MICROBIAL BIOINSECTICIDES AND THEIR EFFECTIVENESS IN CORN PEST CONTROL

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Abstract. *Microbial biopesticides are considered natural elements of biological nature often used to control pests in various agroecosystems. In the present work, we proposed to test some biopesticides to see if they are effective in controlling relevant pests in organically grown corn. Among the frequent pests as target organisms, we considered aphids, chrysomelid (leaf) beetles and lepidopteran larvae. It is known that chemical products cannot be applied in an organic system, that's why we focused on 2 biopesticides (B1-Spinosad and B2-Bactospeine) in use and available on the European market. Thus, in 3 repetitions consisting of different doses, we did tests directly in the field using special cages. I made the observations periodically on 3, 5, 7, 9 and 11 days from July-August, during the year 2022, in a corn crop in Arad County (in western Romania). The effectiveness results were interpreted by the survival rate of the larvae and by the mortality rate. It turned out that both B1 as well as B2 are effective in higher doses. The low survival rate of the targeted pests automatically meant a high mortality rate and vice versa. The efficacy data by the mortality rate were varied depending on the category of pests (64.47%/B1 and 45.56%/B2 for lepidopteran larvae, 40.06%/B1 and 31.12/B2 for chrysomelids and 36.89%/B1 and 45.33% /B2 in aphids). It is clear that where the mortality rate was higher it is the ideal option to be included in the pest control strategy in the maize crop. Of course, a single application is not enough, that's why we recommend a double treatment at an interval of 10-14 days.*

Keywords*: microbial biopesticides, pests, corn, field, bioefficacy.*

INTRODUCTION

Biopesticides have started to replace pesticides for some time in more and more agricultural areas and farmers choose to use the organic system of crops (GUNNAR ET AL., 2011; RAJKOVIĆ, 2021). On the one hand, to protect the environment and for health. Positive perspectives of the increase in the replacement rate of synthetic pesticides were made already 10 years ago through the estimates made by MARRONE (2014). However, the production remains debatable (DAMALAS AND KOUTROUBAS, 2018).

Comparing synthetic and microbial pesticides, the latter are specific, without residual effects, durable and can be obtained easily (MODUPE ET AL., 2023).

To give a definition of biopesticides, we focused on the most complex and recent one. In this sense, KUMAR ET AL. (2021) mention that biopesticides are control agents composed of microorganisms (such as bacteria, cyanobacteria, microalgae, plant-based compounds) useful in keeping under control different pests in agroecosystems.

In organic corn crops, the research in the west of the country carried out during 2020-2022 showed the frequency of several pests, such as: *Diabrotica virgifera, Oulema melanopus, Phyllotreta vittula, Tanymechus dilaticollis, Opatrum sabulosum, Agriotes sp., Chaetocnema tibialis, Rhopalosiphum maidis, Rhopalosiphum padi, Metcalfa pruinosa, Nezara viridula, Ostrinia nubilalis, Helicoverpa armigera* and *Agrotis sp*. (COSTEA AND GROZEA, 2022).

Most approaches to combat corn pests are focused on chemical insecticides (insecticides) and less on biopesticides (FLORIAN ET AL, 2013). There are other non-chemical alternatives that have been put into practice by specialists in experimental plots or by farmers in the western part of Romania. More precisely, it is the use of colored or pheromonal traps with a fairly good effect or the exploitation of natural enemies (PALAGESIU ET AL., 2001; GROZEA, 2010; GROZEA AND COSTEA, 2022).

Spinosad is among the biopesticides recommended at the international level, as an effective control agent, with a wide use and application on the ground or in the air (ZUKOFF SI COL., 2022). This biopesticide, Spinosad (Laser) (spinosyn A + spinosyn D) is composed of soil bacteria (*Saccharopolyspora spinosa*) and obtained from fermentation (MERTZ AND YAO, 1990). It has proven to be effective against a wide range of pests including to coleopteran, lepidopteran, thrips, dipterans, hymenopteran and orthopterans (Sparks et al. 1995).

