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OCCURENCE AND RANGE OF DAMAGE ON SPRING WHEAT AND TRITICALE CULTIVARS CAUSED BY GOUT FLY (*Chlorops pumilionis* BJERK.) IN SOUTH-EASTERN POLAND

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Abstract. The research was conducted in Boguchwała in crops of spring wheat, in the years 2006-2007, and spring triticale, in the years 2008-2009. The aim of the research was to evaluate susceptibility of different varieties of spring triticale and spring wheat to damage caused by the spring generation of barley gout fly. The experiment was installed with the randomized blocks method in four replications. Analyses covered 9 varieties of spring triticale and 16 varieties of spring wheat. The percentage of plants damaged by barley gout fly larvae was calculated by analysing 100 successive stems in a field. The analyses were conducted when the plants were at the full milk maturity stage. The plant damage was classified using three-step rating scale. In the years of research the spring wheat showed a high degree of damage, i.e, on average 41.6% damaged plants, while spring triticale showed on average a low degree, 8.9%. Individual varieties of spring triticale and spring wheat showed a different degree of damage by barley gout fly larvae. The least susceptible to damage caused by that pest were wheat varieties: Hewilla, Griva, Żura and Koksa, and spring triticale varieties: Mieszko, Milkaro and Milewo.

Keywords: cereal cultivars, *Chlorops pumilionis*, spring triticale, spring wheat

INTRODUCTION

A growing economic importance of pests in cereal growing is observed in Poland. This refers mostly to cereal leaf beetles, aphids, gout fly, midges and thrips [Mrówczyński *et al.* 2005, Walczak 2010]. The factors that favor their occurrence include: a considerable proportion of cereals in the cropping system, simplifying methods of cultivation and monoculture. Losses caused by cereal pests, although not always observable, pose a significant economic problem.

One of economically important pets commonly occurring on cereals in the area of north and central Europe is gout fly (*Chlorops pumilionis* Bjerk.) (Diptera,

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Chloropidae). Gout fly attacks wheat, barley, less frequently rye and oat, also various species of grasses, especially wheat grass, timothy, creeping bent grass and Kentucky bluegrass [Gołębiowska and Boczek 1959]. This pest occurs commonly in Poland, and every several years it appears in large numbers and then it causes considerable losses in crops, especially of spring cereals. The most frequently attacked species are spring wheat and winter wheat as well as spring barley. From the inter-war period until the 1970s this species was considered as an important cereal pest in Poland [Simm 1937, Ruszkowski 1950, Studziński 1971]. Feeding of gout fly on cereal stems results in a decrease in the weight of grain and straw [Sekuła *et al.*1965].

In Poland studies over the noxiousness of gout fly and resistance to damage were conducted in winter wheat and spring wheat growing, as well as in spring barley [Studziński 1971, Boczek and Żmijewska 1972, Lisowicz 2000, Kaniuczak and Matłosz 2003].

In the integrated control of the gout fly it is necessary to apply several methods jointly. The cheapest of them and the easiest in practical application would be sowing cultivars that are less susceptible to feeding of this pest [Lisowicz 2000].

The aim of this study was to assess the susceptibility of selected cultivars of spring triticale and spring wheat on damage caused by the spring generation of gout fly.

MATERIAL AND METHODS

The study was carried out in the spring wheat crop in 2006-2007 and spring triticale crop in 2008-2009 in Boguchwała (21°57' N; 49°59' E). The experiment was established with the randomized blocks design in four replications, in brown soil of the quality class IIIa. The previous crop was legumes. In accordance with the recommendations of IUNG – PIB and IOR – PIB cultivation and weed control practices were carried out. Grain sowing was carried out from the 1st to the 10th April, sowing 450 grains·m^{-2}. Grain was dressed with Zaprawa Funaben T (carbendazym 20 + tiuram 45) in a dose of 200 g·100 kg^{-1}. The following fertilization was applied: in spring triticale N – 80 kg·ha^{-1}, P – 33 kg·ha^{-1}, K – 75 kg·ha^{-1}; in spring wheat – N – 90 kg·ha^{-1}, P – 26 kg·ha^{-1}, K – 87 kg·ha^{-1}. Weed control was performed in spring wheat with the herbicide Mocarz 75 WG (dicamba 500 + tritosulfuron 250) in a dose of 200 g·ha^{-1}, in spring triticale with preparations: Lintur 70 WG (dicamba 65.9 + triasulfuron 4.1) in a dose of 150 g·ha^{-1} and Chwastox Turbo 340 SL (MCPA 300 + dicamba 40) in a dose of 1.0 dm^3·ha^{-1}.

