JOURNAL OF PLANT PROTECTION RESEARCH
Vol. 40, No. 1 2000

FAUNA AND IMPORTANCE OF THRIPS (*THYSANOPTERA*) FOR RYE AND WINTER WHEAT IN POLAND

PART I.
FAUNA OF *THYSANOPTERA* ON RYE AND WINTER WHEAT IN POLAND

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Abstract. On the basis of sweep netting samples and young plant and spike samples, the species composition and the incidence of thrips (*Thysanoptera*) on rye and winter wheat in different regions of Poland have been determined. A list of 49 *Thysanoptera* species found on these cereal crops and an overview of 11 species referred to "cereal thrips" have been given.
The undertaken studies have showed that *Haplothrips aculeatus* Fab. was dominant on both rye and winter wheat crops.

Key words: thrips, species composition, rye crops, winter wheat crops, overview of important species

I. INTRODUCTION

The so-far knowledge what thrip species occur on various cereal crops in Poland and what is their importance as pests is fragmentary and not sufficient (Gromadska and Rolko 1971; Adomas 1976; 1979a and 1979b; Luterek 1977; 1988; Żurańska 1985; Kot and Głuchowska 1987; Miętkowski and Starczewski 1987). Our own faunistic observations of thrips on various crops and wild-growing plants in different regions of Poland conducted for many years showed the presence of many *Thysanoptera* species on cereals. The most frequently recorded species were biologically associated with grassy plants and also frequent were species developing on dicotyledonous plants.

Information of plant protection services about mass occurrence of thrips on cereal crops in some years has stimulated us to undertake detailed studies on the species composition of *Thysanoptera* occurring on cereals and on the importance of their particular species for these plants. At the first stage the studies were conducted on two economically most important cereals in Poland – rye and winter wheat. The studies were begun in 1981 and continued throughout 1983-1991.

The performed studies covered the following problems:

1) determination of the species composition of *Thysanoptera* and particular species domination on rye and winter wheat on the area of Poland;
2) tracing the course of changes in the population numbers of the most numerous pest species on rye and wheat during the vegetation season of these cereals and description of kernel injuries caused by individual thrip species on rye and wheat.

The obtained results will be presented in too separate papers concerning the too mentioned problems.

II. METHODS

Thrips were collected by two methods:

1) Sweeping method – the size of a sweep sample consisted of 100 net sweeps; in the case of small fields the sample size was sometimes reduced to 50 net sweeps;

2) Method of collecting thrips from plant fragments, namely, from ears as well as from leaf blades and sheaths. A sample consisted of 10 stems together with leaves and ears, or later it only consisted of 10 ears. Stems were cut at the height of the third node and immediately put into a dense cotton bag, which was tied tightly. Thrips were manually picked up after shaking them out of ears, leaf blades and sheaths onto a white paper and then transferred with a brush into test-tubes containing alcohol. In part of the samples, pests were picked up from each ear under microscope.

Samples were taken once or many times from small plantations and from large fields of state farms covering many hectares. The material was collected in the periods from the moment of cereal plant shooting up to full ripe of grain. If samples in a given region could be taken only once, they were collected at the time of kernel development, in the period from milk ripe to the final stage of waxy ripe.

The material was collected in 36 administrative districts belonging to 15 provinces. With the aim to establish the occurrence range of particular species in Poland, we grouped the inspected districts of the country into 11 conventional regions (Fig. 1, Tab. 1) and the accumulated material was handled separately for each region. However, the numbers of samples collected in these regions differed significantly. For this reason, to be able to compare the occurrence of particular species in different regions of the country we did not use the number of really found specimens when estimating the pest number on each studied cereal, but the mean number of specimens per sample. The mean number of thrips in one sample was calculated by dividing the number of each species specimens collected in a given region by the number of all the samples taken in that region. The frequency of species occurrence is given in percentage of samples, in which the species was present (percentage was calculated from the number of all samples taken in the region).

III. RESULTS AND DISCUSSION

During all the years of the studies totally 590 samples containing 40,161 adult individuals and larvae of thrips belonging to 49 species were collected. A list of all thrip species that where found on the both cereal crops under study (Tab. 2) was prepared in alphabetical order within the suborders *Terebrantia* and *Tubulifera*.

A group defined as "cereal thrips" was selected among these species. A criterion to refer a species to that group was its capability for a full development of one generation on at least one cereal crop. When qualifying species we based on:

