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IMPACTS OF TRITICALE CROP SOWING DATE ON THE INSECT PEST SPECIES COMPOSITION AND DAMAGE CAUSED

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Abstract

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The effect of three sowing dates of triticale in the autumn of 2008 (September 30, October 10 and October 22) and 2009 (September 25, October 9 and October 26) on insect pest abundance and degree of damage to the crop by the main pest species was evaluated. Twenty-four insect species belonging to the orders Hemiptera (18 species), Coleoptera (1 species) and Diptera (5 species) were found to damage triticale shoots. Cereal flies have a major share in damaging triticale stems. The autumn wheat-shoot fly (*Phorbia fumigata* Meigen), and the frit flies *Oscinella frit* (Linnaeus) and *Oscinella pusilla* (Meigen) were the most damaging pests during the autumn vegetation period and *Ph. fumigata* was the dominant pest in both years of the study. The dipteran larvae mainly damaged triticale crops sown in the last decade of September and, in case of favorable climatic conditions, the first decade of October. Twelve leafhopper species of 3 families of the order Hemiptera were identified, among which family Cicadellidae was represented by the highest number of species. In 2008 the leafhoppers *Psammotettix provincialis* (Ribaut) and *Psammotettix striatus* (Linnaeus) were the dominant species, while in 2009 *Empoasca pteridis* (Dahlbom) and *Hardya anatolica* Zachvatkin were dominant. Infestation by aphids was reported only in the crops with earliest sowing dates (September), where the dominant species was *Sitobion avenae* (Fabricius). During the two years of the study most of the identified insects have demonstrated highest harmfulness in triticale crops from the first sowing period. Sowing the crop in later periods (second and third decades of October) could therefore be recommended in order to prevent or diminish pest damages on triticale.

Key words: triticale, sowing date, insect pests, population dynamics, damages

Introduction

Triticale is a high-yield hybrid cereal created by crossing wheat and rye. The crop was adopted by Bulgarian agriculture in 1980 and has been cultivated since then. The total cultivated area in Bulgaria varies from 5000 to 10 000 hectares while globally triticale areas tend to gradually and continuously increase. Triticale grain is used for the production of animal feed, diet food, spirits and beer. Triticale flour contains less low quality gluten, thus being suitable for making cakes. Triticale is also grown for green mass forage containing more protein than the one produced from wheat and rye. Flour made from green felt is rich in carotenoids and minerals (Kolev and Ivanov, 2005).

In some seasons pests can greatly reduce yield

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and grain quality and crop protection is important for maintaining high productivity. In Bulgaria, the data on the pest species composition and damage level in different phenological stages of the development of triticale are scarce (Krusteva and Ventsislavov, 2006; Krusteva et al., 2006). This motivated research on the insect fauna of cereals which was conducted at Plant Protection Institute (PPI), Kostinbrod. The purpose of the study was to investigate the influence of the time of sowing of triticale on the species composition, population dynamics and the degree of pest damage during the autumn growing period. The study results could be further used in developing a strategy for pest control in cereals.

Materials and Methods

In 2008-2009 investigations were conducted in the experimental field of PPI, Kostinbrod, with triticale variety *Vihren* planted as follows: (i) growing season 2008 - three sowing dates (September 30th, October 10th and October 22th); (ii) growing season 2009 - three sowing dates (September 25th, October 9th and October 26th). The population dynamics of leafhoppers, plant bugs and cereal flies were monitored using a sweep-net (5 sets of 20 sweeps (d=300 mm)) in each surveyed field from seedling emergence until late November, when cold weather settles. Samples were obtained every 2 to 6-7 days. The rule of "5 sweeps = 1m^2" was used to calculate the number of flies/m^2 (Mihailova et al., 1982). After the first symptoms of damage (withering and yellowing of the main shoot) samples of 0.5 linear meters were regularly collected and analyzed in order to clarify the species composition of pests, damaging triticale shoots. Damaged shoots were dissected and the phenophase and type of damage were documented. The pest species and their developmental stages were described. The percentage of damaged shoots per sample was calculated.