The study involved 9 cultivars of spring triticale and 16 cultivars of spring wheat sown on plots with an area of 16.5 m^2. The percentage of penultimate nodes damaged by larvae of gout fly was calculated analyzing 100 successive stems on each plot. The analyses were carried out at the time when the plants were at the full milk maturity stage (71-77 BBCH according to Adamczewski and Matysiak [2002]). Plant damage was classified in accordance with the three-degree scale given by Węgorek [1972]:

1) low damage – the spike completely pulled out of the sheath, a shallow and long groove on the penultimate node,
2) medium damage – the spike partially hidden in the leaf sheath,
3) high damage – stems not eared, the penultimate node heavily shortened, a deep groove.

The results of analyses were worked out statistically, and significant differences were determined based on the Duncan test at the level 0.05%.

RESULTS AND DISCUSSION

Meteorological conditions in the years of the study were extremely varied. The course of temperature and rainfall measured at ten-day intervals during the flying out of the dipterans, laying eggs and development of larvae of the spring generation on cereals were presented in Table 1.

Table 1. Weather conditions in Boguchwała in 2006-2009
Tabela 1. Przebieg warunków pogodowych w Boguchwale w latach 2006-2009

Month Miesiąc	Weather parameters Parametry pogodowe	10 day period – Dekada			Mean/Sum monthly Średnia/Suma miesięczna
		I	II	III	
		2006			
April Kwiecień	Daily average air temperature, °C Średnia dobowa temperatura powietrza	7.3	7.7	13.2	9.4
	Rainfall sum – Opad, mm	8.1	29.6	0.0	37.7
May Maj	Daily average air temperature, °C Średnia dobowa temperatura powietrza	11.8	14.7	13.7	13.4
	Rainfall sum – Opad, mm	4.7	45.2	56.4	106.3
June Czerwiec	Daily average air temperature, °C Średnia dobowa temperatura powietrza	11.5	18.0	21.3	16.9
	Rainfall sum – Opad, mm	37.1	6.7	47.4	91.2
		2007			
April Kwiecień	Daily average air temperature, °C Średnia dobowa temperatura powietrza	6.6	9.6	10.6	8.9
	Rainfall sum – Opad, mm	9.1	9.1	9.0	27.2
May Maj	Daily average air temperature, °C Średnia dobowa temperatura powietrza	10.4	16.1	19.9	15.4
	Rainfall sum – Opad, mm	15.8	17.4	6.7	39.9
June Czerwiec	Daily average air temperature, °C Średnia dobowa temperatura powietrza	18.6	20.4	17.7	18.9
	Rainfall sum – Opad, mm	28.4	13.7	28.4	70.5
		2008			
April Kwiecień	Daily average air temperature, °C Średnia dobowa temperatura powietrza	7.9	9.8	10.0	9.2
	Rainfall sum – Opad, mm	9.5	32.1	3.9	45.5
May Maj	Daily average air temperature, °C Średnia dobowa temperatura powietrza	11.3	14.7	14.4	13.4
	Rainfall sum – Opad, mm	30.3	45.6	29.4	105.3
June Czerwiec	Daily average air temperature, °C Średnia dobowa temperatura powietrza	17.9	16.2	19.7	17.9
	Rainfall sum – Opad, mm	1.4	40.0	45.3	86.7
		2009			
April Kwiecień	Daily average air temperature, °C Średnia dobowa temperatura powietrza	11.3	9.8	12.0	33.1
	Rainfall sum – Opad, mm	2.5	1.2	0.0	3.7
May Maj	Daily average air temperature, °C Średnia dobowa temperatura powietrza	12.6	13.5	14.6	13.6
	Rainfall sum – Opad, mm	1.6	56.0	45.0	102.6
June Czerwiec	Daily average air temperature, °C Średnia dobowa temperatura powietrza	14.9	15.2	17.3	15.9
	Rainfall sum – Opad, mm	17.8	60.9	50.7	137.5

The weather conditions in 2006-2009 were changing, those particularly favorable for the development of gout fly were recorded in 2006. In that year, in spite of the cool air and rainfalls in spring, later improvement of thermal conditions favored settling plants by gout fly. The occurrence of favorable meteorological conditions caused considerable damage of stems (on average 60.3%). In 2007 the weather conditions in spring also were favorable for gout fly development, and the damage of wheat stems was relatively high (47.6% damaged stems), although lower than in the previous year (Fig. 1).

