera*, *Diptera* and *Orthoptera* were noted. Among these groups 22 species were stated as phytophagous, additional taxons were indentified to 5 genus (*Thrips*, *Mamestra*, *Polia*, *Agrotis*, *Agriotes*) and 3 families: fungus gnats (*Sciaridae*), march flies (*Bibionidae*), crane flies (*Tipulidae*). Furthermore 7 species of saprophagous *Diptera* were collected from damaged onions during harvest.

The most common dominant species occurring in all regions of onion production were: onion fly (*Delia antiqua* Meig.), onion thrips (*Thrips tabaci* Lind.), onion weevil (*Ceutorhynchus suturalis* Fabr.), leek moth (*Acrolepiospis assectella* Zell.) and cutworms (Noctuidae). The population density of: onion beetle (*Lilioceris merdigera* L.), garlic fly (*Suillia lurida* Meig.) and leek miner fly (*Napomyza gymnostoma* Loew) were only a seasonal danger, especially in southern regions of Poland. On wet and rich in organic matter soils some soil dwelling insects such as larvae of *Melolontha* species (Scarabaeidae), larvae of *Agriotes* (Elateridae), flies (*Diptera*) from *Tipulidae* and *Bibionidae* families were also occurring periodically.

The species and population changes of above mentioned pests allowed to elaborate effective pest control methods of onion plantations. The pest control was performed after field monitoring on the basis of constantly updated short - and long-term forecasting.

key words: entomofauna of onion: *Diptera*, *Lepidoptera*, *Coleoptera*, *Thysanoptera*, *Homoptera*, *Heteroptera*, *Orthoptera*

INTRODUCTION

In the field of vegetable production majority of papers concerns research on most commonly occurring pest species causing serious and economically important losses. The occurrence of phytophagous species on single vegetable

crops has not been yet described as a full description in a monographic paper. The same problem applies to injurious fauna of onion crops. The constant monitoring of pest occurring on domestic vegetable plantations started in 1919 and it was constantly carried out afterwards by plant protection services. Up to the present moment only pest species occurring on spring planted onion crops have been registered (Ruszkowski 1933, Ruszkowski *et al.* 1935, Szwejda 2006 a, b). Due to the climate change with warmer winters the area of autumn planted onion crops is extending. Observations performed so far shows that there are important changes in dominant phytophagous species population due to extended vegetation period in autumn and also in early spring planted onion crops. (Szwejda 2005b). It especially concerns onion thrips (*Thrips tabaci*) which population density depends on the time of autumn onion sowing (Wrzodak 2008).

In years 1919-2007 on domestic onion plantations there have been no major changes in pest species composition. However, the analysis of long-term observations have shown major quantitative differences in registered phytophagous species. Some species such as: *Lilioceris merdigera*, *Eumerus tuberculatus*, *Hydrellia griseola* only occurred sporadically and are not currently registered as pests (Ruszkowski 1933, Ruszkowski *et al.* 1935, Kuntze 1936, Hennig 1953, Osmołowski 1980, Szwejda 2005a).

CLASSIFICATION AND FREQUENCY OCCURRING OF PHYTOPHAGOUS ENTOMOFAUNA ON ONION PLANTATIONS

In the discussed period of time on onion plantations 37 phytophagous species taxons representing 7 insect orders: *Diptera*, *Lepidoptera*, *Coleoptera*, *Thysanoptera*, *Homoptera*, *Heteroptera* and *Orthoptera* were noted. Among these groups 22 species were stated as phytophagous, additional taxons were identified to 5 genus (*Thrips*, *Mamestra*, *Polia*, *Agrotis*, *Agriotes*) and 3 families: fungus gnats (*Sciaridae*), march flies (*Bibionidae*), crane flies (*Tipulidae*). Furthermore 7 species of saprophagous *Diptera* were collected from damaged onions during harvest (Table 1).

All insects were collected from production farms all around Poland in years 1919-2006 from damaged parts of plants in the first and in the second year of onion vegetation.

Only species which life cycle is connected with onion crops as a larvae and pupae were taken into account. Later on into the adult stages, there were identified.

Collected species were divided into three groups based on the presence frequency and economic importance as pests (Table 1).

Group A: species occurring on onion in large numbers causing significant economic losses.

Group B: commonly occurring species which may cause damages locally.

Group C: sporadically occurring species – potential pests.