Analyses were carried out in 4-6 replicates in the phenophase of third leaf - tillering. The population dynamics of aphids were monitored by counting insects on 100 stems (collected at 10 different locations, 10 stems per location) at 3-5 day intervals from seedling emergence until the weather conditions allowed. The counting of aphids was performed both directly in the field and by dissecting the shoots in the laboratory, depending on the observed species. Taxonomic analysis was performed for aphids after Blackman, Eastop (1989) and Emden (1972), for Diptera after Beshovski (1985), Narchuk (1980) and Hennig (1976), for plant bugs by comparison to a collection identified by Yosifov, Zoological Institute, Bulgarian Academy of Science (BAS), and for leafhoppers using a collection of PPI, identified by Viola Bayryamova (Zoological Institute, BAS) and Venelin Pelov (PPI, Kostinbrod).

Results and Discussion

Insects from three orders were identified as pests on triticale in autumn: Hemiptera (Tables 1 and 2), Coleoptera and Diptera (Table 3). The species composition of wireworms (Elateridae; Coleoptera) was not determined, only the percentage of shoots damaged by their larvae was calculated. The most numerous established hemipterans were leafhoppers (Table 2). They were represented by 12 species of three families, the ratio between which varied depending on the weather conditions over both years, the date of sowing and seedling emergence of crops. The most abundant species belonged to family Cicadellidae.

In 2008 infestations by leafhoppers were observed in the fields of the first and the second sowing date and in 2009 – in all experimental variants. Adults started migrating to the fields during the emergence of the seedlings and inhabited them untill the permanent cooling of the weather in late November (Figures 1 and 2). In 2008 *Psammotettix provincialis* and *Psammotettix striatus* were the dominant leafhopper species, and in 2009 - *Empoasca pteridis* and *Hardya anatolica*. In both years the density of harmful leafhoppers was highest in crops sown during the last decade of September with maximum density

Table 1

Species composition and relative frequency (%) of aphids (Aphididae) and plant bugs (Miridae, Hemiptera) in triticale fields in relation to sowing date, 2008-2009, Kostinbrod

Family	Species	Relative frequency, %		
		Sowing date		
		30/09/2008	10/10/2008	25/09/2009
Aphididae	*Rhopalosiphum maidis* (Fitch)	8.96*		
	Schizaphis graminum (Rondani)			3.23*
	Sitobion avenae (Fabricius)	91.04*		96.77*
Miridae	*Leptopterna dolabrata* (Linnaeus)	50**	50**	
	Lygus rugulipennis Poppius	50**		
	Notostira erratica (Linnaeus)		50**	100**

* - % of the total amount of the aphids

** - % of the total amount of the plant bugs

Table 2

Species composition and relative frequency (%) of leafhoppers (Hemiptera:Cicadomorpha and Fulgoromorpha) in triticale fields in relation to sowing date, autumn, 2008-2009, Kostinbrod

Family / Species	Relative frequency, %				
	Sowing date				
	30/09/2008	10/10/2008	25/09/2009	09/10/2009	26/10/2009
Aphrophoridae					
Philaenus spumarius (Linnaeus)	0.77	0.45	0.82		
Cicadellidae					
Balclutha punctata (Fabricius)			1.62		
B. rhenana Wagner			0.82		
Empoasca pteridis (Dahlbom)	6.19	6.73	30.89	33.9	5.26
Hardya anatolica Zachvatkin	8.5	8.97	8.94	23.73	10.52
Macrosteles laevis (Ribaut)			8.94	1.7	
Psammotettix alienus (Dahlbom)	0.51				
P. provincialis (Ribaut)	29.9	33.63	31.71	22.03	63.16
P. striatus (Linnaeus)	44.59	46.19	2.44	1.69	15.8
P. spp.	1.55	1.79	5.69	16.95	5.26
Ziginidia pullula (Boheman)	7.73	2.24	8.13		
Delphacidae					
Laodelphax striatellus (Fallen)	0.26				

of 3.25 (20/10/2008) and 3.35 individuals per m^2 (23/10/2009), respectively. The favorable climatic conditions in 2008 were a prerequisite for higher density of leafhoppers in the field of the second sowing date with a maximum of 2.35 individuals per m^2 (23/10/2008) (Figure 3). Reduced population densities and prolongation of pest development were observed in the variant with the latest

Table 3

Relative part of triticale shoots damaged by plant bugs, Elateridae and Diptera larvae in relation to sowing date, Kostinbrod, 2008/2009 (% of the total amount of shoots/0, 5 m)