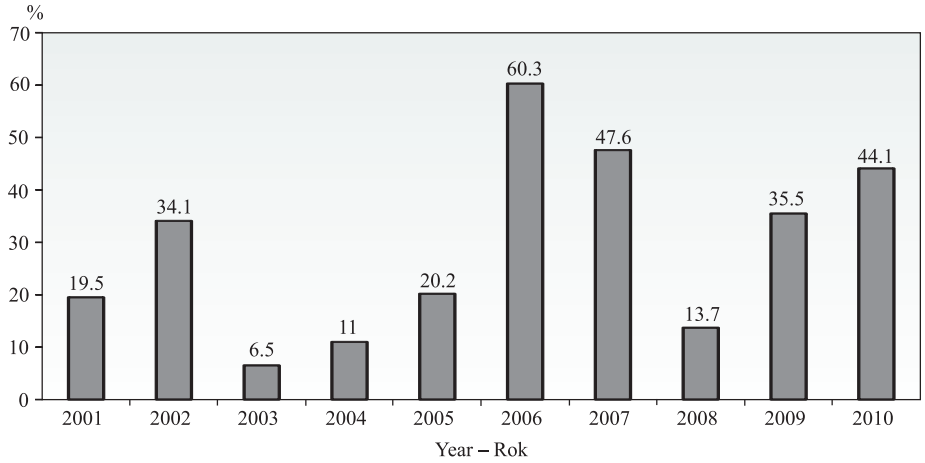

Fig. 1. Dynamics of damage of spring wheat stems by gout fly in 2001-2010 in Boguchwała
Rys.1. Dynamika uszkodzeń źdźbeł pszenicy jarej przez niezmiarkę paskowaną w latach 2001--2010 w Boguchwale

In 2008-2009 the weather conditions in May were not favorable for the development of gout fly, particularly in the period of the flying out of the dipterans and laying eggs, when intensive rainfalls and strong wind occurred. Damage of spring triticale stems ranged from 2.0 to 21.0%.

The occurrence of gout fly on spring wheat in the vicinity of Wrocław during the study conducted by Sekuła *et al.* [1965] was relatively high (27-58% infested plants). The percentage of stem damage caused by gout fly was similar to the results obtained in Boguchwała.

According to some authors, the cool years are particularly favorable for the development of gout fly, but if intensive and prolonged rainfalls and strong winds occur during the flying out of dipterans and laying eggs, they can reduce the numbers of this species [Gołębiowska 1957, Gołębiowska and Boczek 1959].

Also other pests occurred on spring wheat and spring triticale: leaf beetles (*Oulema* spp.), aphids (*Aphididae)*, thrips (*Thysanoptera*), gall midges (*Cecidomyiidae*), frit fly (*Oscinella frit* L.) and others. In the years of the study, gout fly and leaf beetles occurred in the largest numbers, aphids, gall midges and thrips in weak intensity, and other insects in a very poor intensity. Apart from gout fly, plants of spring wheat and spring triticale can also be threaten by leaf beetles, aphids, frit fly and gall midges, which is reported by the authors conducting studies in different regions of Poland

[Miczulski 1973, Jańczak *et al.* 1990, Wałkowski 1991, Kąkol and Miętkiewski 2002, Mrówczyński *et al.* 2005].

The percentage of penultimate node damages of spring wheat and spring triticale cultivars caused by gout fly was presented in Tables 2, 3, 4 and 5.

Table 2. Damage of spring wheat penultimate nodes by gout fly in 2006
Tabela 2. Uszkodzenie dokłosi pszenicy jarej przez niezmiarkę paskowaną w 2006 r.

