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BIOLOGICAL EFFICACY OF SELECTED INSECTICIDES FOR THE CONTROL OF THE GREEN APPLE APHID *APHIS POMI* (DE GEER, 1773) ON APPLE IN BULGARIA

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Abstract

The aim of this study was to evaluate the biological efficacy of chemical insecticides, from different chemical classes, recommended for the control of the apple aphid *Aphis pomi* in apple orchards in Bulgaria. The experiment was carried out in 2023 in the experimental field of Agricultural University-Plovdiv. The insecticides tested were spirotetramat (Movento 100 SC), flonikamid (Teppeki) and acetamiprid (Mospilan 20 SG). The insecticides were applied at the concentrations recommended for the control of this and other pests. All the tested chemical insecticides showed very high biological efficacy, therefore they can be recommended as suitable for efficient control of *Aphis pomi* on apple.

Keywords: Chemical insecticides, Movento, Teppeki, Mospilan, *Aphis pomi*, Apple, Bulgaria

INTRODUCTION

In the world, aphids (*Insecta: Hemiptera: Aphididae*) account for about 4700-5000 species (Remaudiire & Remaudiire, 1997; Blackman & Eastop, 2006). Aphids are considered important pests which threaten both the quality and quantity of the yield. The green apple aphid (*Aphis pomi* de Geer) (*Hemiptera*: *Aphididae*) is economically significant pest of apple (Malus Mill., Rosaceae) in the Pacific Northwest and wordwide (Lowery et al., 2006). The species is widespread in Europe, the Middle East, North America and New Zealand (Blackman and Eastop, 1985). *Aphis pomi* is one of the most important pests from the *Aphididae* family in Slovenia (Vrabl, 1999) as well as in other European countries (Yvon et al., 2000). The green apple aphis *Aphis pomi* is one of the most economically important aphid species in Serbian apple orchards (Dimić, 2000; Petrović-Obradović, 2003).

According to Popov (1971), Pelov (1977), and Grigorov (1980, 2004) the most important aphid species on apple in Bulgaria is the green apple aphid *Aphis pomi*. The aphid damages apple and other pome fruit species, including pear, quince and hawthorn. It is feeding also on host from the genera *Rosa*, *Spiraea*, *Cornus*, *Sorbus*, *Cotoneaste*r, *Chaenomeles* and Mespilus (Volkov et al., 1955; Brunt et al., 2005; Pfeiffer et al., 1995). The green apple aphid completes its life cycle on a single host species but according to Grigorov (1980) it is a migrating species. However, it is very likely that such reports were related to the presence of the green citrus aphid (*Aphis spiraecola*), which is very similar in morphology. The two species can very easily be misrecognized on apple and other common hosts (Blackman and Eastop, 1989, 2004; Brunt et al, 2005; CABI, 2023). The green apple aphid is feeding in dense colonies on the young shoots and undersides of leaves of apple. They do not cause severe deformations, but significantly slow down shoots growth. As a result of the damage, the chlorophyll is destroyed, photosynthesis rate decreases, the leaves turn yellow and fall off, and the shoots have a slow growth. Aphids excrete abundant

"honey dew" (Grigorov, 1980; Kaakeh et al, 1993; Pfeiffer et al, 1995).

For the control of this aphid and other aphids, different chemical insecticides are used in Bulgaria (BFSA, 2023). The aim of this study was to establish the efficacy of chemical insecticides, from different groups, which are recommended for the control of *Aphis pomi* on apple orchard in Bulgaria.

MATERIALS AND METHODS

The study was carried out in June 2023 with apple variety Pinova in an experimental apple orchard, , at the Agricultural University - Plovdiv. The biological efficacy of three insecticides from different chemical classes was tested - spirotetramat (Movento 100 SC), flonikamid (Teppeki) and acetamiprid (Mospilan 20 SG) (Table 1).

