THE INFLUENCE OF BIOPREPARATIONS AGAINST *MYZUS PERSICAE* SPECIES (SULZER) IN THE POTATO AGROECOSYSTEM

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Abstract. *Pests are a major pressure on the quantity and quality of potato plants. In potato culture, apart from the most damaging disease, downy mildew, the most important pests are aphids because of the large number of viruses they transmit. The green peach aphid (Myzus persicae) is a threat to potatoes being able to cause serious injury (directly by depriving the plant of essential nutrients), vectors of viruses (potato virus Y, cucumber mosaic virus and PVY) and develop easily resistant races to insecticides. Control of Myzus persicae is necessary to achieve optimal potato production. The purpose of the study was to test the effectiveness of some bioinsecticides in the control of green peach aphid. The trial was located near Belinț (Timiş county). Bioinsecticides used to control the green peach aphid were: Kabon, Bitoxybacilin, Konia K Plus. The assessments of the products effectiveness was established at: 24 hours, 5 days, 10 days. At the time of applying the biological treatments, the population density of Myzus persicae was 52 - 86 individuals/10 potato plants. The bioinsecticide Konia K Plus had the highest effectiveness in reducing the population of Myzus persicae (in all three assessments determining positive differences related to the mean). The lowest mortality of the peach green aphid, in potato crop, was achieved in the variant treated with Kabon.*

Keywords*: Myzus persicae, control, biopreparations, potato, efficacy*

INTRODUCTION

The potato originates from South America, from the Andes Mountains region (https://ro.wikipedia.org/wiki/Cartof). Potato culture occupies the largest areas in Asia, Europe and Africa. In Romania, the potato has been cultivated in recent years on an area between 170.1 thousand ha (INS, 2020) and 75 thousand ha (INS 2023), the average production varying between 15.2 and 11.87 t/ha. The potato is one of the most important food crops in the world (DEVAUX A. et al., 2014; XU J. et al., 2019). Potato production is threatened by various groups of pathogens and pests (CĂRĂBEȚ A. et al., 2008; DE VRIEZE M., 2020). *Myzus persicae* is one of the pests present in potato agroecosystems, it is considered as one of the most destructive aphid globally, causing losses between 10% and 80% in the crops where it is present (JAMIN Ali., 2023; Boiu-Sicuia et al., 2017).

Myzus persicae is a polyphagous, cosmopolitan pest with a global distribution, predominantly in North America, Europe and Asia *(*ALI J. et al., 2021; ALI J. et al., 2023).

The green peach aphid, *Myzus persicae* (Sulzer), is a major threat to crops due to its ability to adapt to a wide range of plant species (NIKOLAKAKIS N.N. et al., 2003) and easily develop resistance to insecticides. In addition to being a significant plant pest, the peach green aphid also serves as a vector for potyviruses, resulting in significant yield losses (LIU J. et al., 2019; BERA S. et al., 2022). Transmission of viruses occurs at the time of feeding. *Myzus persicae* transmits potato virus Y, cucumber mosaic virus and PVY in a non-persistent manner, thus making management of the species a major concern (LIU J. et al., 2019; BERA S. et al., 2022). *Myzus persicae* produces both direct and indirect damage, for example, directly - by sucking sap from the phloem, and the honeydew produced can indirectly affect photosynthetic and respiratory functions, favoring the development of pathogens (GOGGIN F.L., 2007; RODRIGUEZ-SAONA et al., 2010).

Studies to date show that the population of Myzus persicae can be managed using chemical, biological and cultural methods (LONDON et al., 2020).

Among the methods listed, the use of chemical products is the most widely used due to their availability, effectiveness and ease of use (LONDON et al., 2020). Studies to date show that synthetic insecticides containing active ingredients such as pyrethroids, carbamates, organophosphates and neonicotinoids have a strong negative effect on a number of phytophagous insects, including *Myzus persicae* (LI et al., 2016; NAMPEERA, 2022).

As a result, a wide variety of synthetic insecticides are constantly used to control potato aphids; however, the associated risks have become a major concern and synthetic insecticides need to be replaced by biopesticides as environmentally beneficial strategies (NDERITU et al., 2009).

