CONTRIBUTION TO THE STUDY OF CICADA (HOMOPTERA-AUCHEENARRHYNCHA) POPULATIONS FROM WINTER WHEAT CROPS IN OLTENIA PLAIN

Emilia Baniță*, Margareta Cantoreanu, Aurelia Jilăveanu*****

ABSTRACT

The populations of cicadas existing in wheat crops of Oltenia, represent 2-67 % from the total insect pests. Arid climate (frequent drought years) from sandy soils area, the low level of crop technologies, the neighbourhood with perennial grasses are the main factors determining a high rate of the increasing of insect populations. Under such conditions the populations could reach 255 insects/square meter.Qualitatively, the populations are made up of a basic nucleus of *Psamotettrix striatus* (45 % at Șimnic and 91 % at Dăbuleni), and *Yavesella* pellucida (49% at Șimnic and 6% at Dăbuleni), beside other 17 different species, of which at least ten species are known as biological vectors for viruses and mycoplasmas.

Key words: biocenose, *cicada*, virus, wheat

INTRODUCTION

Among the biocenoses of damageable arthropods from the winter wheat agroecosystems, the cicadas have a very important place.

In their feeding process, the cicadas act negatively on plants: a mechanical action by harming the vegetal tissue during feeding and egg laying, a toxic action due to the phytotoxicity of their saliva and an infectious action, some species being biological vectors.

As phytophagous insects, cicadas cause important damages immediately after the emergence of cereals, and then in spring by reducing leaf area, the growing rate and finally the yield potential. Economic damages caused by this pest were registered in North Western and Central Europe, Russia, Japan and USA.

The majority of cicadas found on cereals are biological vectors for pathogen agents, particularly for viruses and mycoplasmas. Thus, at least 18 species of cicadas were cited in the literature as vectors for the majority of cereal viruses (Vacke et al., 1966, 1980; Lin et al., 1983; Conti, 1982; Bisztray et al., 1991; Lapierre and Causin, 1991; Gustina and Lebrun, 1991; Foheer et al., 1992; Moreau et al., 1992).

Cicadas from diferent biotops of Romania were studied by Cantoreanu (1969). The relationship between cicades as vectors and wheat dwarfism syndrom was communicated at Turda by Munteanu et al. (1969) and at Fundulea by Ploaie (1969). Wheat dwarfism virus (WDV) was identified and transmitted by cicada *Psamotettrix alienus* (Jilăveanu and Vacke, 1994).

The purpose of this study was to identify the species of cicadas which populate the winter wheat crops from Oltenia Plains and their evolution according to locations, phenological stage of host plants, climate conditions and the level of crop technology.

MATERIALS AND METHODS

The biological material was collected from winter wheat fields from two main cropping areas: Șimnic, on a forestry brown-luvic soil in a cereal area and Dăbuleni, on a sandy irrigated soil in a horticultural area.

Samples were collected during 1991-1996 from plots larger than 50 ha with optimal technology (M) and from small plots of about 2 ha (m) where a minimum technology was applied.

Collecting was made almost simultaneously in the two locations (2 days delay) in the main phenological stages: the beginning of stem elongation (J,K); heading (L, M); end of heading and flowering (O, P) and milky-waxy maturity (Q).

Several collecting methods were used: entomological netting with 300 nets set equidistantly in 10 sites on the both diagonals of the plots; from the soil at the same site by collecting the arthropods from an area of 0.25 s.m; capture from 100 ears using a "Tulgren" device by 48 hours exposure.

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Data were processed for two parameters: abundance and density/s.m. In winter wheat area where the study was performed, small cereals emerged often during the winter "windows", so that autumn populations could not be collected.

RESULTS AND DISCUSSIONS

Different climate conditions during the experimental period 1991-1996, influenced plant phenology, evolution of biocenoses of wheat arthropods in general and particularly the dynamics of cicada population developments, as shown in table 1, obtained at Şimnic in the variant "m".