Table 1. List of the tested plant protection products for the control of *Aphis pomi* under field conditions

Active ingradient	Chemical class	Trade name	Concentration
spirotetramat	derivatives of tetramic acid	Movento 100 SC	0.075% and 0.12%
flonicamid	pyridinecarboxamide	Teppeki 50 WG	0.01% and 0.015%
acetamiprid	neonicotinoid	Mospilan 20 SG	0.025%

Spirotetramat (Movento 100 SC) is a systemic insecticide from a new group - derivatives of tetramic acid, which move both acro and basipetal in the treated plants. It is intended for foliar treatment against a wide range of sucking insects. Due to its systemic effect, it can compensate for small patches in the treatment. The product inhibits the synthesis of lipids, which is why it acts mainly during the juvenile stages of the pests and does not have a knockdown effect. On the other hand, it has a very long aftereffect. Movento 100 SC does not have cross-resistance with pyrethroids and nicotinoids and can successfully control populations of aphids, whiteflies and scale lice resistant to these active substances.

Flonikamid (Teppeki 50 WG) is a systemic pyridine insecticide with contact and stomach action, which also penetrates in the treated plants with a translaminar and acropetal movement in the plant. The product is an antifeedant - a neuroinhibitor of feeding activity. It causes spontaneous peristalsis of the digestive tract and makes feeding impossible. It is suitable for insects with piercing-sucking mouthparts. In Bulgaria, it it well-known, but it is not officially registered for the control of aphids on fruit crops.

Acetamiprid (Mospilan 20 SG) is a neonicotinic (chlornicotinyl) insecticide from the group of nitromethylenes. It has translaminar and systemic (mostly acropetal) movement in plants. It penetrates into the body of insects by contact and ingestion. Acetamiprid is a nicotinic agonist that reacts with nicotinic acetylcholine receptors (nACh-R). The activation of the nACh-R receptors causes hyperactivity, muscle spasms, and death. Acetamiprid is highly toxic to insects, but less to mammals. This is the newest insecticide from the group of neonicotinoids, authorized for use in Bulgaria. It is widely used to control insects with piercing-sucking mouthparts in a wide range of agricultural crops, including the test aphid species with an application dose of 250 g/ha (0.025%), therefore it was chosen as an etalon.

The species *Aphis pomi* was confirmed using the identification keys of Blackman and Eastop (2004). The treatment was carried out by spraying directly on medium-sized colonies of the aphid (Figure 1), in which individuals were previously counted with tested concentrations of the selected chemical insecticides and the control was treated with water. Each variant was comprised of 5 replicates. The number of surviving individuals was recorded on the 1st, 3rd, 5th, and 7th day after the treatment. The

biological efficacy was calculated using the formula of Henderson & Tilton (1955).

Figure 1. Colonies of green apple aphids *Aphis pomi*

RESULTS AND DISCUSSION

The product with active substance spirotetramat (Movento 100 SK) showed excellent activity against *Aphis pomi* (Figure 2). At the higher concentration (0.12%), the efficacy reached 99.8% on the first day after treatment, and 100% on the 3rd day. At the lower concentration (0.075%) – 100% mortality was recorded on the fifth day (Figure 3). The product with the active ingredient flonikamid (Teppeki 50 WG) also showed a very good effect. At the higher concentration (0.015%), the efficacy measured one day after treatment was 98.5% and reached 100% on the 3rd day. At the lower concentration (0.01%), the efficacy diminished and reached 100% on the 5th day after treatment. The product with active ingradient acetamiprid (Mospilan), which was used as an etalon also showed a very good effect against green apple aphid, and on the 7th day after treatment, the efficacy reached 100%.