Biological control can be an alternative to chemical control approaches (BARRATT et al., 2018), involving a number of living organisms belonging to different kingdoms and phylum, microorganisms (fungi, bacteria and viruses), nematodes and insects (parasitoids and predators) including potassium salts of fatty acids (insecticidal soaps) (CIANCIO et al., 2010; CHIRILOAIE-PALADE et al., 2020; MANOLE et al, 2001). Potassium salts of fatty acids act only in direct contact with the pest, washing away the protective layer on the surface of the insect and penetrating the cell membrane, causing disruption of its permeability and dehydration of the insect (MOHAMAD et al., 2013). Potassium salts of fatty acids are effective against most soft-bodied pests and have been used successfully in aphid management with very good efficacy (DHEERAJ et al., 2013; WAFULA et al., 2017).

This study was conducted to determine the efficacy of potassium salts of fatty acids (*Kabon, Konia K Plus*) and the bacterium *Bacillus thuringiensis* (*Bitoxybacilin*) in the management of the potato aphid *Myzus persicae*.

MATERIAL AND METHODS

The experiment, regarding the biological control of the species Myzus persicae, was carried out in the field of a farmer near Belinț (figure 1), Timiș county (in Western Romania).

Figure 1. Aspects of the trial setup and location
(https://www.google.com/maps/@45.7533826,21.7745081,370m/data=!3m1!1e3)

The variety used in the experiment was Condor, an early variety. The experience regarding combating the *Myzus persicae* species consists in four variants laid out according to the randomized block method, in three replicates, the harvestable area/plot having 30 m^2.

The experimental variants differed by the bioinsecticide applied. Bioinsecticides were applied when 20% of the plants closed the row (BBCH 32-33). The assessments regarding the effectiveness of biopreparations, trough determination of larvae number (nymphs) and adults,

were performed 24 hours after application, 5 days after application and 10 days after application, respectively. The assessments regarding the population density of *Myzus persicae* were performed on 10 plants/variant.

In order to reduce the population of *Myzus persicae*, from the potato crop, bioinsecticides were applied: Kabon, Bitoxybacilin and Konia K Plus (table 1).

Table 1.

Detailing experimental variants

Variant	Commercial product	Active substance	Dose (l/ha)
Variant 1	Untreated	-	-
Variant 2	KABON	50% potassium salt from vegetable oil extract	0,900
Variant 3	BITOXYBACILIN	*Bacillus thuringiensis* $1{,}0x10^{9}$ CFU/cm^3	1.0
Variant 4	KONIA K PLUS	Fat acids potassium salt	0,900

Insecticide efficacy was determined using the Abbott calculation formula:

$$\text{Abbott}\,\% = \left(1 - \frac{n\,in\,T}{n\,in\,C}\right) x\ 100$$

where: n - insect population; T- treated variant; C- untreated (control)

RESULTS AND DISCUSSIONS

Figure 2 shows the population density of *Myzus persicae*, in all four experimental variants, treated with bioinsecticides. The maximum population was recorded in the untreated variant (201 sum of aphids/10 plants/3 assessments), whilst the variant treated with Konia K Plus presented the lowest density (58 sum of aphids/10 plants/3 assessments). 24 hours after applying the treatments, the population abundance of *Myzus persicae*, present in the experimental variants, was 113 individuals/10 plants, after 5 days - 132 individuals/10 plants, and after 10 days 158 individuals/10 plants. Similar population levels were recorded in the variants treated with Kabon and Bitoxibacillin.

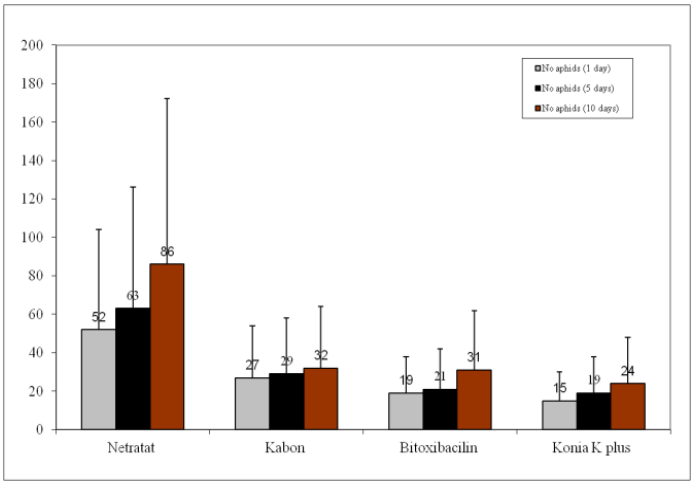

Figure 2 Population density of *Myzus persicae* recorded in variants cultivated with potato