PHYTOPHAGOUS INSECT SPECIES RECORDED ON ONION FIELDS IN 1919-2007

Order	Species	Frequency of occurring
<i>Thysanoptera</i>	<i>Thrips tabaci</i> Lind.	A
	<i>Thrips</i> spp.	B
<i>Heteroptera</i>	<i>Carpocoris fuscipinus</i> Boh.	C
	<i>Dolycoris baccarum</i> L.	C
<i>Homoptera</i>	<i>Nectarosiphon ascalonicus</i> Donc.	C
	<i>Trioza brassicae</i> Vas.	C
<i>Lepidoptera</i>	<i>Acrolepiopsis assectella</i> Zell.	A
	<i>Margarita strictalis</i> L.	C
	<i>Mamestra</i> , <i>Polia</i> spp.	C
	<i>Noctuidae</i> – <i>Agrotis</i> spp.	A
<i>Coleoptera</i>	<i>Ceutorhynchus suturalis</i> Fabr.	A
	<i>Lilioceris merdigera</i> L.	A
	<i>Elateridae</i> , <i>Agriotes</i> , <i>Athous</i> spp.,	B
	<i>Scarabaeidae</i> – <i>Melolontha</i> spp.:	
	<i>M. melolontha</i> L.	B
	<i>M. hippocastami</i> Fabr.	B
<i>Diptera</i>	<i>Delia antiqua</i> Meig.	A
	<i>D. platura</i> Rond.	C
	<i>D. florilega</i> Zett.	C
	<i>Suillia lurida</i> Meig.	B
	<i>Eumerus strigatus</i> Fall.	A
	<i>E. tuberculatus</i> Rond.	C
	<i>Napomyza gymnostoma</i> Loew	B
	<i>Liriomyza cepae</i> Hend.	C
	<i>Phytomyza atricornis</i> Loew	C
	<i>Chromatomyia horticola</i> Gour.	C
	<i>Hydrellia griseola</i> Fall.	C
	<i>Sciaridae</i>	C
	<i>Bibionidae</i>	C
	<i>Tipulidae</i>	C
	<i>Dorsilopha busckii</i> Coqu.*	A*
	<i>Fannia canicularis</i> L.*	A*
	<i>F. scalaris</i> Fabr.*	A*
	<i>F. leucostica</i> Meig.*	B*
	<i>F. manicata</i> Meig.*	B*
	<i>Muscina assimilis</i> Fall.*	A*
	<i>M. stabulans</i> Fall.*	A*
<i>Orthoptera</i>	<i>Gryllotalpa gryllotalpa</i> L.	C

* saprophagous species

Group A : species occurring on onion in large numbers requiring control.

Group B : commonly occurring species which may cause damages locally.

Group C : sporadically occurring species – potential pests.

RESULTS AND DISCUSSION

Onion crops as an important part of agrocenosis are a natural environment for many insect populations, not only phytophagous but also sapro- i zoo-phagous species (Tischler 1965, Crüger 1991, Szwejda 2003).

Phytosaprophagous entomofauna showed in table 1 is eurytopic, oligo- and polyphagous and furthermore commonly occurs in the area of Palearctic region. Beside onion crops they are also present in other agrocenosis as well as in non- farm areas (wild growing species reservoirs, fallows, parks and woods). Onion crops were attacked by pests from the beginning of onion production in Poland and the oldest note concerning pests on vegetable crops applies to onion fly (*Delia antiqua*) causing damages on onion patches (Belke 1861).

Flies (*Diptera*)

Flies is a very rich group of insects both in species and individual. Adults of discussed species are melitophagous, they mainly feed on flower nectars, plant juices, liquids of live or dead plants or animals. They take part in flowers pollination and transport of other organisms such as *Acari*. They are themselves a source of food for many insectivorous species and pathogenic organisms. However, the trophic structure of pests larvae mentioned in Table 1 is significantly differentiated. They are endophagous and they feed inside soft plant tissue.

