

ORIGINAL SCIENTIFIC PAPER

## Aphids at rye cultivated in organic farming

Vasilina Maneva<sup>1</sup>, Dina Atanasova<sup>1</sup>, Velichka Koteva<sup>1</sup>, Marina Marcheva<sup>2</sup>

<sup>1</sup>*Institute of agriculture – Karnobat, Bulgaria*

<sup>2</sup>*Institute of plant genetic resources “K. Malkov” - Sadovo, Bulgaria*

( e - mail: maneva\_ento@abv.bg)

### Abstract

The composition of aphids species in the rye cultivated in organic farming has been researched. The influence of weed vegetation, characteristic of such a system of growing, on aphid's parasites has been determined. The species *Sitobion avenae* and *Graminum schizaphis* have been found in rye crops. Close relation between the weeds species and their density and infested aphids has been registered.

**Keywords:** aphids, parasites on aphids, weeds, organic farming.

### Introduction

The organic agriculture is a production system that sustains the health of soils, ecosystems and people. Large attention has been paid to it and it is a policy in a number of countries in the EU (Dimitrov, 1995). The cereal crops are of great significance in organic farming because of their advantages as easy cultivation practices, including a comparatively successful mechanic control on weeds, control on diseases through rational crop-rotation, possibilities to maintain biologic control on the basic pests (Kitchen et al. 2003; Leibl et al.; 2000; Petr et al. 2000, etc.).

In cereal crops cultivated in conventional agricultural system there have been observed following species of aphids: *Metapolophium dirhodum*, *Rhopalosiphum padi*, *Rhopalosiphum maidis*, *Schizaphis graminum* and *Sitobion avenae*. It has been determined that in a low density in nature there exist species of the family *Chrysopidae*, the predatory bug *Nabis pseudoferus* Rem., the parasites *Ephedrus plagiator*, *Lysiphlebus fabarum*. New species from genera *Aphidius* Nees 1819 have been reported, (Todorov, 2006, 2007), but they do not have a significant influence upon the aphid's density (Grigorov, 1972,1980; Egina, Tsinovskii, 1980; USDA/ APHIS/ PPQ, 1993).

Some authors recommend growing of sunflower, maize, tobacco, alfalfa, annual and perennial grass species, nectarous plants and bushes in adjacent fields to cereal fields in order to raise the importance of ovum-eating parasites and other specific omnivorous predators and parasites (Kaitazov et al., 1982; Harizanov et. al., 1996).

It is established that in organic farming a low weed population can be beneficial to the crop as it provides food and habitat for a range of beneficial organisms (Patriquin et al., 1988, Clemens et al., 1994).

The purpose of the research is to determine the aphid species composition in rye grown in organic agriculture and to evaluate the natural occurring weeds impact on aphid's parasites.

## Material and methods

The research has been carried out during the period 2006 – 2008 in the Institute of Agriculture – Karnobat in a certified mini-field for biological agriculture, which is developed according to the Bulgarian legislation. A two crop rotation was settled in the experimental field – rye variety Milenium, and pea-sunflower mixed crop. The rye is grown by standard cultivation technology but without application of any fertilizers or pesticides.

For the purposes of this research monitoring of the aphid species composition, the contamination with aphid's parasites, the density and the composition of weed species have been carried out.

The aphids have been calculated directly on 100 rye stalks – 10 stalks at 10 places and determined according to Emden (1972). The aphids contaminated with parasites have been gathered from 100 stalks – 10 stalks at 10 places.

The agrochemical characteristic of soil has been made according to the in the Republic of Bulgaria commonly accepted methodologies of determining mineral nitrogen (according to Tiurin - Kononova), determining mobile P<sub>2</sub>O<sub>5</sub> (according to Egner-Riehm) and mobile K<sub>2</sub>O (in 2 n HCl).

The weeds have been calculated as number per square metre during October, January, March and June.

The experiment was carried out on pellic vertisols, whose 0 - 40 cm cultivable layer has heavy texture (volume density 1.10 – 1.20 g/cm<sup>3</sup>), light acid soil reaction (pH<sub>KCl</sub> 6.5), average humus content (2.5 – 2.9 %), weak reserve of mineral nitrogen (30 - 40 mg/kg soil) and mobile phosphorus (2.5 – 3.8 mg/100 g soil) and a very good reserve of available potassium (35 – 42 mg/100g soil)

The climate conditions in the region are intermediate-continental, with an average sum of rainfall 549 mm per year. The winter is relatively warm, the spring is short and cold, the summer is hot and dry, and the autumn is long-lasting and warm.