The evolution of the population of *Myzus persicae* nymphs showed variations depending on the treatment (15-52 individuals/10 plants). The highest number of nymphs was recorded in the untreated control, with highly significant differences compared to the three

treatments (DL5% = 5.29; DL1% = 8.02; DL0.1% = 12.88). Distinctly significant differences were found when comparing the efficacy of the potassium salts (Konia K Plus) treatment with the mean efficacy of the treatments (DL5% = 5.25; DL1% = 7.95; DL0.1% = 12.77). Intermediate values (63%), regarding the efficacy of bioinsecticides, were recorded in the variants treated with the product based on *Bacillus thuringiensis* (Bitoxibacilin), these being insignificant compared to the experience average (60.67%) (figure 2). Treatment with Kabon 0.9 l/ha reduced the population of *Myzus persicae* by 48%, the difference being distinctly significant compared to the control (mean of experience).

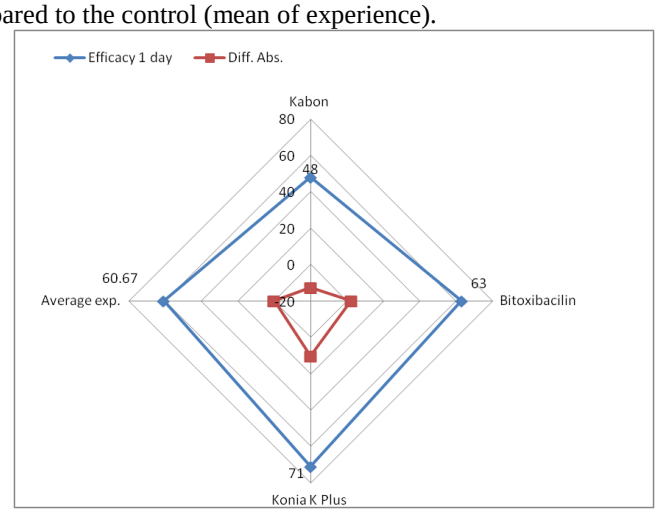

Figure 2. Statistical results of Myzus persicae aphid mortality percentages 24 hours after treatment for all products tested in the experimental field

Five days after the biological treatments were applied, the II evaluation was conducted. It showed that the potato crop was protected by 54–70% and that all treatments had a significant impact on the aphid population when compared to the untreated control. (DL5% = 4.12; DL1% = 6.24; DL0.1% = 10.03).

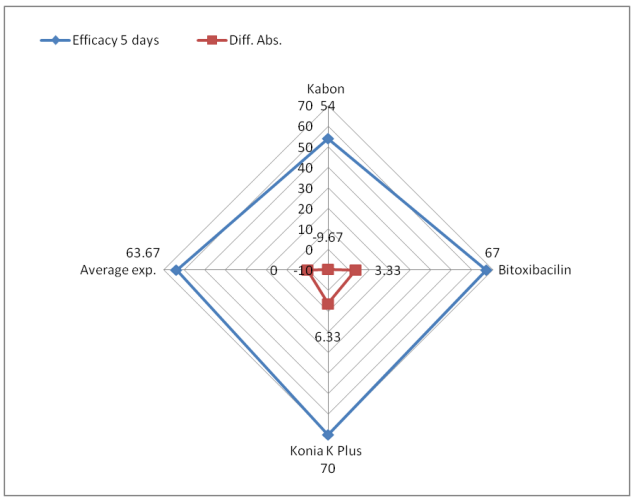

Figure 3. Statistical results of the mortality percentages of the *Myzus persicae* aphid 5 days after applying the treatments in the experimental field

When compared to the experience average, potassium salts of fatty acids from the Konia K Plus 0.9 l/ha product showed the highest difference (+6.33), with very positive results (figure 3). The second product, Kabon 0.9 l/ha, which is based on potassium salts, is at the opposite pole and caused 54% mortality in the population of *Myzus persicae*, the recorded difference (-9.67) was highly significantly negative (Figure 3).

The product Bitoxibacilin 1.0 l/ha, based on *Bacillus thuringiensis* 1.0x10 ^{9} CFU/cm^{3}, reduced the population density of *Myzus persicae* by 63%, the results being distinctly significantly positive compared to the control (mean of experience) (DL5% = 2.82; DL1% = 4.28; DL0.1% = 6.88).