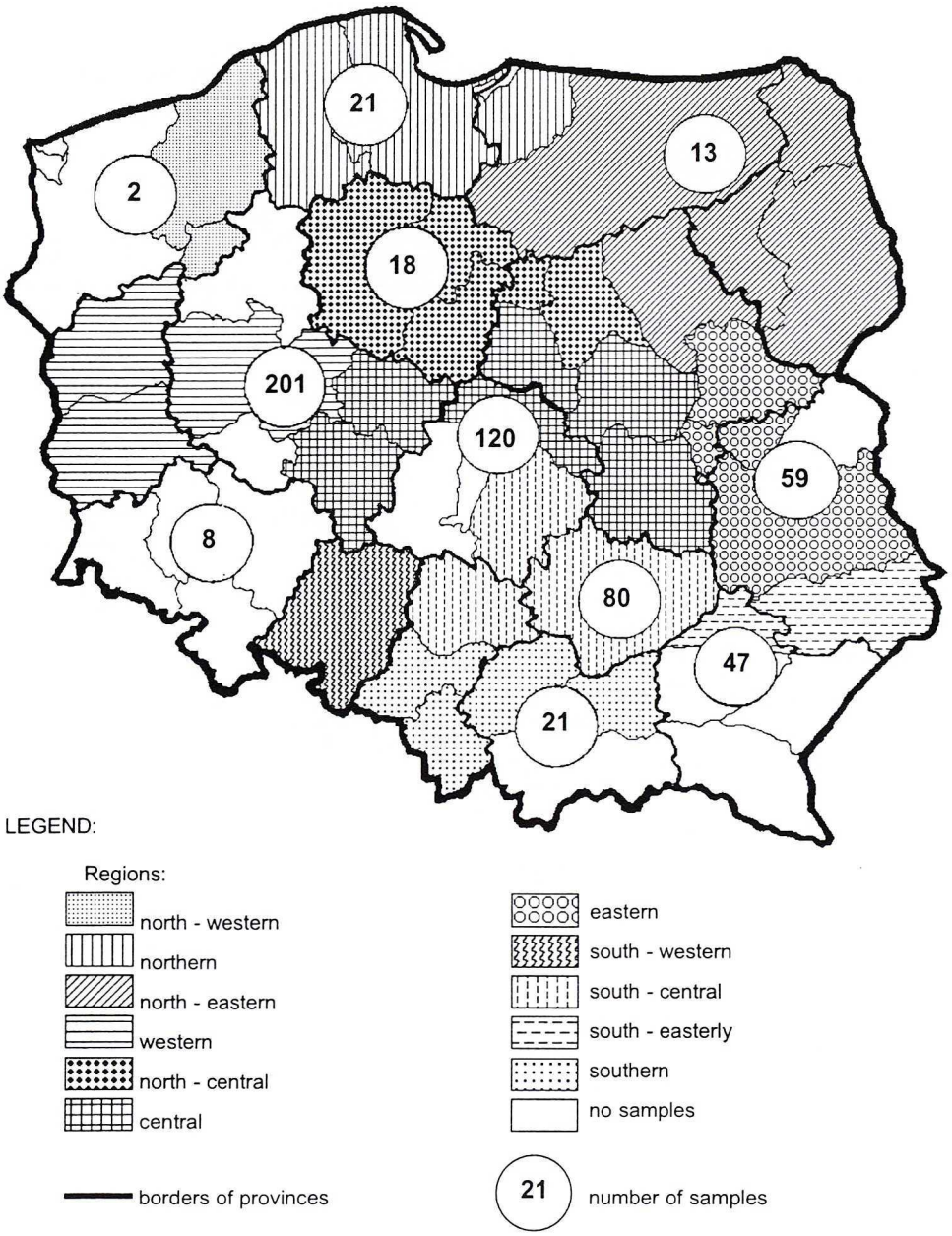

Fig. 1. Regions of Poland, in which the thrips on rye and winter wheat were collected

1) results of collections of thrip larvae and adult individuals from rye and winter wheat;
2) our own biological observations concerning species development on individual cereal crops, and
3) literature data.

Table 1

Polish administrative units, in which the thrips in rye and winter wheat crops, were collected

Region	Administrative district	Province
Southern	Kraków; Tarnów Bielsko-Biała; Katowice	małopolskie śląskie
South-easterly	Rzeszów; Tarnów Zamość	podkarpackie lubelskie
South-central	Piotrków Trybunalski Pińczów Częstochowa	łódzkie świętokrzyskie śląskie
Eastern	Chełm Siedlce	lubelskie mazowieckie
North-eastern	Białystok; Łomża; Suwałki Ostrołęka Olsztyn	podlaskie mazowieckie warmińsko-mazurskie
Central	Płock; Radom; Warszawa Skierniewice Konin; Kalisz	mazowieckie łódzkie wielkopolskie
North-central	Bydgoszcz; Toruń; Włocławek Ciechanów	kujawsko-pomorskie mazowieckie
Western	Gorzów Wlkp.; Zielona Góra Poznań	lubuskie wielkopolskie
South-western	Kędzierzyn-Koźle; Nysa; Prudnik	opolskie
North-western	Koszalin	zachodnio-pomorskie
Northern	Gdańsk; Malbork; Słupsk Elbląg	pomorskie warmińsko-mazurskie

Eleven species have been referred to "cereal thrips", including:

2 monophagous species:

Haplothrips tritici Kurdjumov (on wheat)

Stenothrips graminum Uzel (on oats)

8 oligophagous species specialized on plants from the family *Poaceae*:

Anaphothrips obscurus (Müller)

Aptinothrips rufus (Haliday)

Aptinothrips stylifer Trybom

Chirothrips manicatus Haliday

Frankliniella tenuicornis (Uzel)

Haplothrips aculeatus (Fabricius)

Limothrips cerealium Haliday

Limothrips denticornis (Haliday)

1 polyphagous species feeding and reproducing on both dicotyledonous plants and plants from the family *Poaceae*:

Thrips angusticeps Uzel

Samples from the both cereals under study were very frequently found to contain a zoophagous species – *Aeolothrips intermedius* Bagnall. This is a common polyphagous species throughout Poland, adult individuals of which feed mainly with plant sap, while larvae are very active predators (Bournier et al. 1978) and attack eggs and small insects with soft cuticle, such as aphids, thrips larvae, true fly larvae etc. This species is not associated with any plant group, nor with any specific environment. It occurs and reproduces on plants of different families, including cereals, if it can find there its victims. During the present studies, adult specimens as well as larvae of *Aeolothrips intermedius* occurring on rye and winter wheat were not numerous. Mostly 1-2 individuals of this species were encounted in the samples. Only 6 samples were found to contain a dozen or so individuals each (including adult individuals and larvae), and only 1 sweep netting sample was found to have over 20 specimens (namely, 43 adult individuals) of this species – in May, during a spring flight of young indviduals over fields.

Though *Aeolothrips intermedius* is a stable element of fauna on cereals and reproduces on them, it is associated with them first of all only through its animal hosts. Since the population of this species on rye and wheat was usually very low and it might be assumed that it is not important in cereal thrip reduction, it was omitted in the further part of the present paper.

All other phytophagous species mentioned in Table 2 independently of their numbers in samples, were recognized as occasional elements on the plantations of rye and winter wheat and were not taken into consideration in this paper.

Review of species referred to "cereal thrips"

ANAPHOTHRIPS OBSCURUS (MÜLLER) is a common species throughout Poland, frequently encountered on various meadow and forest grasses, on seed plantations of fodder grasses and also on cereal crops. It occurs in different habitats, but seems to prefer moist places.

In our studies, the occurrence of *Anaphothrips obscurus* was not numerous on the both cereals in all the years under studies, though its specimens were recorded more frequently and in larger numbers on wheat than on rye (Tabs. 2, 3, 4a, 4b, 5a, 5b). In ear samples they were encountered very seldom and mostly singly. Thrips of this species occurred more frequently in sweeping samples, though their larger number was found only twice: 68 long-winged (macroptera) and 2 short-winged (brachyptera) females on winter wheat (June 5, 1985 in Złotniki near Poznań); 80 long-winged females and 1 larva on spring wheat (June 20, 1985 in Złotniki near Poznań). These two samples were taken in the fields, where thrips were collected every day within studies on population dynamics of cereal thrips. Samples from the same places of thrip occurrence taken earlier and during the next weeks until the end of the season were found to contain only single adult individuals and single larvae of

Table 2

List of thrips species and number of individuals collected in rye and winter wheat crops in 1981 and 1983-1991 in Poland