Other organic products commonly used today are based on *Bacillus thuringiensis* (B.t.) (SALAMA ET AL., 1993). According to LUTHY ET AL. (1982) this was the first bacterium used in a commercial insecticide such as Bactospeine, Biobit, Thuringin, Dipel, Foray and others.

Bio efficacy is different from pest to pest and depending on the biopesticide (microbial or based on plant extracts). The best results were obtained especially against aphids (ALAM ET AL., 2019).

With all this in mind, we proposed that in the present work we would test the effectiveness of 2 common but less tested bioinsecticides on corn for aphids, chrysomelids and lepidopteran larvae.

MATERIAL AND METHODS

The place of study

The test researches were carried out during 2022, between July and August, in an organic corn crop in the western part of Romania. The culture was managed by the company MDF Agro SRL from Sicula locality, Arad County.

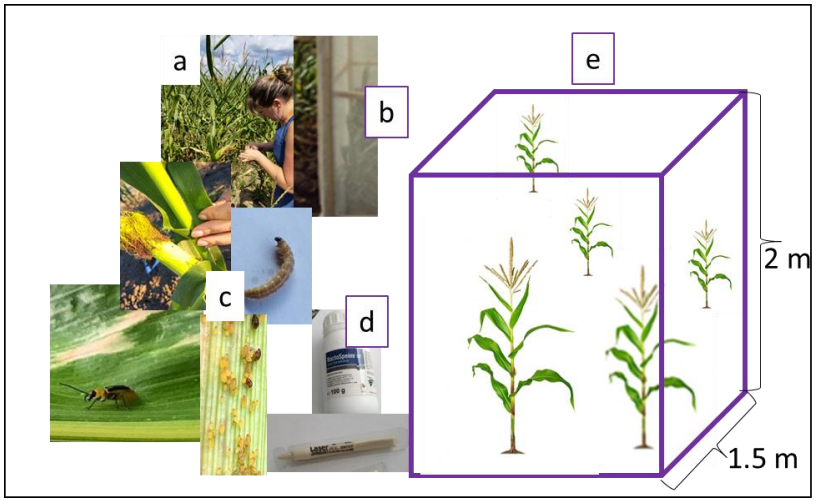


Figure 1. Materials used in the study: a, the experimental field from which the insects were collected; b, field cage; c, targeted pests (chrysomelids, lepidopteran larvae, aphids); d, microbial biopesticides; field cage diagram

Used products

In order to test the effectiveness, we used 2 biopesticides, namely B1-Laser 240 SC (s.a. Spinosad) and B2-Bactospeine (based on *Bacillus thuringiensis* k.) (Table 1) considering that they are available on the Romanian and European markets.

Table 1

Characteristics of the products (bioinsecticides) used

Products	Formuation	Proposed doses s.a./ha (mL/mg)*	Doses	Code	Company/trader
Spinosad (B1)	Concentrated suspension (SC)	75 (mL)/ha	D1	B1D1	Dow AgroSciences (producer)
		150 (mL)/ha	D2	B1D2	
		250 mL/ha	D3	B1D3	
Bactospeine (B2)	Granules dispersed in water (WG)	600 mg/ha	D1	B2D1	Nufarm (trader)
		750 mg/ha	D2	B2D2	
		800 mg/ha	D3	B2D3	

*dilution depending on the concentration, in 600-1000 l of water

Methodology

We used 3 field cages with 5 corn plants each (Figure 1), constituting 1 different dose (concentrations) for each product and 1 cage for the Control version. Observations on the effectiveness were made at intervals of 3, 5, 7, 9 and 11 days. The results expressed in live individuals (pests) and their mortality rate were interpreted statistically by comparisons between the treated variants and also with the Control variant.