Thus, in very dry years 1992 and 1993, unfavourable for winter wheat, the most abundant populations of cicadas developed 1480 and 1162 insects respectively.

In 1991 and 1994, with wet and cold weather during the summer, medium favourable for wheat, the smallest populations of cicadas were registered: 11 and 110 insects respectively for all captures.

In 1995, a year with very favourable conditions for wheat, medium abundance of cicadas (638 insects for all captures) was registered.

The ratio of cicadas from the total harmful insects collected (Figure 1), varied between very large limits, 2-67 %, depending on the experimental variant.

Thus, the highest abundance (67 %) was recorded in 1992 at Şimnic, where the plot of wheat was in the vicinity of a perennial grass plot, from which the cicadas immigrated during the whole period of vegetation.

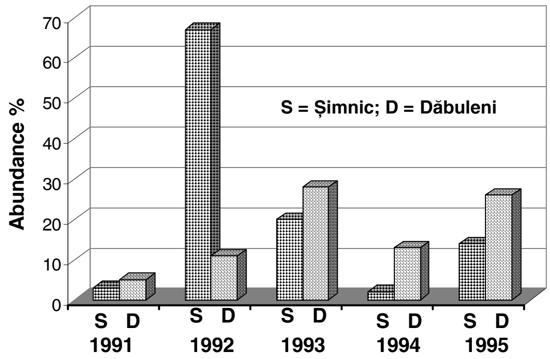

Figure 1. Abundance of cicada populations in wheat crops, depending on years and locations (in plot type)

Although is generally known that cicadas as phytophagous insects depend on the presence of host plants, most of the species may live on spontaneous vegetation, in our case on perennial grasses, and immigrate continuously to winter wheat crops.

In 1993, under prolonged drought conditions when the total number of harmful insects captured from wheat was the highest, the relative abundance of cicadas was of 20 and 28 % at Şimnic and Dăbuleni respectively.

The lowest abundance was registered in 1994 (2-13%) and in 1991 (3-5%).

From these data, the conclusion may be drawn that cicadas are present in wheat crops every year, but under favourable conditions for infestation and evolution, they could represent more than half of the total harmful collected insects.

The two experimental locations were different concerning the quantitative accumula-

Table 1. Evolution of the populations of cicadas from winter wheat crops of Oltenia Plain (1991-1995)

Year	Plot variant	Location:x) Şimnic	Location:x) Dăbuleni	Total / plot type	Anual total
1991	m under 2 ha	11	173	184	
	M over 30 ha	11	2274	2285	2469
1992	m under 2 ha	1480	551	2031	
	M over 30 ha	311	249	560	2591
1993	m under 2 ha	1162	1400	2562	
	M over 30 ha	793	3830	4623	7185
Total 1991 - 1995 m + M		3768	8477		12245
1994	m under 2 ha	110	729	839	
1995	m under 2 ha	638	972	1610	
Total 1991 - 1995 m		3401	7226		
General total		4516	10178		14694

x) No. of insects captured by 300 nettings x 4 collectings tion of cicada populations (Table 1). The most numerous cicadas - 10,178 insects - were captured at Dăbuleni under arid conditions of sandy soils. At Șimnic, on forestry brown-luvic soil, under rainfed conditions, only 4516 insects were collected. The capacity of infestation at Dăbuleni was very important in 1993 when a density of 255 insects/s.m was registered.

The two variants of plots differing in size and technological level, showed differences in population abundance between 1991-1993, the variant "m" registering 2643 insects, while the "M" type plots only 1115 insects.

Plot type "m" under 2 ha and with low-input technology, were not treated during the vegetation period for controlling the weeds, diseases or pests.

On the contrary, plot type "M", larger than 30 ha, were treated with herbicides and at least twice with insecticides for controlling sunbug (*Eurygaster integriceps*), another major pest of winter wheat in Romania. These treatments reduce generally the whole fauna of arthropods and the infestation with cicadas.

