RELATIONSHIP BETWEEN APHID POPULATION AND THE PATHOSYSTEM BARLEY YELLOWS DWARF VIRUS (BYDV)-BARLEY

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***Abstract**. Small cereals such us wheat, barley, oat, and other grasses are very much influenced when talking about crop production and various pathogens which can infect them during growth stages. Among these pathogens like downy mildew, tan spot, Septoria disease and other fungi also the viruses contribute to the yield decreasing and loses. Barley Yellows Dwarf Virus is well known as a pathogen strong related to its carrier (vector) being distributed and transmitted by a whole range of aphid species. The aim of this paper is to compare the relationship between aphids and the pathosystem BYDV- barley under certain treatments with different active ingredients used to control the virus vector. To achieve that we assessed the symptoms like leaf discoloration (lose of green colour) turning in bright yellow and trough influence on tillering, linked to the treatments applied and dosage used. The trial setup consists in 7 treatment including untreated laid in four replicates using randomised blocks. Three assessments were performed, to establish the aphid population, followed by assessment of leaves presenting symptoms of viral infection. We observe that, in the variants where a high density of Rhopalosiphum padi was present, the symptom like yellowing was better exerted compared to the plots where other aphid species were observed and build the aphid population.*

***Keywords**: BYDV, virus vector, Rhopalosiphum padi, symptomes*

INTRODUCTION

Small cereals such us wheat, barley, oat and other grasses are very much influenced when talking about crop production and various pathogens which can infect them during growth stages. Among these pathogens like downy mildew, tan spot, Septoria disease and other fungi also the viruses contribute to the yield decreasing and loses. *Barley Yellows Dwarf Virus* (BYDV) is well known as a pathogen strong related to its carrier (vector) being distributed and transmitted by a whole range of aphid species.

BYDV transmited obligatory by aphid vectors is the most destructive virus in cereal crops in the world (LISTER and RANIEN, 1995; MILLER et al., 2002; KENNEDY and CONNERY, 2005), cousing significant yield losses in major cereal crops such as wheat, barley, maize, oat (KADDACHI et al., 2014; RASTGOU et al., 2005)

Barley yellow dwarf virus (BYDV) is the type member of the *Luteovirus* group (WATERHOUSE et al., 1988; INGWELL et al., 2014) in the family *Luteoviridae* (D'Arcy, 2000). BYDV is mostly transmited by *Rhopalosiphum padi* (L.) the most common and economically important species, accounting for up to 90% of the total aphids. *Schizaphis graminum* (Rondani), *Rhopalosiphum maidis* (Fitch), and *Sitobion avenae* (F.) are counted also as vector aphids (ZWIENER et al. 2005).

The type and severity of host reaction to virus infection depend greatly on the crop genotypes, virus strains, age of plant at the time of infection and are influenced by environmental conditions (KADDACHI et al., 2014). The most severe effects have been reported on oats, where reddening of the leaves and blasting of the florets are easily observed (OSWALD and HOUSTON, 1953; BURNETT, 1984; D'ARCY, 1995). Other symptoms are stunted growth and late heading (YOUNT et al., 1985). The severity of BYDV effect on plants is determined also by the time of infection (SMITH, 1967), the virus species involved (BALTENBERGER et al., 1987), and the cultivar genotype (JEDLINSKI, 1972).

BYDV may cause considerable losses of small grain cereals worldwide, up to 40% in *Triticum aestivum* (wheat), 25% in *Hordeum vulgare* (barley) and 15% in *Avena sativa* (oat) (LARKIN et al., 2002; ORDON et al., 2009).

Based on this, we considered that an in-depth study of the aphid population control could bring new information on this issue by applying a phytosanitary treatment plan, in certain growth phases, to minimize the production losses implicitly of the decrease of its quality.

MATERIAL AND METHOD

The researches within the topic were carried out in the experimental field located in vicinity of Șag locality, Timiș county. The influence of treatments against virus vector of BYDV (*Barley yellow dwarf virus*) to barley has been studied.

The application of the studied products as experimental variants was performed in the spring of 2021 at the beginning of the elongation of the straw growth stage BBCH 31-32. The following active substances were considered: deltamethrin (0.62 l/ha), sulfoxaflor (0.048 kg/ha) and acetamiprid (0.1 kg/ha).

The evolution of the number of aphids at 3, 7 and 14 days after application (DAT) and the appearance of specific BYDV symptoms on the leaves was observed, being analyzed 25 plants per variant.

The field experiment was randomized. Each plot is subdivided into four replicates, with four variants, measuring 10 x 3.0 m (30m2), in total we have 20 microplots for barley cultivation. The experimental variants taken in the study were: TRT 1- untreated check; TRT 2 – deltamethrin; TRT3 – sulfoxaflor and TRT4 – acetamiprid, conducted under EPPO Guidelines PP 1/20 (3) - *Aphids* in cereals and PP 1/152 Design and analysis of efficacy evaluation trials.