Larvae of majority of mentioned pests such as: onion fly (*D. antiqua*), bean seed flies (*D. platura* and *D. florilega*; *Anthomyiidae*) and onion bulb fly (*Eumerus strigatus*; *Syrphidae*) are phytosaprophagous. The most dominant phytophagous species among flies is onion fly (*Delia antiqua*). This species is widely distributed in Palearctic, from Japan throughout Asia and Europe, including Poland, northern Africa and America, to Alasca. In all mentioned regions the population of this pest is at the level which requires controlling. Depending on the latitude there is a difference in the number of generations of onion fly (*D. antiqua*) per year. In Norway there is only one generation per year (Rygg 1960), in the Netherlands there may be 2 to 3 generations (Loosjes 1976), in Poland there are 2 generations of onion fly per year (Szwejda 1982), whilst in Austria there were noted 3 to 4 generations (Schreier 1953). There are several factors influencing the number of generations: weather conditions (temperature, air and soil humidity, the length of the day), access to host plants, the number of natural enemies. Even though climatic conditions in mentioned countries are similar and the distance between them is slight the above factors are significantly influencing the number of pest generations. In the last decade in Poland changes in weather such as longer autumn and warm winters have also been observed. Extended vegetation period of grown onion crops and favourable environment conditions may induce next generation adults flight by interrupting diapause. The same factors may induce the number of onion fly generations in Poland, including the presence of the third one. The changes in onion production technology such as new varieties requiring different length of growing period and irrigation systems may also influence the number of pest

generations. In the last few years the extension in overwinter onion production (from autumn sowing) has been observed. The results of observations performed so far show that the harmfulness of flies in autumn is rather significant – up to 10% of damaged plants (Szwejdą 2005b). The higher plants infestation by flies is also closely connected with plants health. The females of flies are more likely to lay eggs on plants formerly attacked by plant pathogens (Hausmann, Miller 1989). On onion and garlic plantations other species of flies may also commonly occur: *D. platura* and *D. florilega* (Ruszkowski *et al.* 1935, Finlayson 1956, Loosjes 1976, Szwejdą 2003). The popular phytosaprophagous species which larvae feeds on damaged onion tissue is a onion bulb fly (*Eumerus strigatus*) (Ruszkowski 1933, Schreier 1953, Szwejdą 2003). In years of massive occurrence at the time of onion ripening the population of lesser bulb-fly may be even higher than that of onion fly (Szwejdą 1998). Very little is still known about leaf miners (*Agromyzidae*), even though they are quite common in agrocenosis. Among several species belonging to this group the best known is leek miner fly (*Napomyza gymnostoma*), which has been harmful to onion and leek crops not that long (from 90.) (Sionek 2001). Larvae of leek miner fly feed inside mid-leaves what causes plant death (Sionek 1998). Leaves of onion crops are also attacked by polyphagous leaf-miner flies species such as *Phytomyza atricornis* and *Chromatomyia horticola*, which are common in agricultural areas but are not especially danger to onion crops (Ruszkowski 1933, Osmołowski 1980). The range of occurrence of onion leaf miner (*Liriomyza (Phytobia) cepae*) in Poland is not fully known, even though it is known as an onion pest in Germany (Hennig 1953, Crüger 1991). The species migrating from southern to northern Europe is garlic fly (*Suillia lurida*) from *Helomyzidae* family. In Poland it was first noted in 70. of the last century in numbers causing 70% damages of garlic crops in autumn production (Szwejdą 1988). In recent years *S. lurida* is also appearing on overwinter onion plantations from autumn sowing (Szwejdą 2005b).

On wet and rich in organic matter soils onion bulbs are also damaged by march flies (*Bibionidae*) and crane flies (*Tipulidae*) larvae. They are phytosaprophagous and also present on non-agricultural lands (Ruszkowski 1933, Mikołajczyk 1981, Clements 1984, Mrówczyński *et al.* 2006).

Saprophagous species were a big part among all diptera flies occurring on onion crops. Onions in the early stage of phonological development is attacked by phytophagous species, but later on numerous saprophagous species also appear. Saprophagous species females are attracted to lay eggs by damaged and deteriorating plant tissues, where larvae are developing. In conducted long-term experiments they made up 42% of all collected diptera flies in the vegetation season (Szwejdą 2003). Among saprophagous flies shown in Table 1 (marked with a star) the most numerous were species belonging to: muscids - *Fannia* (Muscidae) and drosophilids - *Dorsilopha* (Drosophilidae), including *D. busckii* which may damage onion seeds. They commonly inhabit various crops agrocenosis, especially numerously on onion, garlic and Brussels sprout crops (Szwejdą 2003).