In 1992 and 1993, the "m" plot from Șimnic was in the vicinity of perennial grasses plots, and so, the highest infestation was recorded (1480 and 1162 insects, respectively).

At Dăbuleni, on sandy soils, under irrigation, the most numerous population was captured in the variant plot "M", 2274 and 3830 insects in 1991 and 1993, respectively. In the excessively dry climate of this area, where the temperature at the soil surface might overpass 60^{o}C in May-July, the populations of cicadas immigrated to irrigated plots, where the plant remained green for a longer period of time, were more vigorous and had a greater leaf area. Such irrigated plots represent ideal sites for feeding and refuge. Additionally, in 1991 and 1993, no insecticide was applied on wheat crops. In 1992, when the beetle *Oulema melanopa* was controlled by insecticide treatments, the populations of cicadas in "M" type plots was the lowest (249 insects).

The cicadas are present in the wheat crops during the whole period of vegetation. Data regarding the dynamics of the populations in the main vegetation stages at Șimnic in "m" variant plot with the most frequent counting during 1991-1996 (Figure 2) showed a continuous increase of the number of cicadas from the stem elongation stage (Y-K) till waxy maturity stage (Q). The largest population accumulated in waxy maturity stage, when mature and young ages of both generations overlapped. Only in 1995 the populations of cicadas collected in the last two vegetation stages (O-P and Q), i.e. end of heading - waxy maturity, were almost equal due to climate conditions from May-July, with lower air temperatures and frequent rainfalls of 159 and 75 mm respectively.

The presence of cicadas in the stages of adult and all nymph ages during the whole experimental period and in all plots checked, in some years with very high densities has suggested the economic importance of this group of insects as pest and biological vectors for continuous potential source of virus infestation of wheat crops. It is known that cicadas have the capacity to transmit wheat dwarfing virus from the infected plants in all stages of the in-

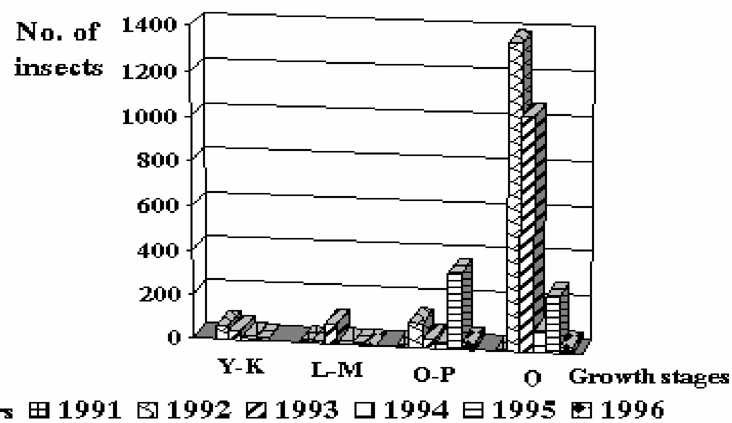

Figure 2. Dinamics of cicada populations from wheat crop in the main growth stages

sect: adult, nymph or egg (Vacke, 1996; Hoppe et al., 1972; Bisztray et al., 1989).

Some other cereal viruses, as shown in table 3, were cited in the literature as transmitted by species of cicadas identified in Oltenia (Table 2) as well as by other species of insects.

Table 2. Species of Cicadinea (Hom. Aucheenarrhyncha) present in winter crops of Oltenia Plains

Species	Abundance, %	
	Şimnic	Dăbuleni
Psamotettrix striatus L.[x]	45.7	90.7
Yavesella pellucida F.[x]	49.4	6.1
Macrosteles laevis Rib.[x]	2.5	0.2
Psamotettrix provincialis Rib.[x]	0.6	0.0
Psamotettrix confinis Dhlb.[x]	0.5	1.0
Zyginidia pullula Boh.[x]	0.2	0.4
Euscelis incisus Kbm.[x]	0.3	0.3
Macrosteles fieberi Edm.[x]	0.1	0.6
Macrosteles spp.[x]	0	0.3
Agrocephalus longuidus Flor.	0.05	0.3
Eupteryx stachydearum[x] Hardy.	0.1	0.1
Stenocranus minutus F.	0.1	0.0
Neophilaenus lineatus L.	0.1	0.0
Neophilaenus campestris Fall.	0.0	0.1
Graphocraerus ventralis Fall.	0.1	0.0
Psamotettrix helvalus Kbm.	0.0	0.1
Oliarus pallene Germ.	0.05	0.0
Daratura homophyla Fler.	0.05	0.0
Streptanus sordidus	0.05	0.0