Fig. 2. The green apple aphids one day after treatment with Movento SK (spirotetramat)

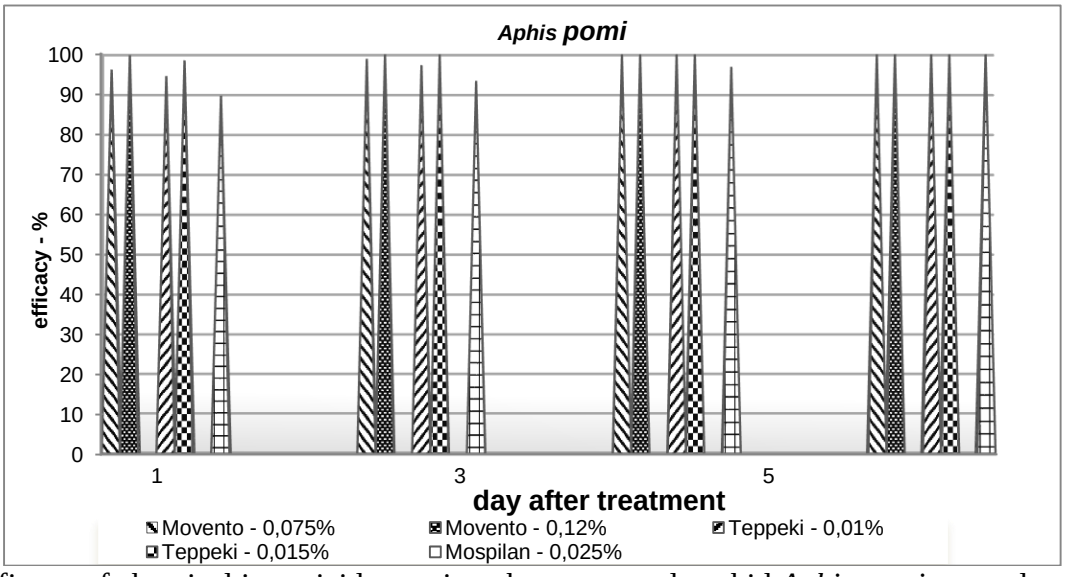

Fig. 3. Efficacy of chemical insecticides against the green apple aphid *Aphis pomi* on apple under field conditions

Tamaš el al. (2012) reported similar results from the field trials in the Radmilovac and Bela Crkva sites, Serbia, which showed high efficacy of acetamiprid (Mospilan) – 92.8-100% in controlling *Aphis pomi*.

The results on the effect of various treatments on population of green apple aphid revealed Spirotetramat (Movento) 15.31% OD @0.024% and Fipronil 5% SC @0.008% resulted in highest mean percent reduction of 85.10% and 80.38% respectively which were statistically at par. Spirotetramat 15.31% OD @0.024% recorded highest increase in qualitative yield of apple (44.18%) over control (Jan, 2023).

CONCLUSION

1. The tested chemical insecticides have very high biological efficacy against *Aphis pomi*. Of these, Movento 100 SC (spirotetramat) in a concentration of 0.12%, reached 100% efficacy on the 3rd day after treatment.
2. The product Teppeki (flonikamid) in its higher concentration 0.015% also reached 100% efficacy on the 3rd day after treatment.
3. In the widely distributed Mospilan 20 SG (acetamiprid), 100% efficacy was found on the 7th day after treatment.
4. All tested chemical insecticides are suitable for efficient control of the green apple aphid *Aphis pomi* on apple, even at their lowest recommended concentration.

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REFERENCES

BFSA (Bulgarian Food and Safety Agency) (2023). *List of plant protection products and fertilizers authorized for marketing and use in the Republic of Bulgaria*. Videnov & Son.

Blackman, R. L., & Eastop, V. F. (1985). *Aphids on the world’s crops: An identification and information guide*, John Wiley & Sons.

Blackman, R. L., & Eastop, V. F. (1989). *Aphids on the World's Crops*. An Identification and Information Guide.John Wiley.

Blackman, R., & Eastop, V. (2004). *Aphids on the world's crops*. An identification and information guide. John Wiley.

Blackman, R., & Eastop V. (2006). *Aphids on the World’s Herbaceous Plants and Shrubs*.