RESULTS AND DISCUSSIONS

The efficiency expressed by the number of larvae (*Ostrinia n.*) alive, at different intervals, after the application of the biopesticide Spinosad shows that out of the total of 30 larvae, the most were in the B1D1 variant (at the lowest dose), and the fewest in the variant B1D3 (at the highest dose). The same trend was recorded after the application of the biological product Bactospeine (Figure 2). In the case of Spinosad D2 and D3, the efficiency started to be visible on the 5th day after application, when the number of live larvae dropped below 50% (8-15 live larvae). In case of Bactospeine D3, the efficiency was observed only on the 9th day after application (14 live larvae).

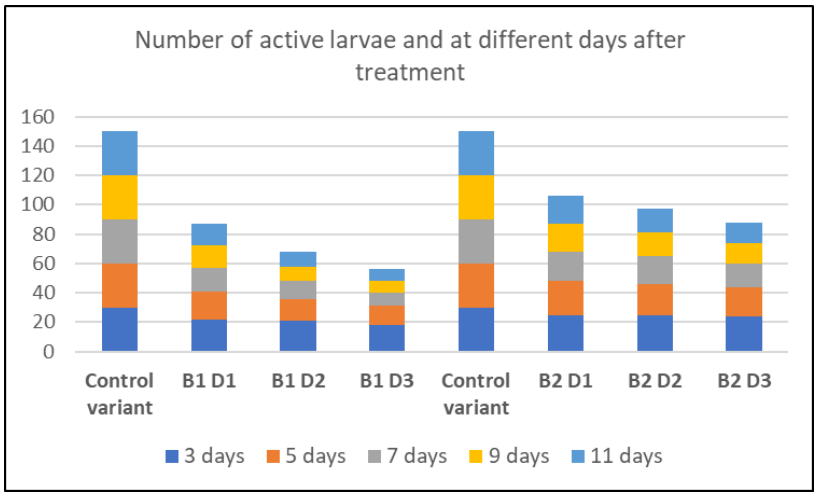


Figure 2. Effectiveness of treatments (in corn field) by number of active larvae of *Ostrinia nubilalis* at different time intervals after treatments with bioinsecticides

The Figure 3 shows the efficiency of biopesticides expressed by living adult chrysomelids. Thus, in variant B1 (Spinosad), regardless of the dose used (D1, D2, D3) and the interval considered (even after 11 days), the number of beetles alive was high, 17-20 ad. Likewise in the version with B2 (Bactospeine), where the chrysomelids were even more (20-22 ad.).

The fewest active aphids (20-24) out of 50 initially introduced and treated with Spinosad, were observed at 9-11 days in the variants with higher doses (D2, D3) (Figure 4). In the variants with Bactospeine, at all doses, the situation was a little different, even after 11 days from the application, the number of active larvae did not drop below 50%, they being still at high values (26-27 aphids).

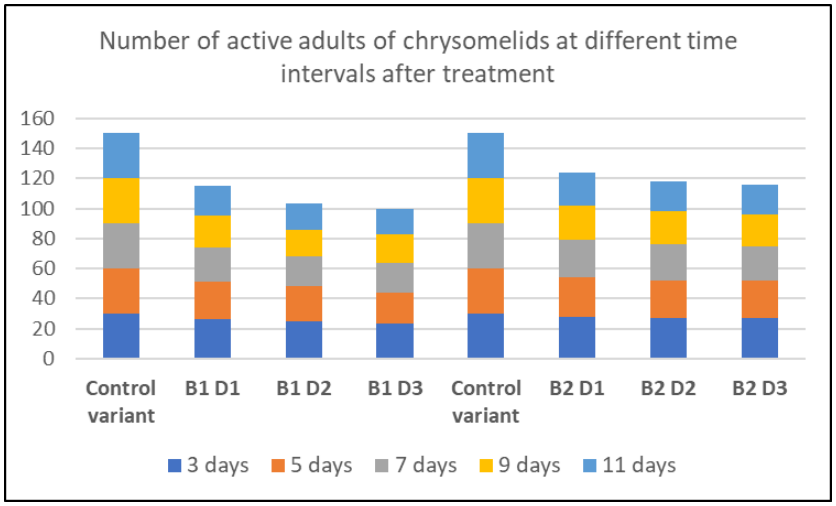


Figure 3. Effectiveness of treatments (in corn field) by number of active adults of *chrysomelids* at different time intervals after treatments with bioinsecticides

