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EFFICACY OF CITROMAZINC FOR THE BIOLOGICAL CONTROL OF THE *APHIS SPIRAECOLA* PATCH (*HEMIPTERA*: *APHIDIDAE*) ON APPLE TREES IN BULGARIA UNDER LABORATORY AND FIELD CONDITIONS

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Abstract

The invasive *Aphis spiraecola* Patch, which originated in Eastern Asia, recently became a common pest on apple in Bulgaria. The aim of the study was to determine the efficacy of the biological insecticide Citromazinc in concentrations of 0.15% and 0.3% under laboratory and field conditions, against the green citrus aphid (*Aphis spiraecola*) on apple. Citromazinc is a corrector of manganese and zinc deficiency, which are essential for the formation of chlorophyll. Manganese also acts as a catalyst in many enzymatic processes. Zinc acts as an activator of some important functions and participates in the formation of auxins and growth hormones. Citromazinc showed excellent biological efficacy against the green citrus aphid under laboratory conditions. In both applied concentrations (0.15% and 0.3%), the efficacy reached 100% on the 7th day after treatment. The effect of the product was also very good under field conditions. On the 7th day after treatment, the efficacy reached almost 100% in the higher concentration (0.3%) and 90% in the lower concentration (0.15%). The tested biological insecticide Citromazinc is suitable for the efficient control of the green citrus aphid in apple orchards, even at its lower applied concentration.

Keywords: Green citrus aphid, biological efficacy, insecticide, apple

INTRODUCTION

Aphids (Insecta: Hemiptera: Aphididae) worldwide number approximately 4700-5000 species (Remaudiire & Remaudiire, 1997; Blackman & Eastop, 2006). More than 120 species of aphids, enemies of agricultural crops, have been reported in Bulgaria (Grigorov et al., 2004). According to Angelova et al. (1996) they rank third among the pests of the apple. Aphids appear annually in apple orchards and are rightly considered one of the most damaging species, especially in wetter conditions. In years of mass reproduction, they can cause deformations, stunting, general exhaustion of plants and a significant reduction in yields, even on large fruit trees. Their harmful activity includes alsothe transmission of viral diseases (Grigorov, 1980).

The green citrus aphid *Aphis spiraecola* Patch probably originated in the Far East. Blackman and Eastop (2000) reported the species as present in North America at least since 1907, while introductions occurred in the Mediterranean region around 1939, Africa in 1961, Australia in 1926 and New Zealand in 1931. *Aphis spiraecola* invaded Southern Europe in the middle of the 20th century (Gómez-Menor, 1943; Barbagallo, 1966) and has been reported from Central and Northern European apple orchards since the 2000s (Thieme, 2002; Petrović-Obradović et al., 2009; Rakauskas et al., 2015; Borbély et al., 2020). *A. spiraecola* is now distributed in temperate and tropical regions of the world. (CABI, 2024). For

Bulgaria the species was first reported in 2007 by Andreev et al. (2007) on apple.

Main hosts are *Spiraea* spp. and *Citrus* spp. There are a large number of secondary hosts from over 20 botanical families, mostly Caprifoliaceae, Compositae, Rosaceae, Rubiaceae and Rutaceae (Blackman and Eastop, 2004; CABI, 2024).

The control of aphids in orchards in Bulgaria is usually carried out by repeated treatments with broad-spectrum systemic insecticides (BFSA, 2024), toxic to all beneficial insects in the agrocenosis, thus interfering with the natural regulation of other groups of pests, and leading to environmental pollution. In recent years, plant protection in Bulgaria has undergone significant changes related to the ban on several insecticides, which are highly toxic to bees and beneficial arthropods, and have long persistence. The farmers look for new products that meet modern requirements to replace those that are going out of use, especially organophosphorus insecticides and neonicotinoids. In the literature, there are a few papers on different alternative control methods for the aphids on apple. Several alternative plant protection products for the control of *Aphis spiraecola* were evaluated under field conditions in the region of Plovdiv (Central-South Bulgaria) (Andreev et al., 2012). The authors found that the botanical insecticides Neem Azal T/S (azadirachtin) and Pyretrum FS EC (pyrethrum) showed high efficacy against the rosy apple aphid but not against the green citrus aphid. The microbial insecticides Naturalis (*Beauveria bassiana*) and Preferal WG (*Paecilomyces fumosoroseus*) had a delayed initial effect. However, five to seven days after treatment, these pesticides showed a very good biological efficacy against *A. spiraecola* and excellent against *D. plantaginea*. In tests with an aphid on apple from the same genus (the green apple aphid *Aphis pomi* De Geer) Ganchev (2022) e found a strong contact insecticidal effect of the products Panamin and Panatop (Panamin suspension and Panatop Immuno Save) which have a high silicon content.

The aim of this study was to assess the efficacy of the botanical insecticide Citromazinc against the green citrus aphid *Aphis spiraecola* on apple under laboratory and field conditions.

a **b**

Figure 1. A colony of *Aphis spiraecola* - before treatment with Citromazinc 0.3% (a) and on the 5th day after treatment (b) under laboratory conditions

MATERIALS AND METHODS

The experiments were conducted under laboratory and field conditions at the Agricultural University-Plovdiv. Citromazinc is a manganese and zinc deficiency corrector, ideal for application to a number of crops. The special formulation of the product allows a more uniform distribution of the drops and a better adhesion of the products with which it is applied - increasing the efficiency and action of plant protection products and fertilizers.

Manganese and zinc are essential for the formation of chlorophyll. Manganese also acts as a catalyst in many enzymatic processes. Zinc acts as an activator of some important functions and participates in the formation of auxins and growth hormones.