Butterflies and Moths (*Lepidoptera*)

Butterflies and moths are not as numerous as Diptera flies on onion plantations, but they are a significant importance. The most dangerous pest is leek moth (*Acrolepiospis assectella*) developing in Poland 2-3 generations. In Palearctic region it has been inhabiting onion crops for many years (Ruszkowski 1933, Osmołowski 1980). Likewise onion fly (*Delia antiqua*), weather and environment conditions have a crucial influence on the number of pest generations. Larvae of the first generation of *A. assectella* damage only onion leaves whilst next generations also injure flowers and seeds (Szwejdą 1998) as well as impede overwinter onion germination (Szwejdą 2005b). Among phytophagous eudominants of onion crops there is a number of cutworms (*Noctuidae*). They are polyphagous and the most numerous are species of cutworms - *Agrotis*: *A. segetum* Schiff., *A. exclamatoris* L. and *A. ypsilon* Rott. (Ruszkowski 1933, Napiórkowska-Kowalik 1996). In years 2004-2005 on vegetable crops the dominant species was *A. segetum* and it made up over 90% of all caught larvae (Rogowska & Wrzodak 2006). In recent years on onion leaves until the time of chive bending *Mamestra* sp. were also observed, especially cabbage moth (*Mamestra brassicae* L.).

In faunistical papers other species of butterflies are noted as polyphagous and mentioned as species occurring on onion crops only temporarily i.e.: the meadow moth (*Loxostege sticticalis* L.) (Ruszkowski 1933, Osmołowski 1980).

Beetles (*Coleoptera*)

Beetles are a significant part of phytophagous entomofauna of onion crops. The species of economic importance is onion weevil (*Ceutorhynchus suturealis*). It is especially harmful for onion in the early stage of development (germination) (Ruszkowska 1952, Osmołowski 1980, Szwejdą 2005b). This species is antagonistic to leek moth (*Acrolepiospis assectella*) due to the fact that they occur on same host plants, where they are both eurytopic. In years 1970-2000, leek moth (*A. assectella*) was definitely dominating but in recent years in many regions of onion production the most numerous was onion weevil (*C. suturealis*) and the population of leek moth completely disappeared. This phenomenon is repetitive in cycles and it was observed in 30. of last century (Ruszkowska 1952). Onion beetle (*Lilioceris merdigera*) also appears periodically. Population of this species on plantations in central Poland was rather small in the last decade and was not significantly harmful (Szwejdą 1998) comparing to 30. of last century when it was colonizing onion crops in large numbers (Kuntze 1936). In recent years in the southern Poland the population of *Lilioceris merdigera* stays at the level which requires controlling (Wiewióra & Łuczak 2001). Alike in other agrocenosis periodic threat are also polyphagous beetles, wireworms (larvae of *Agriotes* sp.) and grubs (larvae of May beetles from *Scarabaeidae* family i.e.: *Melolontha*: *M. melolontha* and *M. hippocastani*) (Ruszkowski 1933, Sądej *et al.* 2003, Mrówczyński *et al.* 2006). They are usually occurring in large numbers and they completely damage underground parts of onions.

Thrips (*Thysanoptera*)

Thrips is rich in species and numerous insect order commonly occurring in agroecosis (Zawirska 1994). Onion thrips (*Thrips tabaci*) is the dominant species on vegetable plantations and its number usually exceeds the state of damage level on onion, leek and white head cabbage plantations (Szwejd 2005a). This species is cosmopolitan, polyphagous and it has been occurring in agroecosis on all continents for many years (Balachowsky & Mensil 1936). In the early stage of germination (1-2 leaves) chive is damaged by thrips adults and later on, in favourable weather conditions larvae are inhabiting plants in large numbers before forming and development of onion bulbs. Damages caused in this time are influencing the yield size. The presence of 10 thrips per plant at the time of onion bulb forming was decreasing the size of crop by 2-3%. It was noted that the presence of 150-170 specimens per plant was declining the yield level by 34-43% (Kendall & Capinera 1987). The threshold level for thrips damage has been determined by Fournier *et al.* (1995) as 0.9-2.2 specimens per leaf. The population density of thrips on overwinter onion crops significantly depends on the time of sowing.

On seed plantations, apart from chive *T. tabaci* is feeding inside inflorescence what in consequence is causing seed malformation (Osmołowski 1980). Onion crops are also attacked by other thrips species i.e.: *T. angusticeps* Uzel and *T. denticornis* Holiday (Crüger 1991).