Family / Species	Damaged shoots, %		
	Sowing date		
	30/09/2008	10/10/2008	25/09/2009
Miridae	1.34	3.44	4.93
Elateridae			0.74
Cecidomyiidae			
Mayetiola destructor Say	0.76		
Chloropidae			
Oscinella frit (L.), O.pusilla(Meig.)	14.02	22.74	9
Anthomyiidae			
Phorbia fumigata Meigen	16.88	18.45	17.79
Delia platura Meigen	1.5		0.81

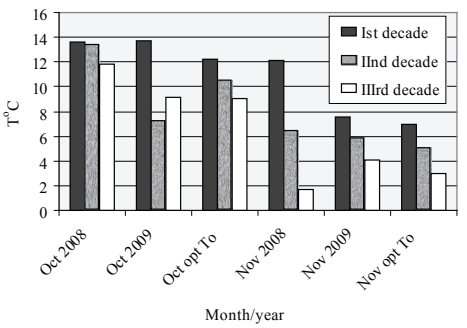

Fig. 1. Average daily temperature and optimal To per decade in the autumn growing period of triticale, 2008-2009

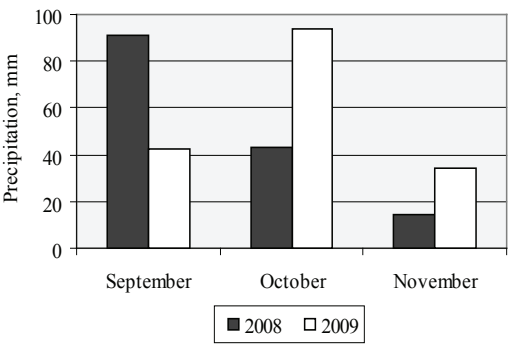

Fig. 2. Sum of precipitation (mm) in the autumn growing period of triticale per month, 2008-2009

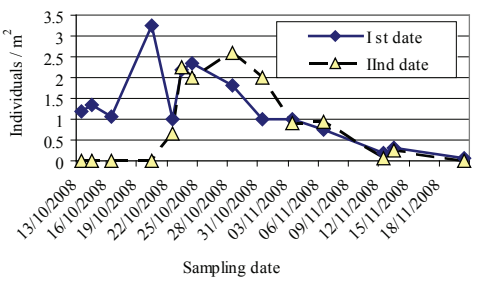

Fig. 3. Population dynamics of leafhoppers in t riticale fields sown on 30.09.2008 (first sowing date) and 10.10.2008 (second sowing date)

sowing date under the unfavorable conditions in late autumn.

The other species of order Hemiptera - aphids (Aphididae) and plant bugs (Miridae), were detected in low densities. Infestation by aphids was reported only in the variant with early sowing dates (September) with dominant species *Sitobion avenae* (Table 2). Winged aphids migrated to the sowings at seedling emergence and inhabited the plants by the end of October. The maximum number of larvae ranged from 0.23/plant (29/10/2008) (Figure 3) to 0.56/plant (10/23/2009) (Figure 4) while the percentage of infested plants was under

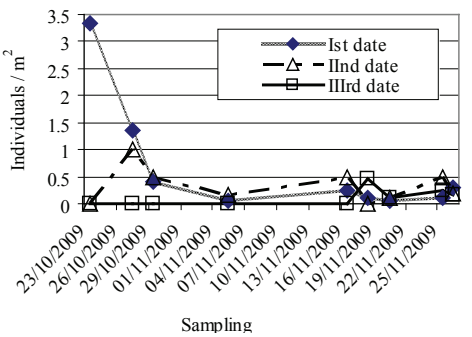

Fig. 4. Population dynamics of leafhoppers in triticale fields sown on 25.09.2009 (first sowing date), 9.10.2009 (second sowing date) and 26.10.2009 (third sowing date)

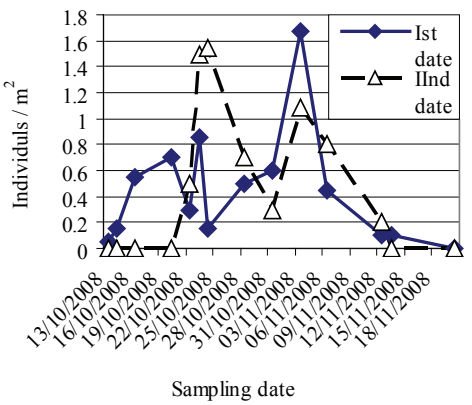

Fig. 5. Population dynamics of frit flies (O. frit and O. pusilla) in triticale fields sown on 30.09.2008 (the first sowing date) and 10.10.2008 (the second sowing date)

40%.