Species	Rye		Winter wheat		Total		Prefered host plants
	Number of insects						
	adults	larvae	adults	larvae	adults	larvae	
TEREBRANTIA							
Aeolothrips intermedius Bagn.	155	40	68	101	223	141	zoophag; different plants
Aeolothrips melaleucus Hal.	1	–	–	–	1	–	zoophag; deciduous trees and bushes
Aeolothrips versicolor Uzel	–	–	1	–	1	–	zoophag; deciduous trees
Anaphothrips atroapterus Pr.	1	–	–	–	1	–	*Euphorbia* spp.
Anaphothrips obscurus (Müll.)	95	7	314	71	409	78	*Poaceae*
Aptinothrips elegans Pr.	1	–	–	–	1	–	*Poaceae*
Aptinothrips rufus (Hal.) *Aptinothrips stylifer* Tryb.	189	90	245	385	434	475	*Poaceae*
Chirothrips aculeatus Bagn.	1	–	2	–	3	–	*Poaceae*, mainly *Bromus* spp.
Chirothrips hamatus Tryb.	4	–	–	–	4	–	*Alopecurus pratensis* L.
Chirothrips manicatus Hal.	610	2	171	1	781	3	*Poaceae*
Chirothrips pallidicornis Pr.	5	–	5	–	10	–	*Dactylis glomerata* L.
Dendrothrips ornatus Jabl.	–	–	1	–	1	–	deciduous trees and leafy shrubbery
Dictyothrips betae Uzel	1	–	–	–	1	–	leaves of different herbaceous plants
Firmothrips firmus (Uzel)	2	–	–	–	2	–	*Vicia cracca* L.
Frankliniella intonsa (Tryb.)	19	–	39	1	58	1	flowers of different plant
Frankliniella tenuicornis (Uzel)	155	28	705	197	860	225	*Poaceae*
Kakothrips robustus (Uzel)	–	–	2	–	2	–	*Fabaceae*
Limothrips cerealium Hal.	73	–	1	–	74	–	*Poaceae*
Limothrips consimilis Pr.	–	–	–	–	1	–	*Poaceae* mainly *Bromus erectus* Huds.
Limothrips denticornis (Hal.)	5352	660	1870	33	7222	693	*Poaceae*
Melanthrips sp.	–	–	–	1	–	1	flowers of different plants

Odontothrips confusus Pr.	–	–	1	–	1	–	*Medicago* spp.
Odontothrips loti (Hal.)	–	1	1	1	1	2	*Fabaceae*
Oxythrips ajugae Uzel	1	–	1	–	2	–	coniferous and deciduous trees
Oxythrips bicolor (O.M. Reuter)	9	–	2	–	11	–	coniferous and deciduous trees
Rubiothrips silvarum (Pr.)	1	–	–	–	1	–	*Galium* spp.
Stenothrips graminum Uzel	14	2	130	23	144	25	*Avena sativa* L.
Taeniothrips picipes (Zett.)	–	–	1	–	1	–	flowers of different plants
Thrips angusticeps Uzel	18	16	124	14	142	30	leaves and flowers of different plants
Thrips atratus Hal.	39	–	86	–	125	–	flowers of different plants
Thrips flavus Schrank.	2	–	7	–	9	–	flowers of different plants
Thrips fuscipennis Hal.	246	1	505	–	751	1	flowers and leaves different plants
Thrips major Uzel	8	–	11	–	19	–	flowers and leaves of different plants
Thrips minutissimus L.	3	–	–	–	3	–	leaves of trees
Thrips physapus L.	7	–	7	–	14	–	flowers of *Asteraceae*
Thrips tabaci Lind.	78	16	76	15	154	31	flowers and leaves of different plants
Thrips trehernei Pr.	8	–	7	–	15	–	flowers of *Asteraceae*
Thrips validus Uzel	3	–	1	–	4	–	flowers of *Asteraceae*
Thrips vulgatissimus Hal.	5	–	4	–	9	–	flowers of different plants
TUBULIFERA							
Haplothrips aculeatus (Fabr.)	9884	4317	5516	2471	15400	6788	*Poaceae*
Haplothrips cerealis Pr.	1	–	–	–	1	–	*Poaceae* mainly *Bromus* spp.
Haplothrips leucanthemi (Schr.)	4	–	5	–	9	–	*Chrysanthemum leucanthemum* L.
Haplothrips niger (Osb.)	1	–	1	–	2	–	*Trifolium* spp.
Haplothrips setiger Pr.	7	–	7	–	14	–	flowers of different plants
Haplothrips statices (Hal.)	1	–	–	–	1	–	*Armeria elongata* (Hoffm.) Koch
Haplothrips subtilissimus (Hal.)	–	1	–	–	–	1	deciduous trees
Haplothrips tritici Kurdj.	157	124	292	4170	449	4294	*Triticum vulgare* Vill., x *Triticosecale* Wittm.
Liothrips setinodis (O.M.Reuter)	1	–	–	–	1	–	deciduous trees
Totally: 49 species	17163	5305	10209	7484	27372	12789	

Table 3

Numbers of "cereal thrips" species collected on rye and winter wheat in 1981 and 1983-1991 in Poland

Species of cereal	Number		% individuals into the total number of "cereal thrips"									
	samples	individuals	*Anaphothrips obscurus*	*Aptinothrips rufus et A. stylifer*	*Chirothrips manicatus*	*Frankliniella tenuicornis*	*Haplothrips aculeatus*	*Haplothrips tritici*	*Limothrips cerealium*	*Limothrips denticornis*	*Stenothrips graminum*	*Thrips angusticeps*
Rye	280	21793	0.50	1.30	2.80	0.80	65.20	1.30	0.30	27.60	0.10	0.20
Winter wheat	310	16733	2.30	3.80	1.00	5.40	47.70	26.70	0.01	11.40	0.90	0.80

Table 4a

Numbers of each "cereal thrips" species on rye in the different regions of Poland

Region	Number		Mean numbers of individuals per 1 sample									
	samples	individuals	*Anaphothrips obscurus*	*Aptinothrips rufus et A. stylifer*	*Chirothrips manicatus*	*Frankliniella tenuicornis*	*Haplothrips aculeatus*	*Haplothrips tritici*	*Limothrips cerealium*	*Limothrips denticornis*	*Stenothrips graminum*	*Thrips angusticeps*
Southern	5	295	0.20	2.40	0.20	0.60	54.80	–	–	0.80	–	–
South-easterly	15	863	0.30	3.10	1.50	0.10	31.10	0.20	–	21.20	0.07	–
South-central	38	2659	1.10	1.90	0.60	0.70	31.80	7.20	–	26.40	0.05	0.20
Eastern	28	1942	0.10	3.70	0.30	0.20	40.10	0.10	–	24.70	0.04	0.10
North-eastern	6	273	0.50	0.20	0.70	0.20	38.70	–	–	5.30	–	–
Central	60	4091	0.30	0.40	3.30	1.60	47.10	–	–	15.70	0.05	–
North-central	8	722	0.10	1.00	1.40	–	64.50	–	–	22.50	0.40	0.40
Western	107	10153	0.30	0.04	3.20	0.40	67.10	–	0.01	23.90	0.02	0.01
South-western	2	122	–	–	–	2.00	12.50	–	–	40.00	0.50	6.00
North-western	1	5	–	–	–	2.00	4.00	–	4.00	–	–	–
Northern	10	668	0.70	1.30	1.60	0.90	52.70	–	10.50	30.80	0.40	0.90
	280	21793	0.40	1.00	2.20	0.70	50.70	1.00	0.30	21.50	0.06	0.10