[x] biological vectors (after Cantoreanu, 1970)

The qualitative study of the structure of species collected from wheat crops revealed the presence of 14 species (Table 2), 16 species captured at Şimnic and 12 species at Dăbuleni. Although, from faunistic point of view the population was abundant and diverse, only 2-3 main species formed its nucleus.

Thus, two species, numerically equal, prevailed at Şimnic: *Psamotettrix striatus* (45.7 %) and *Yavesella pellucida* (49.4%).

Excepting the species *Macrosteles laevis* which was relatively better represented numerically (2.5 %), the other 13 species had very low abundance varying between 0.6 % and 0.05 % of the total number of insects determined.

The species *Psamotettrix striatus* prevailed at Dăbuleni (90.7 %), while the species *Y. pellucida* had a low abundance of 6.1 %. All the other ten species represented 1-0.1 % from the total insects examined.

Research from other geographic areas showed the economic weight of species *Yavesella pellucida* in Finland and *Psamotettrix striatus* in Slovacia.

From the total number of species identified, at least ten are known as biological vectors for the main viruses and mycoplasmas

Table 3. Species of Cicadinea, known as implied in transmitting virus diseases in cereales

Species	Virus transmitted	Host plants	Geografical spreading
Psamotettrix alienus D.	Wheat dwarf virus	wheat, barley, oats, grasses	Northern and Central Europe
Psamotettrix alienus D. *Macrosteles* sp.	Russian winter wheat mosaic virus	winter wheat, rye	Europe, Russia
Psamotettrix striatus L.	Wheat winter mosaic virus	wheat, rye, millet, grasses	Russia
Psamotettrix alienus D. *Macrosteles laevis* Rib.	Wheat pale green dwarf virus	wheat, rye, barley, oats	Central Europe
Yavesella pellucida F. *Yavesella discolor* Boh.	Oat sterile dwarf virus	oats, barley, wheat rye, ryegrass	Central and Northern Europe
Dicranotropis obscurella *Dicranotropis hamata* Boh.	Wheat (European) striated mosaic virus	Avena fatua wheat, barley, oats, rye, grasses	Central and Northern Europe
Yavesella striatella	Oat pseudo-rosette virus	oats, barley, rye, maize, wheat,	Russia
	Cereal (northern) mosaic virus	wheat, oats, barley, rye, grasses	Japan
Macrosteles laevis Rib. *Macrosteles fascifrons*	Oat blue dwarf virus	oats, barley, ryegrass	Central Europe
Endria inimica *Elymona* sp.	Wheat striated mosaic (american) virus	wheat	USA Canada
Leodelphax striatellus	Wheat chlorotic streak virus	wheat	France
	Cereal tillering virus	barley, oats, perennial grasses	Northern Europe (Sweeden)
	Wheat rosette dwarf virus	wheat	China
Leodelphax striatellus *Yavesella pellucida* F.	Barley yellow striated mosaic virus	wheat, barley, oats, grasses	Italy

which affect the small cereals of Romania (Cantoreanu, 1969). Studies concerning the evolution of these pathogens and their pest vectors in Romania were conducted by Jilaveanu and Vacke (1994).

Species *P. striatus*, *Y. pellucida* and *M. laevis* which form the basic nucleus of populations of cicadas from Oltenia, besides the direct injuries to the crops are known as biological vectors for at least five species of viruses infecting wheat, rye, barley, oats, raigrass and perennial grasses (Table 3).