Fig. 1. Experimental plots

Fig. 2. Assessing aphids population within variants

RESULTS AND DISCUSSIONS

Aphids, due to their ability to multiply frequently, up to 9-15 generations per year (GROZEA I. et al., 2009), are treated in terms of the potential for transmitting viruses to plants, as is the case with the BYDV yellow dwarf virus in wheat. Among the aphid species that have the quality of "transmission vector" or carrier, the most common species encountered were *Sitobion (Macrosiphon) avenae*, *Metopolophium dirhodum* and *Schizaphis graminum*. As *Sitobion avenae* represented a higher population, the data obtained from the observations refer only to it. The first assessments were conducted 7 days after the application (DAA) of treatments to control this transmission vector, in an attempt to make a correlation between the population level of aphids and the incidence of BYDV.

Following that, at 7 DAT, the number of aphids, larval and adult forms of development, was on average about 50 aphids per variant in the untreated control (TRT1), 0 insects in the variant where deltamethrin was applied, 2.66 aphids in TRT3 (acetamiprid) and 4 aphids where the insecticide sulfoxaflor (TRT4) was applied.

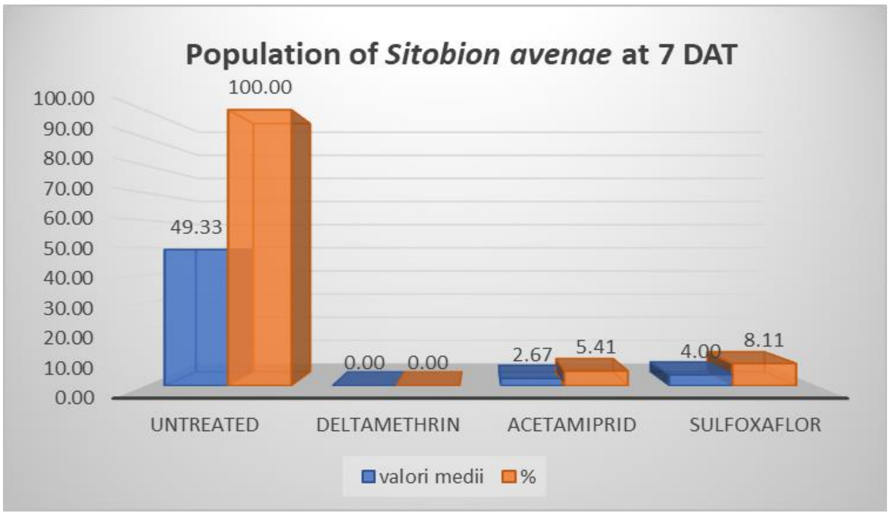

Fig. 3. *SItobion avenae* population at 7 DAT

At 14 days after the application of the treatments, a slight increase of the aphid populations was observed on variants, as an average per variant in the untreated control, 64 aphids (larvae and adult / winged adults) were quantified. The best efficacy is preserved in the case of the insecticide based on deltamethrin, where, in a single replicate, 2 aphids were registered (99% effectiveness).

The increase in the level of aphid populations was also observed in the case of TRT3 (insecticide based on acetamiprid) where it recorded an average of 5 aphids and TRT4 (sulfoxaflor) with 10 aphids on average. After 14 days there is a return of aphids in the treated plots, the best efficacy being preserved in the TRT1 (deltamethrin), figure 4.