Table 4b

Frequency of occurrence of "cereal thrips" species on rye in the different regions of Poland

Region	Number		% of samples with individuals of species									
	samples	individuals	*Anaphothrips obscurus*	*Aptinothrips rufus et A. stylifer*	*Chirothrips manicatus*	*Frankliniella tenuicornis*	*Haplothrips aculeatus*	*Haplothrips tritici*	*Limothrips cerealium*	*Limothrips denticornis*	*Stenothrips graminum*	*Thrips angusticeps*
Southern	5	295	20.0	40.0	20.0	40.0	100.0	–	–	40.0	–	–
South-easterly	15	863	20.0	60.0	20.0	13.3	93.3	6.7	–	80.0	6.7	–
South-central	38	2659	13.2	55.3	21.1	21.1	89.5	21.1	–	76.3	5.3	13.2
Eastern	28	1942	10.7	64.3	25.0	17.9	35.7	10.7	–	64.3	3.6	10.7
North-eastern	6	273	33.3	16.6	50.0	16.7	100.0	–	–	83.3	–	–
Central	60	4091	16.7	11.7	55.0	38.3	96.7	–	–	80.0	5.0	–
North-central	8	722	13.3	50.0	50.0	–	100.0	–	–	100.0	25.0	13.3
Western	107	10153	14.8	1.9	48.1	24.1	89.8	–	0.9	85.2	0.9	0.9
South-western	2	122	–	–	–	100.0	100.0	–	–	100.0	50.0	50.0
North-western	1	5	–	–	–	20.0	40.0	–	40.0	–	–	–
Northern	10	668	20.0	40.0	40.0	30.0	100.0	–	40.0	90.0	10.0	50.0
	280	21793	15.5	24.2	40.9	26.0	87.2	4.3	2.1	80.1	4.3	5.7

Table 5a

Numbers of each "cereal thrips" species on winter wheat in the different regions of Poland

Region	Number		Mean number of individuals per 1 sample									
	samples	individuals	*Anaphothrips obscurus*	*Aptinothrips rufus et A. stylifer*	*Chirothrips manicatus*	*Frankliniella tenuicornis*	*Haplothrips aculeatus*	*Haplothrips tritici*	*Limothrips cerealium*	*Limothrips denticornis*	*Stenothrips graminum*	*Thrips angusticeps*
Southern	16	354	0.80	1.30	0.80	2.40	11.10	3.10	–	2.60	0.10	–
South-easterly	32	1414	0.70	1.80	0.10	0.70	16.40	22.30	–	2.10	0.10	0.03
South-central	42	3989	0.70	3.20	0.40	2.10	12.00	68.20	–	5.60	2.50	0.20
Eastern	31	2688	0.90	13.80	0.20	2.60	40.20	27.00	–	2.30	0.40	0.10
North-eastern	7	142	6.00	0.10	–	3.70	6.30	–	–	4.10	–	–
Central	60	2152	1.20	0.20	1.50	3.60	20.90	–	–	8.50	–	0.05
North-central	10	475	0.30	–	0.70	6.10	31.00	–	–	9.30	–	0.10
Western	94	4331	1.60	–	0.30	3.20	32.30	–	–	8.50	0.10	0.02
South-western	6	49	2.30	0.30	–	0.30	1.80	–	–	2.20	0.20	1.00
North-western	1	233	–	–	1.00	3.00	169.00	–	1.00	2.00	1.00	56.00
Northern	11	906	0.50	–	1.10	5.50	64.30	–	–	4.00	1.80	5.10
	310	16733	1.20	2.00	0.60	2.90	25.80	14.40	0.003	6.10	0.50	0.40

Table 5b

Frequency of occurrence of "cereal thrips" species on winter wheat in the different regions of Poland

Region	Number		% of samples with individuals of species									
	sam-ples	indi-viduals	*Anaphothrips obscurus*	*Aptinothrips rufus et A. stylifer*	*Chirothrips manicatus*	*Frankli-niella tenuicornis*	*Haplothrips aculeatus*	*Haplothrips tritici*	*Limothrips cerealium*	*Limothrips denticornis*	*Stenothrips graminum*	*Thrips angusticeps*
Southern	16	354	50.0	37.5	31.3	62.5	75.0	18.8	–	68.8	6.3	–
South-easterly	32	1414	46.9	40.6	6.3	28.1	100.0	50.0	–	75.0	6.3	3.1
South-central	42	3989	26.2	52.4	9.5	52.4	95.2	64.3	–	69.0	14.3	7.1
Eastern	31	2688	38.7	67.7	19.4	54.8	96.8	80.6	–	67.7	6.5	3.2
North-eastern	7	142	85.7	14.2	–	71.4	86.7	–	–	71.4	–	–
Central	60	2152	36.7	11.7	36.7	73.3	93.3	–	–	75.0	–	5.0
North-central	10	475	30.0	–	30.0	70.0	100.0	–	–	100.0	–	10.0
Western	94	4331	22.3	–	18.1	44.7	83.0	–	–	84.0	3.2	1.1
South-western	6	49	33.3	33.3	–	33.3	66.7	–	–	66.7	16.7	50.0
North-western	1	233	–	–	100.0	100.0	100.0	–	100.0	100.0	100.0	100.0
Northern	11	906	54.5	–	–	81.8	100.0	–	–	100.0	36.4	54.5
	310	16733	34.3	23.3	20.7	54.4	90.6	23.0	0.3	77.7	6.5	6.5

this species. A large number of *A. obscurus* females found on winter wheat of the same farm in early June and on spring wheat two weeks later may indicate that they search for host plants at a certain stage of development (presumably during heading).

APTINOTHRIPS RUFUS (HALIDAY) and *APTINOTHRIPS STYLIFER* (TRYBOM) are morphologically very similar wingless species. Their way of life is the same, they feed and reproduce at the same time and at the same sites on grass and cereal plants and cause the same damages; except for certain morphological details, they differ by somewhat different climatic and environmental requirements. *A. stylifer* is able to live under more severe or harder climatic conditions (e.g. in high mountains), which distinguishes it from *A. rufus* not encountered under such conditions. In the case of arable fields on the area of Poland this is of no importance and in view of that these two species were considered together in this paper.

Specimens of *A. rufus* and *A. stylifer* are very common and abundant in Poland. They occur and reproduce on many grasses. The lack of wings makes it impossible to them to migrate to other fields and to spread on the same field during one season. For this reason their population increase in a definite place lasts several years. A stable, large population of these species is observed on wild-growing grasses – in forests, on various uncut grassy areas and on many-year plantations of seed grasses in later years. More numerous occurrence of these two species on annual cereal plantations is generally impossible (Tabs. 2, 3, 4a, 4b, 5a, 5b). In these studies, specimens of *A. rufus* and *A. stylifer* were found on cereals almost exclusively on the field borders, where they got to from grasses growing on adjacent soil and field paths.