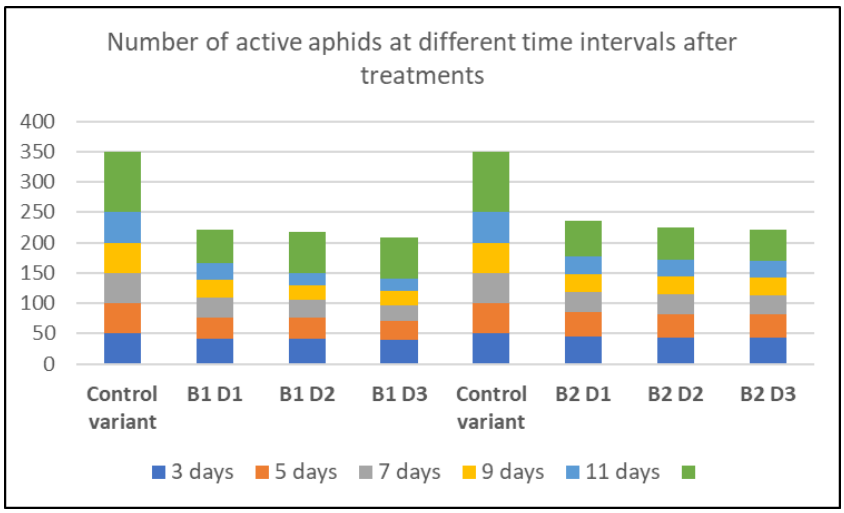


Figure 4. Effectiveness of treatments (in corn field) by number of active *aphids* at different time intervals after treatments with bioinsecticides

Table 2

The percentage of survival and the mortality rate among the larvae of *Ostrinia n.*

Variant	Analyzed young larvae (number)	The percentage of live larvae after treatment	Mortality percentage
Control variant	30	100	-
B1 D1	30	50	50
B1 D2	30	30	70
B1 D3	30	26.66	73.34
Average/B1		35.55	64.47
Control variant	30	100	-
B2 D1	30	63.33	36.67
B2 D2	30	53.33	46.67
B2 D3	30	46.66	53.34
Average/B2		54.4	45.56

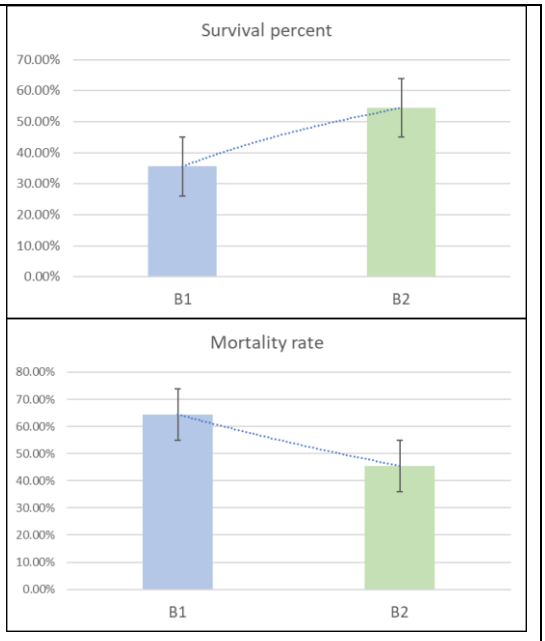
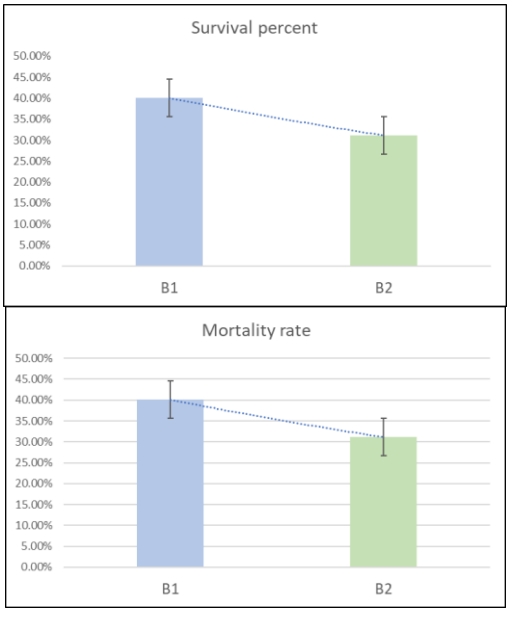