No. Lp.	Cultivar Odmiana	% of damaged penultimate nodes – % uszkodzonych dokłosi			
		in degree – w stopniu			ogółem total
		weak – słabym	weak – słabym	strong – silnym	
1	Bombona	1.4	13.3	26.6	41.3
2	Bryza	1.3	18.6	20.1	40.0
3	Griva	1.3	16.0	17.3	34.6
4	Hewilla	2.6	21.4	18.6	42.6
5	Jasna	3.8	20.2	14.6	38.6
6	Koksa	1.3	17.3	32.0	50.6
7	Monsun	6.6	14.6	18.6	41.3
8	Nawra	1.4	13.3	26.6	41.3
9	Parabola	2.6	21.3	26.7	50.6
10	Partyzan	2.6	21.3	13.3	37.3
11	Radunia	5.3	17.4	22.6	45.3
12	Raweta	4.0	25.3	22.7	52.0
13	Tybalt	4.0	12.0	40.0	56.0
14	Zadra	0.0	25.3	29.3	54.6
15	Zebra	8.0	20.0	16.0	44.0
16	Żura	6.6	21.3	30.6	58.6
$LSD_{0.05}$ – $NIR_{0,05}$					9.78

Table 3. Damage of spring wheat penultimate nodes by gout fly in 2007
Tabela 3. Uszkodzenie dokłosi pszenicy jarej przez niezmiarkę paskowaną w 2007 r.

No. Lp.	Cultivar Odmiana	% of damaged penultimate nodes – % uszkodzonych dokłosi			
		in degree – w stopniu			ogółem total
		weak – słabym	weak – słabym	strong – silnym	
1	Bombona	5.2	15.4	24.0	44.6
2	Bryza	6.0	25.6	20.3	51.9
3	Hewilla	5.2	12.4	7.3	24.9
4	Koksa	4.2	10.2	15.0	29.4
5	Monsun	5.4	15.3	25.0	45.7
6	Nawra	4.0	15.4	17.2	36.6
7	Parabola	8.3	16.2	9.2	33.7
8	Radunia	5.0	20.0	18.2	43.2
9	Raweta	8.2	9.4	22.0	39.6
10	Tybalt	6.0	4.2	30.2	40.4
11	Zadra	8.0	14.2	14.0	36.2
12	Żura	4.3	16.0	7.3	27.6
$LSD_{0.05}$ – $NIR_{0,05}$					5.5

Spring wheat was damaged in 2006-2007 to a high degree i.e. on average 41.6% of plants.

Table 4. Damage of spring triticale penultimate nodes by gout fly in 2008
Tabela 4. Uszkodzenie dokłosi pszenżyta jarego przez niezmiarkę paskowaną w 2008 r.

No. Lp.	Cultivar Odmiana	% of damaged penultimate nodes – % uszkodzonych dokłosi			
		in degree – w stopniu			ogółem total
		weak – słabym	weak – słabym	strong – silnym	
1	Dublet	2.0	7.5	4.5	14.0
2	Kargo	1.0	5.5	3.0	9.5
3	Legato	1.0	4.5	3.5	9.0
4	Matejko	1.0	6.2	3.0	10.2
5	Mieszko	0.0	1.0	1.0	2.0
6	Wanad	1.0	4.5	6.2	11.7
		$LSD_{0.05}$ – $NIR_{0,05}$			2.8

Table 5. Damage of spring triticale penultimate nodes by gout fly in 2009
Tabela 5. Uszkodzenie dokłosi pszenżyta jarego przez niezmiarkę paskowaną w 2009 r.

No. Lp.	Cultivar Odmiana	% of damaged penultimate nodes – % uszkodzonych dokłosi			
		in degree – w stopniu			ogółem total
		weak – słabym	weak – słabym	strong – silnym	
1	Dublet	4.5	6.5	10.0	21.0
2	Kargo	2.0	1.5	4.0	7.5
3	Legato	3.0	2.5	1.5	7.0
4	Matejko	0.0	5.5	6.0	11.5
5	Mieszko	1.0	1.0	0.0	2.0
6	Milewo	0.0	4.5	1.5	6.0
7	Milkano	0.0	1.5	2.5	4.0
8	Nagano	3.0	5.5	4.0	12.5
		$LSD_{0.05}$ – $NIR_{0,05}$			4.7

In 2006 the population of gout fly on spring wheat plants was high, and the larvae of this pet damaged from 34.6 to 58.6%, on average 45.5% of plant penultimate nodes. The most wheat plants were damaged to a high degree (on average 23.4%). The stems of the cultivars: Griva, Partyzan and Jasna were damaged to the lowest degree, and the cultivars: Żura, Tybalt and Zadra, to the highest degree.