The both pest species overwinter in tufts of grasses. In spring they begin a very active life early, immediately after the outset of grass vegetation. Initially they feed and reproduce on the grass leaves and their larvae enter the leaf sheaths deeply, as far as the stem intercalary zone, and feed there. From the moment of ear heading, eggs are oviposited exclusively into the stems and larvae feed on the ovaries and kernels damaging them completely or injuring to a different degree.

CHIROTHRIPS MANICATUS HALIDAY is a very common and abundant species throughout Poland, well flying, occurring and reproducing in panicles and ears of grasses and cereals. Females overwinter mostly in wild-growing grasses. In spring they fly over early heading grasses such as, for instance, early species of meadow grasses or meadow foxtail, and lay out eggs in their panicles or florets. Larvae develop singly in ear florets in the place of a kernel damaged by them and are tightly covered with glumes. Transformation takes place in the same place and after hatching the females fly to later-heading grasses and cereals to overposit eggs of the second generation into their inflorescences. Larvae develop in spikelets and hatched females fly to other, younger grasses or begin overwintering in spikelet in the places of their transformation (Zawirska 1970; 1971).

In all the years of the studies the occurrence of *Chirothrips manicatus* was not so numerous on the both studied cereals, though it was notedly more frequent and numerous on rye (Tabs. 2, 3, 4a, 4b, 5a, 5b).

FRANKLINIELLA TENUICORNIS (UZEL) is a common species throughout Poland, associated with cereals, among which it markedly prefers maize.

On wheat and rye plantations *Frankliniella tenuicornis* was found very often in both sweeping and ear samples, but mostly not numerously (Tabs. 2, 3, 4a, 4b, 5a, 5b). Nevertheless, the total number of adult individuals and larvae of this species was noticeably higher than that of the previously discussed species. The occurrence of *Frankliniella tenuicornis* was significantly more numerous on wheat than on rye. It seems that on these both cereals, the species lives first of all in the ears, where it feeds and reproduces on glumes, in the ear rachilla and on kernels.

HAPLOTHRIPS ACULEATUS (FABRICIUS) is one of the most numerous thrip species in Poland. It feeds and reproduces in panicles and ears of grasses and cereals, noticeably preferring rye (Tabs. 2, 3, 4a, 4b, 5a, 5b). In spring, females and males fly over grasses and cereals at the time of shooting and heading. Eggs are laid out on and between the floret lemmas in ears, in branches of rachides and on the rachis. Larvae develop in ears and panicles, feeding on the lemmas and kernels from the beginning of their milk ripe to full ripe. They are very movable and frequently migrate from one floret to another in the ear, feeding usually on many kernels during their development. Their transformation takes place in spikelets and adult individuals comparatively rapidly leave the plantation or other site of their development and migrate to other, younger grasses and plants. In September, females and males begin overwintering under litter – on the edges of forests, in large concentrations of bushes and field trees. From the end of September no individuals of this species are encountered in samples.

HAPLOTHRIPS TRITICI KURDJUMOV is a warm-requiring species. In Poland it is spread only in the south-eastern part (Fig. 2, Tabs. 2, 3, 4a, 4b, 5a, 5b). Single individuals of this species may sometimes be encountered also in other regions of Poland, however, no stable populations were found there. *Haplothrips tritici* is very markedly associated with winter wheat, though it develops also on triticale and spring wheat.

This species has only one generation a year. Its matured larvae overwinter in soil on the field after wheat, in the ears of which they developed. Transformation takes place in spring in the soil. After emergence, young adult individuals fly over winter wheat plantations in the period of plant shooting and heading. Eggs are oviposited into the ears and larvae feed on developing kernels and glumes. Fully matured larvae enter the soil deeply and overwinter there.

The population numbers of *Haplothrips tritici* on wheat plantations in the region of the species spread differed significantly. On some plantations the species occurrence was abundant, whereas on others, even in the same neighbourhood, plant colonization by the pest was weak.

LIMOTHRIPS CEREALIUM HALIDAY is a species of maritime climate. In the regions of its most numerous occurrence – maritime areas of north-western Europe, *Limothrips cerealium* is first of all an inhabitant of wheat (Bournier and Bernaux 1971; Jenser and Tzanakakis 1985; Lattauschke and Wetzel 1986; Patrzich and Klumpp 1991; Czencz 1994). Adult individuals and larvae feed in ears and in the earlier period – before heading – on the