Brunt, J., K. Becker, L. Charles, L. McGillivray, C. Beverley, H. Crowson, G. Fyson, N. Pasiecznik, Ch. Davies, L. Iles, L. King, Ch. Millard, P. Scott, A. Butler, Ch. Schotman (2005). Crop Protection Compendium. (CD edition), CAB International.

CAB International. (2023). *Crop Protection Compendium*. CAB International. https://www.cabicompendium.org/cpc .

Dimić, N. (2000). The most frequent apple antofags in our country. *Plant doctor*. 28(6), 492- 504.

Grigorov, S. (1980). Listni vashki i borbata s tyah *[Aphids and the fight against them]*.. Zemizdat. [In Bulgarian]

Grigorov, S., Tashev, D., Grigorov, P. (2004). Listni vashki (*Aphidoidea: Homoptera*) ot Balgaria i borbata s tyah *[Aphids (Aphidoidea: Homoptera) from Bulgaria and the fight against them]*. Akademichno izdatelstvo AU, Plovdiv [Academic Publishing House of the Agricultural University -Plovdiv]. [In Bulgarian].

Henderson, C. F., & Tilton, E. W. (1955). Tests with acaricides against the brow wheat mite, *Journal of Economic Entomology*, 48, 157-161.

Jan, Y. (2023). *Bio-efficacy of Newer Insecticides against Major Pests of Apple (Malus domestica Borkh.) in Kashmir*. Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir.

Kaakeh, W., Pfeiffer, D. G. , & Marini, R.P. (1993). Effect of *Aphis spiraecola* and *A. pomi* (*Homoptera*: *Aphididae*) on the growth of young apple trees. *Crop Protection*, 12(2), 141-147.

Lowery, D. T., Smirle, M. J., Foottit, R. G., &Beers, E.H. (2006). Susceptibilities of apple aphid and spirea aphid collected from apple in the Pacific Northwest to selected insecticides. *Journal of Economic Entomology*, 99(4), 1369–1374

Pelov, V. (1977). Listni vashki po yabalkata i lyucernata i tehnite estestveni vragove [Apple and alfalfa aphids and their natural enemies.]. *Rastitelna zashtita [Plant protection]*. 25(2), 3-6. [In Bulgarian]

Petrović-Obradović, O. (2003). Plant aphids (*Homoptera*: *Aphididae*) of Serbia. University of Belgrade, Faculty of Agriculture. 1-153.

Popov, V., Grigorov, S., Makarov, M., Burov, D. (1971). *Opredelitel na vrednite nasekomi po kulturnite rasteniya [Determinant of harmful insects on cultivated plants]*. Zemizdat. [In Bulgarian]

Pfeiffer, D.G., Hull, L.A. Biddinger, D.J., Killian, J.C. (1995). *Mid-Atlantic Orchard Monitoring Guide*, NRAES, 4853-5701

Remaudиre, G. & Remaudиre, M. (1997). *Catalogue des Aphididae du monde — Catalogue of the world's Aphididae [Homoptera, Aphidoidea]*.INRA Paris, .

Tamaš, N., Miletić, N., Elezović., I. (2012). Efikasnost insekticida različitih mehanizama delovanja u suzbijanju zelene vaši jabuke (*Aphis pomi* De Geer) na jabuci. Biljni Lekar, 40 (6), 489-4980.

Volkov, S., Zimin, L., Rudenko, D., Tupenevich, S. (1955). *Albom vrediteley i bolezney selskohozyaystvenih kultur*. GISL. [In Russian]

Yvon, R., Woodford, T. A. T., & Ducray-Bourdin, D. G. (2000). Some epidemiological approaches to the control of aphidbourne virus diseases in seed potato crops in northern Europe. *Virus Res*. 71, 33-47.

Vrabl, S. (1999). Posebna entomologija: škodljivci in koristne sadne vrste na sadnem drevju in vinski trti. Maribor, *Fakulteta za kmetijstvo*, 1-172.