## Results and discussion

After transition to organic rye cultivation and completion of mineral fertilization the soil fertility decreased (Table 1). The nutritional value is below the optimal but still sufficient for crops development and growth. Rotation with leguminous plants is used as compensation to the low nitrogen supply.

**Table 1. Agrochemical characteristics of the soil in the layer 0-40 cm**

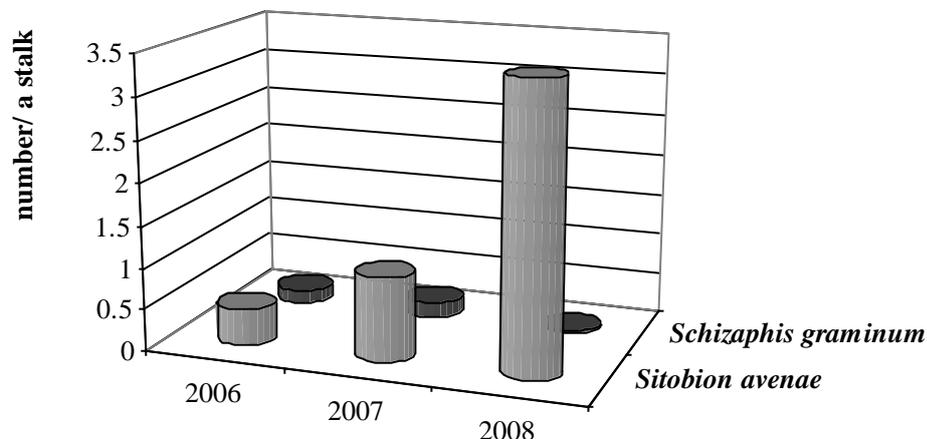
Parameters	1998		2006		2007	
	variation*	average	variation*	average	variation*	average
Mineral N, mg/100g	40.2–45.9	43.6	37.6–39.8	37.9	30.7–35.0	32.9
Mobile P <sub>2</sub> O <sub>5</sub> , mg/100g	5.2 – 5.6	5.5	3.8 – 4.2	4.7	3.7 – 4.1	3.8
Mobile K <sub>2</sub> O, mg/100g	40.8–42.9	41.0	35.7–39.6	36.9	35.7–39.1	37.1

Remark: \* The minimum and maximum values of indicators have been pointed out

In the research period the soil fertility was not restrictive to the normal plants development. That ensured good conditions for aphids feeding.

The species *Sitobion avenae* and *Graminum schizaphis* have been found in rye crops. Climate conditions in the successive years are not influencing the aphid species

composition. The highest density was recorded for *Sitobion avenae*. In 2008 it measured up to 3.4 no/stalk (Fig. 1).