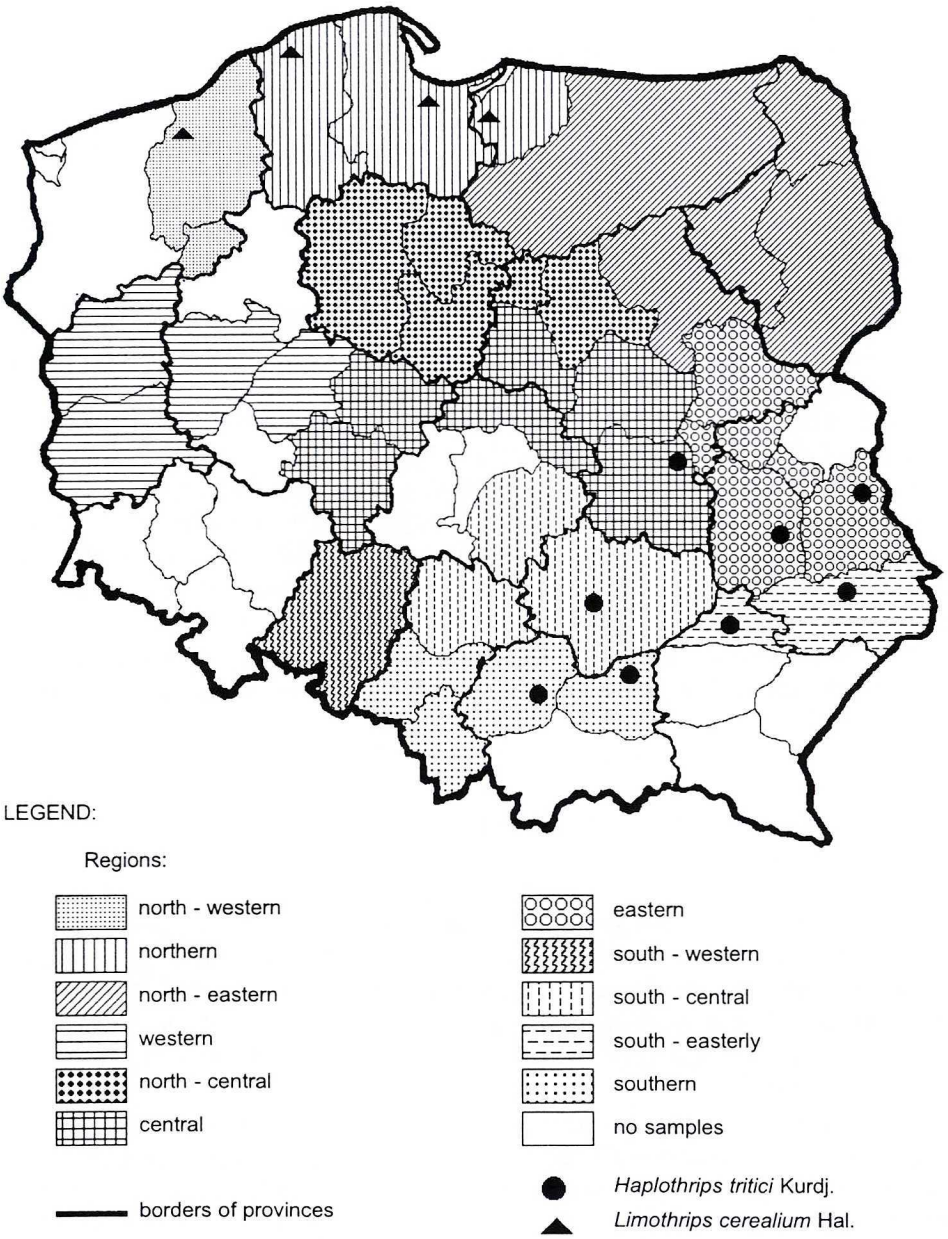

Fig. 2. Occurrence of *Haplothrips tritici* Kurdj. and *Limothrips cerealium* Hal. on rye and winter wheat in Poland

leaves and stems. Two generations develop during a year (Holtmann 1963a; 1963b). In August, after cereal and grass ripening, females of a second generation, and probably also later hatched of a first generation, fly in mass over the neighbourhood and search for a place to overwinter in various secluded places of buildings, board cracks, in tree bark and so on.

In Poland, *L. cerealium* is spread first of all in the seaside belt of provinces zachodniopomorskie i pomorskie (Fig. 2). However, lately a comparatively large population of this species has been encountered in the inland climate of moderate areas of Poznań. In 1995, in Złotniki near Poznań, totally 587 specimens of that species (including 263 females and 324 males) were found on oats in 7 sweeping samples taken every week from June 15 to July 26. A similar situation was observed in Hungary in 1992 and 1993 by Czencz (1994), who found *L. cerealium* habitat in the north-western part of the country.

In the course of the present studies and also in faunistic collections conducted on different plants in different habitats in the vicinity of Słupsk (unpublished data), *Limothrips cerealium* specimens were found on different cereals and on wild-growing meadow and forest grasses. In our samples taken from rye and winter wheat in July in the northern part of seaside provinces (zachodniopomorskie, pomorskie) and in administrative district of Elbląg (province warmińsko-pomorskie), that species specimens occurred most frequently only sporadically (Tabs. 2, 3, 4a, 4b, 5a, 5b). Only in Smołdzino (administrative district of Słupsk), where samples were taken in mid-June, we found a high population of this species. In July 17, 1991, sweeping samples were found to contain 45 females and 17 larvae on flowering rye; 365 females, 1 male and 19 larvae – on already headed, but not yet flowering triticale; 187 females and 1 larva on the soft brome-grass beginning to flower and growing in a trench near rye. In August the same year, already after harvest, mass flights of *Limothrips cerealium* specimens and their settling down on the windows as a place for overwintering were observed in Smołdzino. In August 15, 1991, 370 females of that species were collected from a small part of the window frame and adjacent window glass of an apartment house.

LIMOTHRIPS DENTICORNIS HALIDAY is a very common and abundant species throughout Poland. It occurs on various grasses and cereals, but in connection with its larva development taking place exclusively in leaf sheaths (first of all on the shank) it reproduces on species with a loose leaf sheath. Among cereals this is first of all rye and to a smaller degree – triticale, barley and oats

In spring, the females appear on the field very early, frequently prior to the beginning of the shooting stage of rye and feed on cereal leaves. At the end of the shooting stage of their host plants they lay out eggs in the tissue of the upper part of leaf sheaths. After oviposition, during cereal and grass heading the females feed for some time in very young ears and die after a certain time. Larvae undergo their complete development in the leaf sheath, feeding on the inside leaf side. However, no signs of feeding are usually found on the stem. It has two generations developing during a year – the first one on winter cereals and the second on spring crops (Holtmann 1963a; 1963b).

In the present studies, adult individuals of *L. denticornis* occurred on both, rye and wheat crops. Their number was, however, markedly higher on rye (Tabs. 2, 3, 4a, 4b, 5a, 5b). Larvae were observed to be present exclusively in the leaf sheaths of rye.

STENOTHRIPS GRAMINUM UZEL is a species associated with oats and considered to be a pest of oat seeds. It is spread throughout Poland. According to our observations, its single individuals occurred on many different cereals and grasses, but larvae were found

exclusively on oats. In the present study this species was noted very seldom and always singly on rye and winter wheat (Tabs. 2, 3, 4a, 4b, 5a, 5b).

THRIPS ANGUSTICEPS UZEL – though it is first of all an inhabitant of dicotyledonous plants in Poland, it is capable of feeding and reproduction on grassy plants and on cereals. The development of a wide feeding spectrum in *Thrips angusticeps* was caused by its specific biology. This species has two generations in a year. Its overwintering generation is short-winged, while summer generation is long-winged. The offspring larvae of long-winged specimens after full maturation enter the soil to a significant depth – of 20-80 cm (Franssen and Huismann 1958). They transform there and overwinter there as young, discoloured short-winged individuals. In spring, they appear very early – with the outset of vegetation. Having no wings they are unable to fly and have to stay on the plants they will find after leaving the hibernation place to feed and reproduce on them. These plants are frequently cereals. Adult individuals of the second generation flight to dicotyledonous crops to oviposit there. It is worth mentioning that *Thrips angusticeps* is a typical inhabitant of arable fields, rarely found in non-crop areas, overgrown with wild vegetation. This suggests that this species has definite requirements with regard to the structure and friability of soil enabling its larvae to enter the soil to a significant depth to transform and overwinter there.

In the present studies the occurrence of *Thrips angusticeps* was not numerous. Mostly its single, long-winged specimens were encountered in samples. A larger number of this species individuals was found on July 3, 1987 in the sweeping samples from two wheat fields – 43 macroptera females, 1 brachyptera female, 12 macroptera males (sample from the vicinity of Koszalin) and 27 macroptera females, 5 macroptera males and 6 larvae (sample from the vicinity of Ustka, Słupsk administrative district). Long-winged individuals belonged most probably to a summer generation of this pest population, and its short-winged individuals of the first generation reproduced on wheat plants after leaving their hibernation place.