The numbers of gout fly population on spring wheat in 2007 in Boguchwała was slightly lower, but high as well. Larvae of the spring generation of this pest damaged from 24.9 to 51.9%, penultimate nodes, on average 37.2%. Also a similar distribution of damages was recorded in the following year of the study on this plant. The percentage of damaged stems recorded was as follows: to a low degree – on average 5.8% damaged stems, to a medium degree 14.5%, and to a high degree – 17.4 %. The cultivars: Bryza, Monsun and Bombona were damaged to the highest degree, and Hewilla, Żura and Koksa – to the lowest degree.

In the years of the study 2008-2009, a relatively low damage of spring triticale stems was recorded, that on average amounted to 9.1%.

Damages caused by gout fly on spring triticale in 2008 were relatively low. Larvae of the spring generation of gout fly damaged from 2.0 to 14.0% penultimate nodes of triticale (on average 9.4%). The stems of the cultivars: Dublet, Wanad and Matejko

were damaged to the highest degree, and the stems of the cultivar Mieszko – to the lowest degree.

In 2009 gout fly population was similar to that in the previous year, and pests damaged on average 8.9% penultimate nodes of spring triticale plants. The stems of the cultivar Dublet were damaged to the highest degree and the stems of the cultivars: Mieszko, Milkaro i Milewo – to the lowest degree.

Individual cultivars of spring wheat and spring triticale were to a different degree damaged by the larvae of gout fly – to a lower degree the spring wheat cultivars: Hewilla, Griva, Żura and Koksa, whereas to the lowest degree – the spring triticale cultivars: Mieszko, Milkaro and Milewo.

In the areas of heavy occurrence of gout fly cultivars less susceptible to feeding of the spring generation larvae of that dipteran should be grown (spring wheat – Żura, Hewilla, Parabola and Koksa, and spring triticale – Mieszko, Milkano, Milewo).

Damages caused by gout fly have a negative effect on grain and straw yield. The plant response to larvae feeding on the penultimate node depends on the development stage of the plant, at which the larvae get under the leaf sheath [Derron and Goy 1990, Walczak 2010]. Cultivation practices, particularly an early sowing date, reduce the numbers of gout fly [Gołębiowska 1957, Studziński 1971].

The study over the occurrence of gout fly in south-east Poland was carried out by Lisowicz [2000] in winter wheat and spring barley. Apart from barley, the plants which were most often and strongly damaged by the larvae of its spring generation in this area, is also spring wheat [Kaniuczak and Matłosz 2003].

The study conducted by Sekuła *et al.* [1965] on spring wheat of the cultivar Opolska near Wrocław proved that plants attacked by gout fly responded with a strong shortening of the plant height, particularly the penultimate node. In damaged plants their weight did not increase along with an increase in the grain number, and the damages caused disturbances in normal grain filling in the plants. According to the cited authors, attacking plants did not have a significant effect on the length of spike and the grain number per spike.

Many authors conducted studies over the noxiousness of gout fly, finding that considerable damages are caused by larvae of the spring generation. They feed on the penultimate node, grazing longitudinal grooves on the outside, reaching from the spike to the first internode. As a result of larvae feeding, the plants are shortened, damaged stems do not grow, and the spikes often remain in sheaths. Early attacked plants do not ear and the penultimate nodes are considerably shortened. If the plants are damaged slightly later, the spike only partially comes out of the sheath, and if infestation occurs still later, the spike ears but it is shorter [Gołębiowska 1957, Gołębiowska and Boczek 1959, Sekuła *et al.* 1965, Studziński 1971]. Those studies indicated that there is a large diversification of the infestation of individual cultivars. Spring cultivars with wide leaves and a long growing period were the most infested. Winter cultivars were infested to a much smaller degree than spring cultivars. On the basis of the obtained results, also a considerable diversification of the degree of stem infestation in individual localities and years was observed.

In south-east Poland the study on the occurrence of gout fly was carried out by Lisowicz and Kozioł [2002], who focused their observations on selected cultivars of spring barley. The numbers of gout fly population in the years 2000-2001 in Przecław were low. According to the cited authors, individual cultivars of spring barley were damaged by gout fly larvae to a different degree. The calculated heights of losses in

grain yields were also considerable varied. Larvae of the spring generation of this dipteran damaged on average 2.75% penultimate nodes, resulting in an average loss in grain yield amounting to 2.1%.