**Figure 1. Species variety and numeral dynamics of aphids in rye**

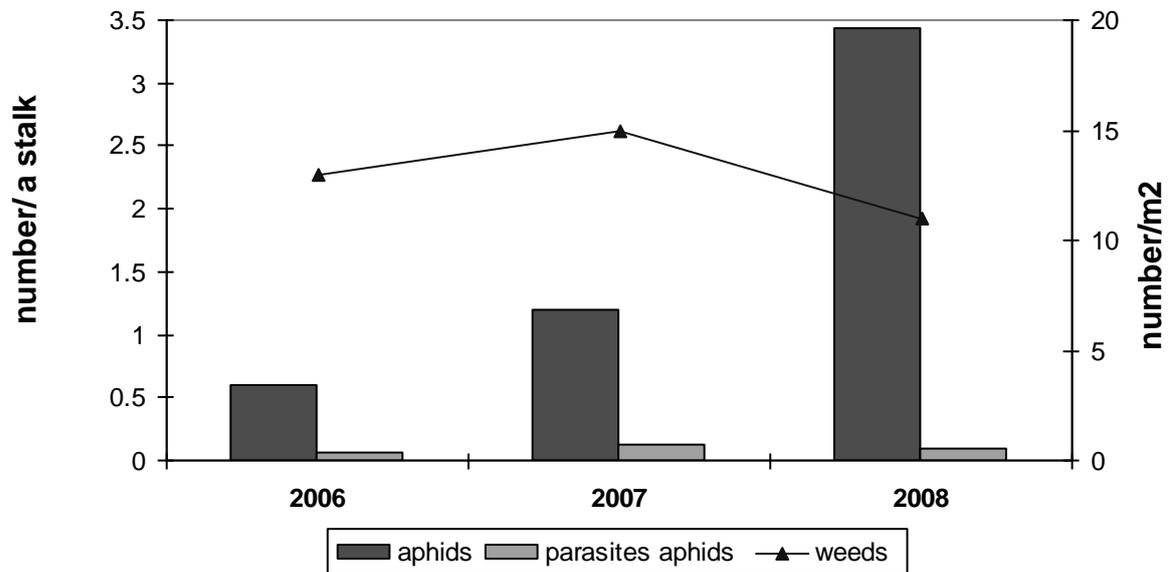
Annual and perennial broad-leaf weeds predominate in rye field. In 2006 density of 13 no/m<sup>2</sup> has been recorded, in 2007 it reached 15 no/m<sup>2</sup>, and decrease to 11 no/m<sup>2</sup> in 2008 (Table 2). Main diminution is marked in perennial herbaceous weeds *Convolvulus arvensis* and *Cirsium arvense*. The highest density in 2007 is due to the biggest amount of annual broad leaf species. These weeds are predominant also in 2008. Many, among them, are flowering in the counting period for aphids and parasites.

**Table 2. Weed infestation of rye during period 2006 – 2008 (number/m<sup>2</sup>)**

WEEDS	no/m <sup>2</sup>		
	2006	2007	2008
ANNUAL BROAD – LEAF			
Anthemis spp.	1	3	3
Galium tricornis With.	-	2	1
Papaver rhoeas L.	1	2	2
Poligonum convolvulus L.	1	1	0
Viola tricolor L.	0	1	1
Veronica hederifolia L.	0	1	1
PERENNIAL BROAD - LEAF			
Cirsium arvense (L.) Scop.	6	3	2
Convolvulus arvensis L.	4	2	1
Total	13	15	11

The weed density does not have negative influence of the rye development but can provoke favourable conditions for additional feeding and host plants for reproduction of the entomophagues. In 2006 at weeds density of 13 no/m<sup>2</sup> (predominant perennial broad – leaf species) the number of aphids attacked by parasites measured up to 0.06 number/stalk at aphids density 0.6 number/stalk. In 2007 mostly annual broad-leaf weeds are observed (15 no/m<sup>2</sup>) and the number of infested aphids reached 0.13 number/ stalk at 1.2 aphids per stalk. The favourable climate conditions in 2008 assisted the good plant development which increased there competitiveness to weeds. This resulted in diminishing number of weeds -11 no/m<sup>2</sup> predominantly annual broad-leaf species. The well-developed plants were

conductive to the feeding of aphids. They reached the highest density - 3.43 of adults per stalk, at decreased number of affected individuals - 0.1 per stalk (Fig. 2).



**Figure. 2. Correlation between the number of weeds and the parasites aphids**

Close relation between the weeds species and their density and infested aphids has been registered. With predominance of annual broad-leaf weeds the number of damaged aphids increase. This could be due to the more intensive flowering of those weeds which facilitates the feeding of adult parasites. The decrease of weed density leads to lower number of affected aphids.

Irrespective to the climate conditions and the weed infestation during all the research period *Sitobion avenae* and *Schizaphis graminum* were present.

## Conclusions

In rye crop cultivated in organic farming system, aphids from genera *Sitobion avenae* and *Schizaphis graminum* were present. The greatest population size in the research period was found for *Sitobion avenae*.

Relation between species composition and density of weeds and the infested aphids had been established. With the decrease of weeds density diminution of damaged insects is observed. In weeded plots with predominantly annual broad leaf species, the number of affected aphids is bigger. This could be due to the more intensive flowering of those weeds which facilitates the feeding of adult parasites. This comes as confirmation of the thesis of Kaitazov (1982) and Harizanov (1996) that increase of the impact of omnivorous predators and parasites in cereal crops can be accomplished by cultivation of flowering nectarous plants, annual and perennial grasses in adjacent plots. Those species create conditions for additional feeding and hosts for reproduction of the entomophagues.

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