The material collected in all the years of the studies from both rye and winter wheat distinguished by a striking within each cereal similarity of the species composition and domination degree of particular *Thysanoptera* species on the plantations under studies, independently of their size, neighbourhood of other crops or habitats, or field localization. The same species composition and the same degree of species domination was found in the materail collected by both, the sweeping method and ear analysis. Of course, differences resulting from a smaller spread range of some cereal species in Poland are omitted here. The presence and number of inidividuals of the species occurring in leaf sheaths can be estimated only by a longitudinal sheath cutting permitting to pick up insects from there.

There are clearly two dominant species on rye throughout Poland. They are: *Haplothrips aculeatus* Fabr., constituting 65.2% of all "cereal thrips" found on that crop, and *Limothrips denticornis* Hal., constituting 27.6% of all individuals (Tabs. 3, 4a, 4b). It should be added, that the population numbers of *L. denticornis* individuals on rye plantations are in fact higher than those given in tables, since the table data cover only part of samples, namely those, in which analyses of leaf sheaths were performed. Samples, from which the pest individuals were flushed only by leaf and ear shaking out, as well as sweeping samples

showed no presence of larvae and nymphs hiden inside the leaf sheath, though they undergo there a complete development from hatching out to transformation into adult insects.

Individuals of the remaining 9 species totally accounted for 7.1% of all "cereal thrips" on rye. The most numerous of them was *Chirothrips manicatus* (2.8% of individuals). Like in the case of *L. denticornis*, shaking out of ears above paper and sweep net catchings showed no presence of *Ch. manicatus* larvae and nymphs either, since they are in the ear florets on the place of kernels, tightly covered with adhesive lemmas. The actual number of this species individuals on plantations is, therefore, higher than that given in the tables by the number of larvae and nymphs present in the ears at the moment of sampling.

The number of other 8 species on rye in all the regions and during all the years of the studies was so low, that despite their possible development on that cereal, they can be treated as occasional elements. Only with regard to *L. cerealium*, results of our so-far studies are not sufficient to evaluate their population numbers on rye and importance for that crop.

The fauna of thrips on winter wheat is more diverse. An important element of it is *Haplothrips tritici* found by us in administrative districts: Kraków, Tarnobrzeg, Kielce, Zamość, Lublin, Chełm and Siedlce (Fig. 2). *Haplothrips tritici* is spread in the eastern and south-western part of the Western Palearctic, first of all in the south-eastern part of Europe and in Asia Minor (Zur Strassen 1984; 1986; Jenser and Czencz 1988; Tunç 1992; Czencz 1994). Places of *Haplothrips tritici* occurrence in Poland found in administrative districts: Chełm, Lublin and Siedlce until now are the northmost places of its occurrence in Europe. In our studies, within the region of its spread, *H. tritici* was found to be present in about 59% of samples taken from the wheat fields and accounted for almost 53% of all "cereal thrips" collected on wheat (Tabs.3, 5a, 5b). On some plantations, the numbers of adult individuals found in the wheat ears and later the numbers of *H. tritici* larvae were so high that in 1993 detailed studies were undertaken on the occurrence and importance of that species under conditions of Poland. Results of these studies will be presented in a separate paper.

On the scale of Poland the most numerous species on winter wheat was *H. aculeatus*. It constituted 48% of all "cereal thrips" and was to be present in about 91% of samples. In the region of *H. tritici* occurrence, the percentage of *H. aculeatus* dropped to 29%, though it was present in 94% of the samples.

Among other cereal species found on wheat and constituting totally 25.6% of all the thrips on the scale of Poland, the most frequent and numerous species were: *Limothrips denticornis* (11.4%) and *Frankliniella tenuicornis* (5.4%). The both species of *Aptinothrips* accounted totally for 3.8% of all the thrips, should be treated rather as occasional elements. They willingly feed and reproduce on wheat, however, as reported earlier, they occur only on the field borders and are unable to spread in the field. *Anaphothrips obscurus* constituting 2.3% of the collected thrips occurred almost always singly and did not settle down on the plantations of winter wheat. In this connection it seems justified to recognize this species presence on wheat as well as its laying-out of not single eggs as occasional.

Each of the remaining species constituted less than 1% of the total number of "cereal thrips" on wheat. This indicates that these species are of no importance as wheat pests and can be recognized occasional on wheat crops.

In the performed studies we have failed to explain problems concerning the spread, numbers and importance of *Limothrips cerealium* in Poland. This species, abundant and common in the maritime climate of the Atlantic zone in the Baltic and Mediterranian regions (Czencz 1994), notedly prefer wheat and is recognized to be an important seed pest of that crop. Results of our so-far studies showing a negligible occurrence of this species in most maritime provinces require further studies and observations.

Species composition of thrips associated with cereal crops is the same throughout Europe. An exception are species, the geographical spread of which is confined by their climatic requirements, namely: *Limothrips cerealium* Hal., common in the north-western region of Europe, and *Haplothrips tritici* Kurdj. occurring in the south-eastern and partially central part of Europe. The area of the spread of other cereal species (*L. denticornis, Ch. manicatus, A. obscurus, F. tenuicornis, H. aculeatus* and *St. graminum*) covers the entire Europe, however, their population numbers on cereals and preference to certain cereal species are different in varios geographical regions.

In the maritime climate of western Westfalia Holtmann (1963a) found that *L. cerealium* is the most numerous species among cereal thrips on all cereal crops, though out of them it markedly prefers oat and then rye. *L. denticornis* and *H. aculeatus* were also observed on all cereals, *L. denticornis* occurring most numerously on winter wheat and *H. aculeatus* on winter and spring barley. *Thrips angusticeps* was found in comparatively high numbers on barley, whereas on other cereals it was observed rarely and mostly singly. The remaining cereal species – *St. graminum, Ch. manicatus, A. obscurus* and *F. tenuicornis* occurred only sporadically and not very numerously.

Köppä (1976) discusses 4 species (*F. tenuicornis, A. obscurus, L. denticornis* and *H. aculeatus)* constituting the basic part of *Thysanoptera* fauna on cereal crops in Finland. Specimens of these species fed and multiplied on all winter and spring cereals studied by the mentioned author. The most numerous among them on all the cereals was *F. tenuicornis*. Another species with regard to its population numbers was *A. obscurus* observed especially numerously on oats. Somewhat less numerous on all the cereals was *L. denticornis*. *H. aculeatus* displayed the lowest population numbers, particularly on spring cereal crops.