At the III evaluation, the effectiveness of bioinsecticides in controlling aphids ranged from 55 to 66%; all treatments demonstrated statistically significant positive differences when compared to the untreated control. (DL5% = 3.41; DL1% = 5.17; DL0.1% = 8.31).

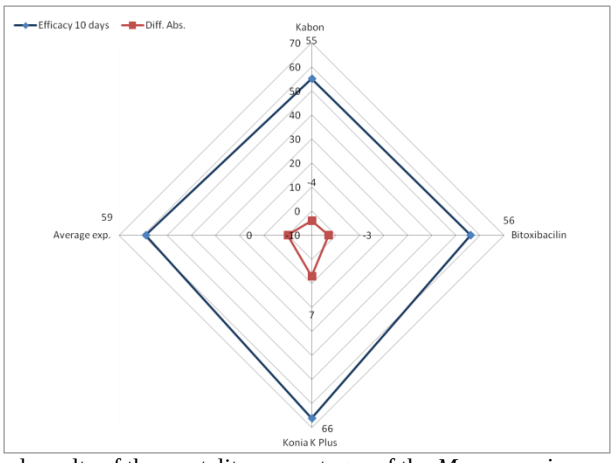

Figure 4. Statistical results of the mortality percentages of the *Myzus persicae* aphid 10 days after applying the treatments in the experimental field

The potato crop was most effectively protected against aphids by the Konia K Plus bioinsecticide at 10 days after application (Figure 4), with a 7 percent difference that was significantly better than the average of the experience.

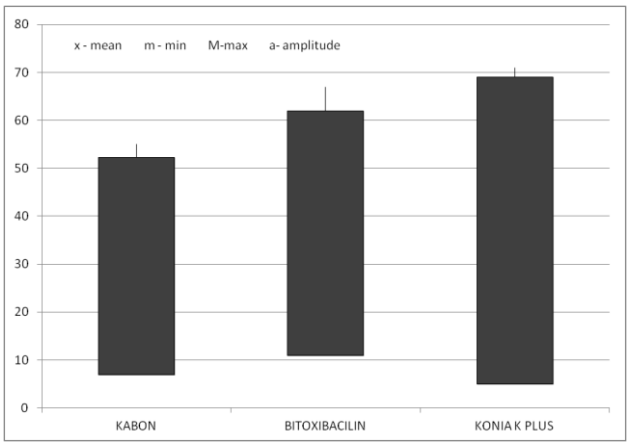

Figure 5. Amplitude of biological insecticides in the control of *Myzus persicae* species in the potato crop

There were no statistically significant variations from the average (59) according to the control percentage of 56% observed in the variants where the product based on *Bacillus thuringiensis* 1.0x10 ^{9} CFU/cm^{3} was applied.

The population of *Myzus persicae* experienced a 55% mortality rate after applying the bioinsecticide Kabon at a dose of 0.9 l/ha; the recorded difference (-4%) from the average was statistically significant (Figure 4). The population of *Myzus persicae* was reduced by potassium salts (found in Kabon and Konia K Plus products) by an average of 60.67%. These results are in line with research done by WAFULA et al. (2017), MOHAMAD et al. (2013), DHEERAJ et al. (2013), LIU et al. (2000), CIANCIO et al. (2010), HOLLINGSWORTH (2005), and VAVRINA et al. (1995).

The mortality of the *Myzus persicae species* in variant 2, treated with Kabon 0.9 l/ha, ranged from 48 to 55%. The highest efficacy was observed 10 days post-application (figures 5).

Applying the product Bitoxibacillin in variant 3, the crop of potatoes was protected in a proportion of 56–67% from the attacks of the *Myzus persicae* species, the maximum protection was observed 5 days after application (figures 5).

The control of the species in variant 4, where the Konia K Plus product was applied, was 66-71%, with the maximum value being recorded 24 hours after application (figures 5).

CONCLUSIONS

Comparing treatments with the bioinsecticides Kabon, Bitoxibacillin, and Konia K Plus to the untreated control, the population of *Myzus persicae* was significantly reduced.

Ten days following application, the bioinsecticides Bitoxibacilin and Konia K Plus lost some of their efficacy.

The bioinsecticide Konia K Plus was most successful in lowering the *Myzus persicae* population (in all three evaluations where positive differences from the mean were found).

The lowest mortality of the peach green aphid, in the potato crop, was achieved in the variant treated with Kabon.

The product based on *Bacillus thuringiensis* 1.0x10 ^{9} CFU/cm^{3} ranked between the two products based on potassium salts.

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