Data about the impact of sowing time on stem-boring pests of triticale during both growing seasons are presented in Table 3. Damages by plant bugs and larvae of Elateridae and dipterans were recorded. The attacked shoots stopped growing and died, the main shoot gradually withered, yellowed and dried, and in some cases remained underdeveloped or completely absent. Diptera larvae belonging to 3 families: Chloropidae (2 species), Anthomyiidae (2 species) and Cecidomyiidae (1 species) caused the most severe damages to shoots. The species of greatest importance were the autumn wheat-shoot fly *Phorbia fumigata* (16.88-18.45%), and the frit flies *Oscinella frit* and *Oscinella pusilla* (9.00-22.74%). In 2008, flight and damage caused by the autumn wheat-shoot fly and the frit flies were observed in the experimental fields of the first and second sowing dates, while in 2009 - only in the first sowing date variant. Frit fly adults invaded crops with their emergence but exhibited different duration and intensity of flight depending on the weather conditions, sowing time and emergence of plants (Figures 5 and 6).

In 2008 flight of *Ph. fumigata* was observed until the beginning of the second decade of November and of *O. frit* and *O. pusilla* - until the middle of the second decade of the same month

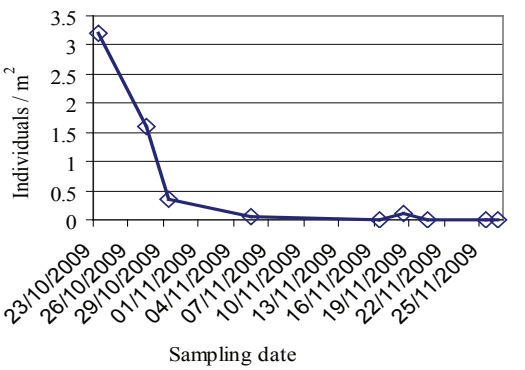

Fig. 6. Population dynamics of frit flies (O. frit and O. pusilla) in triticale fields sown on 25.09.2009 (the first sowing date)

(Table 4, Figure 5). The greater percentage of damaged shoots in the second sowing triticale variant was a result of the higher flight activity of frit flies due to favorable climate conditions (Figures 1 and 2). Flight intensity of adults was similar in crops from the first and second sowing period and reached its peak in the last decade of October and the first decade of November (Figure 5). The autumn growing season of 2009 was characterized by doubled precipitation in comparison with 2008 (Figure 2). As a result, the density and intensity of the flight of *O. frit* and *O. pusilla* in the first and second decades of November 2009 were very

Table 4

Flying period of Phorbia fumigata in triticale fields in relation to sowing date

Year	Sowing date	Emergence of triticale	Flaying period, month/decade			
			October			November
			I	II	III	I
2008	September 30	October 7				
	October 10	October 17				
	October 22	November 1				
2009	September 25	October 6				
	October 9	October 19				
	October 26	November 11				

limited (Figure 6). This could explain the absence of damage by Diptera larvae in the field from the second sowing period. The main harmful species observed in the early sowings in both years of the study was *Ph. fumigata*.

Conclusions

The investigations carried out in the autumn growing period of 2008 and 2009 on triticale crops in the experimental field of PPI, Kostinbrod provided evidence for a number of conclusions:

1. The triticale crop was damaged by 24 species of insects from three orders: Hemiptera, Coleoptera and Diptera.

2. The species from order Hemiptera included aphids, plant bugs and leafhoppers. The representatives of family Cicadellidae were the most abundant, with the highest number of established species. Their density was highest in crops planted in the first sowing period (third decade of September).

3. Triticale shoots were damaged by plant bugs and larvae of Elateridae and dipterans. Damages were observed in the crops sown in the first sowing period (the last decade of September) and, in case of favorable weather conditions, crops sown in the second sowing period (first decade of October);

4. Flies have a major part in damaging triticale shoots. The autumn wheat-shoot fly - *Rh. fumigata* and the frit flies *O. frit* and *O. pusilla* are most harmful during the autumn growing season in the investigated area.

5. During the two years of the study all of the identified insects were most harmful to triticale crops from the first sowing period. Sowing the crop in later periods (second and third decades of October) could be therefore recommended as a way to prevent or diminish triticale pest damages.

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