A similar study was carried out on spring wheat in 2002 by Kaniuczak and Matłosz [2003]. The numbers of gout fly populations were very high. Larvae of spring generation of this pest damaged on average 33.8 % penultimate nodes, causing the loss in grain yield which accounts for 14.1%.

Also parasitic Hymenoptera which occur on larvae and pupae of gout fly contribute to reduction in its noxiousness. According to Sekuła *et al.* [1965] from pupae (on average 41% parasitized) were obtained as follows: Braconidae (Hym., Braconidae) – 34% and Chalcididae *(*Hym., Chalcididae) – 7%.

The initial studies over the chemical control of gout fly on spring wheat were carried out by Kaniuczak [2008]. Spraying wheat plants at two dates gave the highest effectiveness, which on average amounted to 92.6%, and a high increase in grain yield, ranging from 6.9 to 11.3% (on average 8.0%). Slightly lower effects were obtained after the application at the first date of gout fly control. The effects of chemical control of *Chlorops pumilionis* Bjerk. At the second date were characterized by a larger variety as far as the effectiveness and an increase in yield are concerned.

It should be taken into consideration that the susceptibility of individual cultivars of cereals to gout fly can be subject to changes in different years, mostly depending on the course of the weather conditions, which have the dominant effect on the plant growth and intensity of occurrence and development of the pest.

The obtained results justify the need for estimation of the extent of stem infestation of the basic cereal species (particularly spring ones), damaged by gout fly in individual areas of Poland, and they also confirm the previous observations concerning a large harmfulness of the spring generation of gout fly on spring wheat plantations in south--east Poland.

CONCLUSION

In south-east Poland on spring cereal plantations many harmful agrophages occur which cause considerable plant damage. In the period of this study gout fly damaged on average 41.6% stems of spring wheat and 8.9% stems of spring triticale. In areas of high occurrence of gout fly on spring wheat and spring triticale it is recommended to grow cultivars less susceptible to feeding of larvae of the spring generation of this dipterans. The spring wheat cultivars which were the least susceptible to damage caused by this pest were: Hewilla, Griva, Żura and Koksa, and the spring triticale cultivars were: Mieszko, Milkaro and Milewo.

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WYSTĘPOWANIE ORAZ ZAKRES USZKODZEŃ JARYCH ODMIAN PSZENICY I PSZENŻYTA POWODOWANYCH PRZEZ NIEZMIARKĘ PASKOWANĄ (*Chlorops pumilionis* BJERK.) W POLSCE POŁUDNIOWO-WSCHODNIEJ

Streszczenie. Badania przeprowadzono w uprawie pszenicy jarej w latach 2006-2007 i pszenżyta jarego w latach 2008-2009 w Boguchwale. Celem badań była ocena podatności różnych odmian pszenżyta jarego i pszenicy jarej na uszkodzenia powodowane przez wiosenne pokolenie niezmiarki paskowanej. Doświadczenie założono metodą losowanych bloków w czterech powtórzeniach. Analizami objęto 9 odmian pszenżyta jarego oraz 16 odmian pszenicy jarej. Procent roślin uszkodzonych przez larwy niezmiarki paskowanej obliczano poddając analizie po 100 kolejnych źdźbeł na poletku. Analizy wykonano w czasie, gdy rośliny znajdowały się w fazie pełnej dojrzałości mlecznej ziarniaków. Uszkodzenie roślin klasyfikowano według skali trzystopniowej. Pszenica jara była uszkadzana w latach badań w stopniu wysokim, tj. średnio 41,6% roślin, natomiast pszenżyto jare w stopniu niskim – średnio 8,9%. Poszczególne odmiany pszenżyta jarego i pszenicy jarej były w różnych stopniach uszkadzane przez larwy niezmiarki paskowanej. Najmniej podatne na uszkodzenia były odmiany pszenicy jarej: Hewilla, Griva, Żura i Koksa, a pszenżyta jarego odmiany: Mieszko, Milkaro i Milewo.

Słowa kluczowe: *Chlorops pumilionis*, odmiany zbóż, pszenica jara, pszenżyto jare

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