The efficacy of Citromazinc, in two concentrations – 0.15% and 0.3%, against the green citrus aphid on apple was tested. The laboratory experiments were conducted at a temperature of 24°C and 75% relative humidity. Sufficient numbers of natural colonies with nymphs and wingless females of *Aphis spiraecola* were collected from infested apple (*Malus domestica*) trees. Leaves with aphids were placed in Petri dishes and wrapped with moist cotton and PARAFILM® M to keep them fresh for a long time. Treatment was carried out with a hand sprayer on selected, medium-sized colonies of the species in which individuals had been previously counted. The control was treated with water. Live individuals were counted on days 1, 3, 5 and 7 after treatment. All variants were run in 5 replicates, including the control. The test concentrations of the product were applied according to its registration for other pests as well. The biological efficacy was calculated according to the formula of Henderson & Tilton (1955).

The species was identified using microscope preparations of wingless adults. Preparations were prepared according to a modified method of Martin (1983). The modification is to use heated lactic acid to lighten the individuals (remove soft tissue) rather than KOH. Identification was made according to the identification keys of Blackman and Eastop (2004).

RESULTS AND DISCUSSION

Citromazinc showed excellent biological efficacy against the green citrus aphid *Aphis spiraecola* under laboratory conditions (Fig. 1). The effect of the product was better at its higher applied concentration (0.3%), where already on the 3rd day after treatment the efficacy reached 96.3% and 100% on the 5th day (Fig. 2). A very good effect was also found at the lower concentration (0.15%), although the action was slightly slower - 94.2% efficacy was reported on the 5th day and 100% efficacy on the 7th day after treatment. Product efficacy at both applied concentrations (0.15% and 0.3%) reached 100% on the 7th day.

The action of Citromazinc against the green citrus aphid *Aphis spiraecola* on apple under field conditions also was very good. At the higher concentration applied (0.3%), efficacy reached 95% on 5th day after treatment and almost 100% on the 7th day (Fig. 3). At the lower concentration (0.15%), the action is slightly slower - 90% efficacy on the 7th day after treatment.

According to Rasheva (2009), the green citrus aphid *A. spiraecola* has a high degree of resistance to the insecticides used to control aphids - organophosphorus, pyrethroids, and the species could only be controlled with neonicotinoids. However, after the ban on most products from this group, farmers faced difficulties in controlling this pest. The introduction of new effective insecticides can solve the problem and this was proved by the Citromazinc experiment, since in both applied concentrations of the product the efficacy reached 100% by the 7th day after treatment under laboratory conditions and over 90% under field conditions.

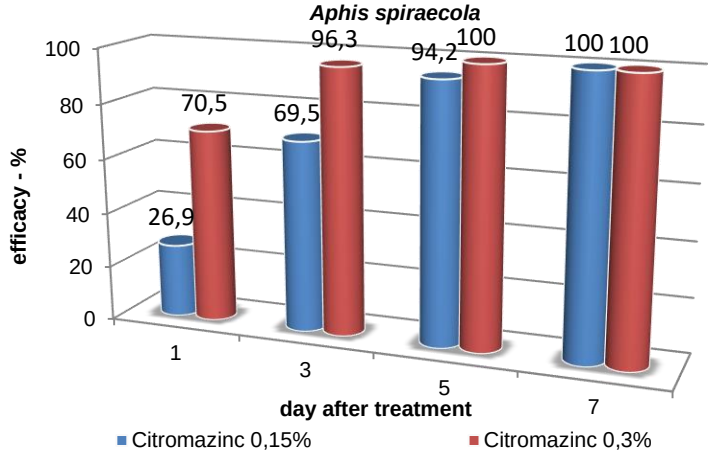

Figure 2. Efficacy of Citromazinc against *Aphis spiraecola* under laboratory conditions

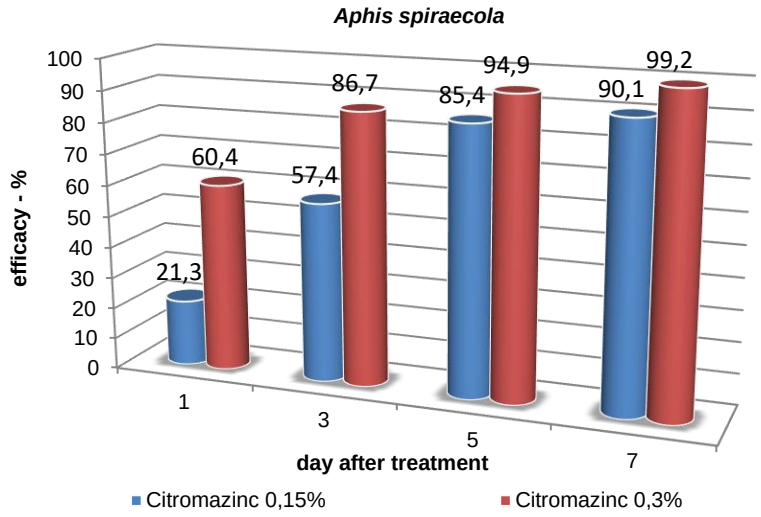

Figure 3. Efficacy of Citromazinc against *Aphis spiraecola* on apple at field conditions

CONCLUSION

The tested insecticide Citromazinc showed excellent biological efficacy against the green citrus aphid *Aphis spiraecola* on apple under laboratory conditions. In both applied concentrations of the product (0.15% and 0.3%), the efficacy reached 100% on the 7th day after treatment. The action of Citromazinc against the green citrus aphid *Aphis spiraecola* on apple under field conditions also was very good. On the 7th day after treatment, the efficacy reached almost 100% in the higher concentration (0.3%) and 90% in the lower concentration (0.15%). The biological insecticide Citromazinc is suitable for efficient control of the green citrus aphid *Aphis spiraecola* on apple, even at its lower applied concentration.

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