CONCLUSIONS

Wheat crops from Oltenia Plains are infested with cicadas in a proportion of 2-67% from the total harmful insects captured during the vegetation period.

The size of the populations is favourably influenced by the arid climate from sandy soil areas, the years with warm and dry weather, the low technological level, particularly by the lack of chemical treatments, and the growing stages of the host plants.

Infestation capacity of cicadas under natural field conditions was of 255 insects/s.m, in 1993.

Qualitative structure of the populations is represented by 19 species but the basic nucleus comprises 2 species: *Psamotettrix striatus* (45.7 %) and *Yavesella pellucida* (49.4 %) at Șimnic, on a forestry brown-luvic soil and *P. striatus* (90.7 %) and *Y. pellucida* (6.1 %) at Dăbuleni on sandy soils, in an arid climate.

The presence in the rotation of perennial grasses favours the immigration of cicadas towards wheat crops.

Chemical treatments particularly those with insecticides applied for controlling pests such as *Eurygaster integriceps* at Șimnic, or *Oulema melanopa* at Dăbuleni decreases significantly the population of cicadas.

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Yavesella pellucida F. Yavesella discolor Boh. Dicranotropis hamata	Oat sterile dwarf virus	oats, barley, wheat rey, ryegrass Avena fatua	Central and Northern Europe

Boh.			
Dicranotropis obscurella			
	Wheat (European) striated mosaic virus	**wheat, barley, oats, rye, grasses**	**Central and Northern Europe**
Yavesella striatella	**Oat pseudo-rosette virus**	**oats, barley, rye, maize, wheat,**	**Russia**
	Cereal (northern) mosaic virus	**wheat, oats, barley, rye, grasses**	**Japan**
Macrosteles laevis Rib. **Macrosteles fascifrons**	**Oat blue dwarf virus**	**oats, barley, ryegrass**	**Central Europe**
Endria inimica **Elymona sp.**	**Wheat striated mosaic (american) virus**	**wheat**	**USA** **Canada**
Leodelphax striatellus	**Wheat chlorotic streak virus**	**wheat**	**France**
	Cereal tillering virus	**batley, oats, perennial grasses**	**Northern Europe (Sweeden)**
	Wheat rosette dwarf virus	**wheat**	**China**
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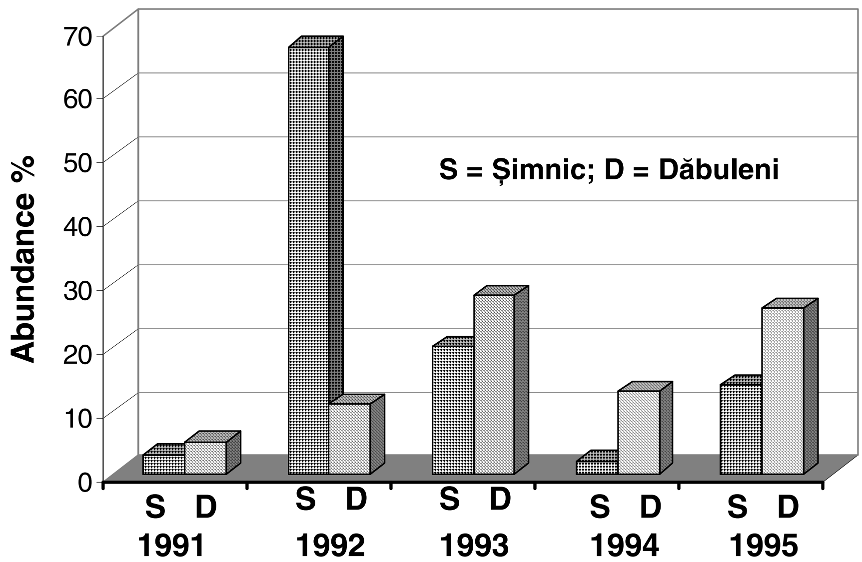

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