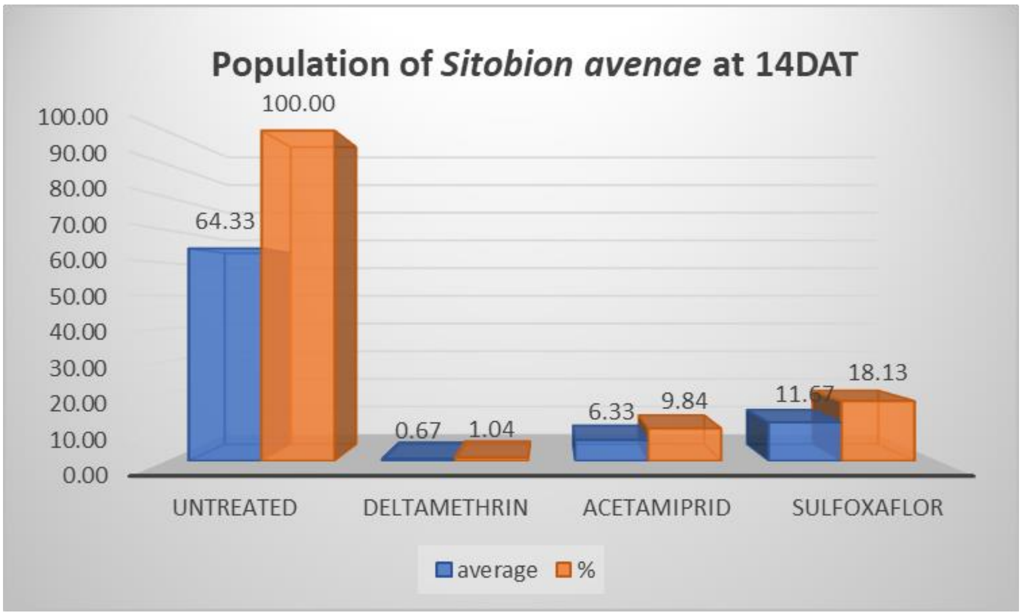

Fig. 4. Vector aphid population 14 days after treatments

Following the application of insecticides and after the interpretation of the data related to the symptoms attributed to BYDV, we can observe their correlation through the control of aphids-symptoms.

Thus, in the untreated plot, out of 25 samples (samples) analyzed at 30 days after treatments, BYDV was present, on average, in 12 samples, followed by insecticide based on sulfoxaflor (V4) with 2.33 infected samples, TRT3 (based on acetamiprid) with 1.33 infected plants and TRT 2 (based on deltamethrin) that no BYDV infections were observed.

Analyzing, as a percentage, the effectiveness of treatments in respect of reducing the incidence of BYDV in the studied treatments, we can say that the best efficacy was attributed to the insecticide based on deltamethrin respectively 100%, followed by active ingredient acetamiprid with 89% and 80% sulfoxaflor active ingredient based product, figure 5.

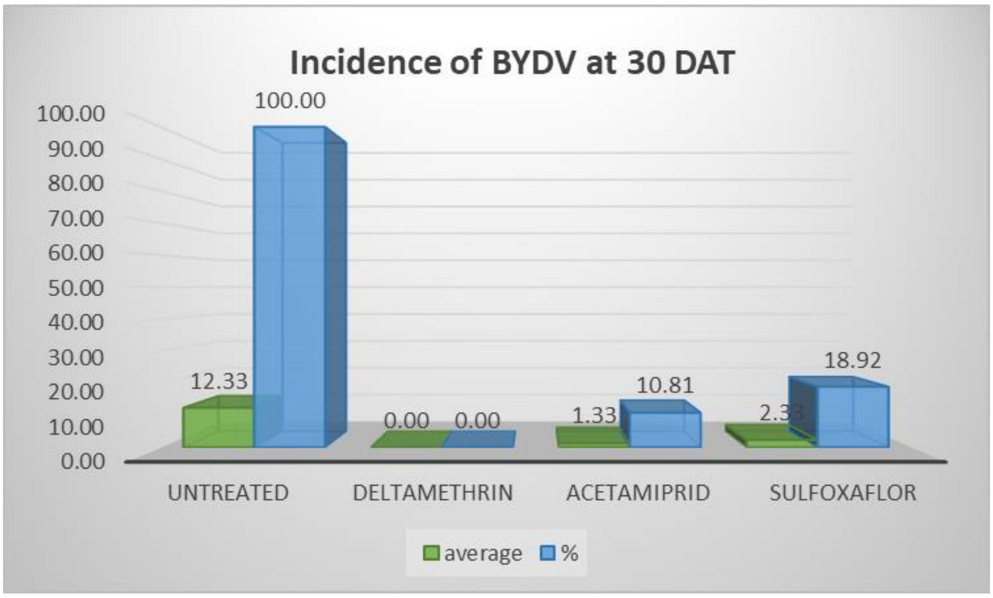

Fig. 5. Incidence of BYDV, on barley, at 30 days after treatments

CONCLUSIONS

• Among the aphid species that have the quality of "transmission vector" of BYDV, the most common species encountered were *Sitobion (Macrosiphon) avenae, Metopolophium dirhodum* and *Schizaphis graminum.*

• As *Sitobion avenae* was the best represented population, the data obtained from the observations refer only to it.

• Thus, at 7 DAT, the number of aphids, the larval and adult forms of development, was on average about 50 aphids on variants in the untreated control (TRT1), 0 aphids in the variant where deltamethrin was applied, 2.66 aphids in TRT3 (acetamiprid) and 4 aphids where sulfoxaflor insecticide (TRT4) was applied.

• At 14 days after the application of the treatments, a slight increase of the aphid populations was observed in plots, as an average per plot in the untreated control, 64 aphids were quantified (larvae and wingless/ winged adults). The best outcome is preserved in the case of the insecticide based on deltamethrin, where, in a single replicate, 2 aphids were registered (99% effectiveness).

• As a result of the application of insecticides and after data interpretation related to the symptoms attributed to BYDV, we can observe their correlation through the control of aphids-symptoms.

• As a percentage, the effectiveness of the treatments in respect of reducing the incidence of BYDV in the studied treatments, we can say that the best efficacy was attributed to the a.i. deltamethrin respectively 100%, followed by a.i. acetamiprid with 89% and 80% the a.i. sulfoxaflor.

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