Table 3

The percentage of survival and the mortality rate among the chrysomelids

Variant	Analyzed young larvae (number)	The percentage of live larvae after treatment	Mortality percentage
Control variant	30	100	-
B1 D1	30	66.66	33.34
B1 D2	30	56.66	43.34
B1 D3	30	56.66	43.34
Average/B1		59.99	40.06
Control variant	30	100	-
B2 D1	30	73.33	26.67
B2 D2	30	66.66	33.34
B2 D3	30	66.66	33.34
Average/B2		68.88	31.12



The percentage of survival among the live larvae of *Ostrinia n.* can be seen in table 2, where after treatment with B1 (Spinosad) it was 35.55, while in the variants with B2 (Bactospeine) it was higher, 54.44.

Which means that the mortality rate of the larvae was higher in the case of the treatment with Spinosad, i.e. 64.47% and in the case of the one with Bactospeine of 45.56%.

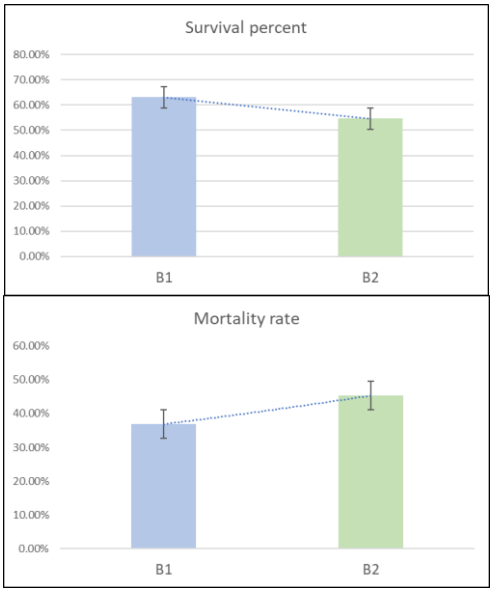
Referring to the survival rate and the mortality rate of chrysomelids, this was as in the case of lepidopterans, higher after the treatment with B1 (59.99) and after the treatment with B2 of 68.88 and the mortality of 40.06%/B1 and 31.12% respectively (Table 3).

The effectiveness of the treatments with the product B1 had a survival rate of aphids also higher after the treatment with B1 (63.11) compared to the treatment with B2 (54.46). The mortality rate was 36.89%/B1 and 45.33%/B2 respectively (Table 4).

Table 4

The percentage of survival and the mortality rate among the aphids

Variant	Analyzed young larvae (number)	The percentage of live larvae after treatment	Mortality percentage
Control variant	30	100	-
B1 D1	30	56	44
B1 D2	30	66.66	33.34
B1 D3	30	66.66	33.34
	Average/B1	63.11	36.89
Control variant	30	100	-
B2 D1	30	58	42
B2 D2	30	54	46
B2 D3	30	52	48
	Average/B2	54.66	45.33



CONCLUSIONS

The effectiveness results obtained through the present observations show that both the treatment with bioinsecticide B1 (Spinosad) and B2 (Bactospeine) require higher doses to be effective. Biopesticide B1 proved more effective than bioinsecticide B2 because the mortality among pests was higher (approximately between 40-65%) while in B2 it was 31-45%. It is obvious that the ideal option is for bioinsecticide B1 to be included in the complex strategy to combat pests in the corn crop through 1-2 treatments using the highest dose.

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