In the climate of central Poland, both the total population number of cereal thrips and preference of their particular species for rye or winter wheat noticeably differed from those described by the cited authors in Westfalia and Finland. The species absolutely dominant on the both studied cereals in Poland is *H. aculeatus*, which is less numerous than *Limothrips* species in northern Germany and is generally the least numerous of four commonly occurring cereal species in Finland.

The second cereal species in Poland as to its population numbers is *L. denticornis* occurring significantly more numerously on rye than on wheat. In our opinion, its preference for rye is caused by a noticeably loosly-set leaf sheath in rye than in wheat, which creats better conditions for larvae and nymphs development in it. However, according to Holtmann (1963a), *L. denticornis,* though it occurs on different cereals, it markedly prefers wheat. *F. tenuicornis* holds the third place in Poland and is considerably less numerous than the both previous species, though its single specimens were frequently found first of all on wheat. In the studies

of Holtmann this species practically did not occur at all (the author only once found a single individual on oats), whereas in Finland it was the most numerous species on all cereal crops.

The remaining "cereal thrips" species in Poland sporadically occurred on rye and winter wheat, but nearly always singly. That concerns, among others, *A. obscurus*, which is a very numerous species in Finland and feeds and multiply on all cereals there. *A. obscurus* always occurs in two forms: macroptera and brachyptera. Macropterous specimens spread the species on a certain plantation and migrate to other crops or wild growing plants, choosing those, which are the most suitable to them. Brachypterous specimens are associated with plants, on which they hatched. On the rye and winter wheat plantations in different regions of Poland, almost exclusively macropterous individuals were found. As a rule the number of brachypterous specimens as well as the number of larvae were negligible. Such situation suggests that neither rye, nor winter wheat is willingly accepted by that species as host plants.

Percentage relations found by us between particular species of thrips living on cereals and their food preferences in relation to rye and wheat are stable throughout Poland, if species with a narrower geographical spread are not taken into consideration. They are not subjected to changes depending on the field size and are the same on small plots of different cereals grown in one block and on large plantations, sparsely dispersed on a certain area.

Similar results of studies concerning specific composition and preference of thrips for particular cereals were obtained by other Polish authors conducting studies on one or several cereal crops in some regions of Poland (Gromadska and Rolko 1971; Adomas 1976; 1979b; Luterek 1977; 1988; Żurańska 1985; Miętkowski and Starczewski 1987).

IV. CONCLUSIONS

1. The species *Anaphothrips obscurus* (Müller), *Aptinothrips rufus* (Haliday), *A. stylifer* Trybom, *Chirothrips manicatus* Haliday, *Frankliniella tenuicornis* (Uzel), *Haplothrips aculeatus* (Fabricius), *Haplothrips tritici* Kurdjumov, *Limothrips cerealium* Haliday, *L. denticornis* Haliday, *Stenothrips graminum* Uzel and *Thrips angusticeps* Uzel have been referred to the group of "cereal thrips" for which at least one cereal crop constitutes a source of feeding and provides a place for reproduction and larvae development.
2. Only three out of these 11 species, namely, *Haplothrips aculeatus* Fabr., *Limothrips denticornis* Hal. and *Chirothrips manicatus* Hal., have been referred to stable elements of rye fauna. The dominating species is undoubtedly *H. aculeatus*, representing 65% of all "cereal thrips" found on rye. *Limothrips denticornis* constituted over 27%, while *Ch. manicatus* – nearly 3%.
3. *Thysanoptera* fauna typical of winter wheat includes four species: *H. aculeatus* Fabr., *H. tritici* Kurdj., *L. denticornis* Hal. and *F. tenuicornis* Uzel. The species *H. tritici* notedly dominated on winter wheat in the region of its spread in south-eastern Poland, constituting 53% of all "cereal thrips" collected there. On the scale of Poland the most abundant species was *H. aculeatus* (48%). *L. denticornis* accounted for 11.4% and *F. tenuicornis* – for 5.4%. Determination of the range of *Limothrips cerealium* Hal. occurrence and numbers requires additional studies.

4. Out of cereal species, a stable element of rye and winter wheat fauna is a polyphagous and predatory species *Aeolothrips intermedius* Bagnall. Its population numbers on the both cereals was very low and for that reason its possible importance as a predator of cereal thrips larvae seems to be negligible.

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FAUNA I ZNACZENIE PRZYLŻEŃCÓW (*THYSANOPTERA*) DLA ŻYTA I PSZENICY OZIMEJ W POLSCE CZĘŚĆ I. FAUNA *THYSANOPTERA* NA ŻYCIE I PSZENICY OZIMEJ W POLSCE

STRESZCZENIE

W latach 1981, 1983-1991 przeprowadzono badania nad występowaniem przylżeńców (*Thysanoptera*) na uprawach żyta i pszenicy ozimej w różnych rejonach Polski. Na podstawie 280 prób z żyta oraz 310 prób z pszenicy ozimej, zebranych w 36 powiatach należących do 15 województw, ustalono skład gatunkowy wciornastków znalezionych na tych zbożach.

W sumie zgromadzono 40 161 osobników dorosłych i larw *Thysanoptera* należących do 49 gatunków. Wśród nich wyodrębniono grupę „wciornastków zbożowych" obejmującą 11 gatunków: *Anaphothrips obscurus* (Müller), *Aptinothrips rufus* (Haliday), *Aptinothrips stylifer* Trybom, *Chirothrips manicatus* Haliday, *Frankliniella tenuicornis* (Uzel), *Haplothrips aculeatus* (Fabricius), *Haplothrips tritici* Kurdjumov, *Limothrips cerealium* Haliday, *Limothrips denticornis* (Haliday), *Stenothrips graminum* Uzel i *Thrips angusticeps* Uzel. Stanowiły one ponad 95% wszystkich zgromadzonych osobników *Thysanoptera*.

Na życie dominowały na terenie Polski dwa gatunki, a mianowicie: *Haplothrips aculeatus* Fab. (65,2% wszystkich znalezionych na tym zbożu „wciornastków zbożowych") oraz *Limothrips denticornis* Hal., stanowiący 27,6% wszystkich osobników.

Z pozostałych gatunków „wciornastków zbożowych" liczniej na życie występował *Chirothrips manicatus* Hal. (2,8% osobników).

Na pszenicy ozimej najliczniejszym gatunkiem był *Haplothrips aculeatus* Fab., który stanowił 48% wszystkich „wciornastków zbożowych". Na terenie południowo-wschodniej Polski dominował *Haplothrips tritici* Kurdj., a procentowy udział *H. aculeatus* spadł do 29%. Wśród innych gatunków zbożowych znalezionych na pszenicy najliczniej wystąpiły: *Limothrips denticornis* (11,4%) i *Frankliniella tenuicornis* (5,4%).

Pozostałe gatunki „wciornastków zbożowych" wystąpiły na życie i pszenicy ozimej tak nielicznie, że można je potraktować jako element przypadkowy na tych uprawach.