Other phytophagous species occurring on onion

In the first and second year of cropping during growing season onion is also attacked by other than mentioned above phytophagous species. They are currently occasional and occur in low numbers which are not a threat to onion plantations. Among sporadic pest of onion crops are: European mole cricket (*Gryllotalpa gryllotalpa*) – polyphagous species feeding in plant root system (Ruszkowski *et al.* 1935), shallot aphid (*Nectarosiphon ascalonicus*) and brassica psyllid (*Trioza brassicae*) damaging leaves (Osmołowski 1980, Crüger 1991) as well as hairy shieldbug (*Dolycoris baccarum*) and *Carpocoris fuscipinus* damaging onion seeds (Osmołowski 1980).

CONCLUSIONS

1. The observations of harmful entomofauna of onion crops carried out in years 1919-2007 in the whole country showed that there are 30 phytophagous species and families present being represented by 7 insect orders: *Thysanoptera*, *Homoptera*, *Heteroptera*, *Lepidoptera*, *Coleoptera*, *Diptera* and *Orthoptera*.
2. The population of collected phytophagous entomofauna was stable regarding species composition during the time of observations in years 1919-2007, however the changes in single species population numbers were highly differentiated.

3. Dominant species commonly occurring on plantations in Poland are: onion thrips (*Thrips tabaci*), onion weevil (*Ceutorhynchus suturalis*), leek moth (*Acrolepiospis assectella*), onion fly (*Delia antiqua*), garlic fly (*Suillia lurida*), leek miner fly (*Napomyza gymnostoma*), onion beetle (*Lilioceris merdigera*) and noctuid moths (*Noctuidae*).
4. The species and population changes of above mentioned pests allowed to elaborate effective pest control methods of onion plantations. The pest control was performed after field monitoring on the basis of constantly updated short- and long-term forecasting.

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FITOFAGICZNA ENTOMOFAUNA WYSTĘPUJĄCA NA PLANTACJACH CEBULI W POLSCE W LATACH 1919-2007

Streszczenie

W okresie od 1919 do 2007 roku, na krajowych plantacjach cebuli zarejestrowano występowanie fitofagicznej entomofauny należącej do 37 taksonów reprezentujących 7 rzędów owadów: przylżeńców (*Thysanoptera*), pluskwiaków równoskrzydłych (*Homoptera*), pluskwiaków różnoskrzydłych (*Heteroptera*), motyli (*Lepidoptera*), chrząszczy (*Coleoptera*), muchówek (*Diptera*) oraz prostoskrzydłych (*Orthoptera*). W obrębie tych grup stwierdzono: 22 gatunki fitofagiczne (phytophagous species) oraz taksony zidentyfikowane do 5 rodzajów - genus (*Thrips*, *Mamestra*, *Polia*, *Agrotis*, *Agriotes*) i 3 rodzin - family (*Sciaridae*, *Bibionidae*, *Tipulidae*). Ponadto zebrano 7 gatunków saprofagicznych muchówek z uszkodzonej cebuli w okresie jej zbioru.

Do dominujących gatunków powszechnie występujących we wszystkich rejonach uprawy cebuli należały: śmietka cebulanka (*Delia antiqua* Meig.), wciornastek tytoniowiec (*Thrips tabaci* Lind.) chowacz szczypiorak (*Ceutorhynchus suturalis* Fabr.), wgryzka szczypiora (*Acrolepiosis assectella* Zell.) i rolnice (*Noctuidae*). Liczebność populacji gatunków: poskrzypki cebulowej (*Margarita stricticalis* L.), błotniszki czosnkówki (*Suillia lurida* Meig.), miniarki porówki (*Napomyza gymnostoma* Loew), stwarzała okresowe zagrożenia, szczególnie w południowych rejonach kraju. Na wilgotnych i zasobnych w substancje organiczne glebach notowano okresowe skupiska szkodników glebowych; larw (pędraków) gatunków należących do rodzaju *Melolontha* (*Scarabaeidae*), drutowców z rodzaju *Agriotes* (*Elateridae*), muchówek (*Diptera*) z rodziny komarnicowatych (*Tipulidae*) i leniowatych (*Bibionidae*).

Stwierdzone zmiany gatunkowe i populacyjne przedstawionych fitofagów pozwoliły na opracowania skutecznych metod ochrony plantacji cebuli. Podstawą do działań ochronnych było monitorowanie pól w oparciu o stale unowocześniany system prognozowania krótko- i długo terminowego (short- and long-term forecasting).