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APPLICATION OF THE FUNGIC FORMULATION ARTHROBOTRIS OLIGOSPORA AGAINST THE NEMATODE DITYLENCHUS DESTRUCTOR

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Abstract

In the year 2008 we started to use a microbiological product based on hyperparasite fungi, named Arthrobotris oligospora against nematodes, on several crops such as potatoes, carrots, parsley, knowing that this pests cause significant damages. We resorted to biological control, seeing as chemical control can be expensive. The purpose of the paper was the monitoring of and the decrease in the rate of the infestation caused by the nematode Ditylencus destructor from 43.2 % to 1.4%. Following application of the microbiological product in various quantities both in autumn and in spring, we reached an optimum dosage during the vegetative stage. The differentiated application of the microbiological product both in autumn, 1.5 kg and in spring, 1.5 kg led to the desired outcome. Based on the results obtained we concluded that in autumn, the product applied against nematodes has enough time to develop and infiltrate the soil to have the desired effect, i.e. capturing nematodes. This can actually be observed in the yield, when for a dose of 1.5 kg fungus / ha applied in the autumn, we obtain a healthy crop of 25.8 to/ha, and for 1.5 kg fungus /ha applied in the spring we obtain a healthy crop of 19.9 to/ ha. When using the fungus, the soil is not chemically loaded and it doesn't present after-effects from other crops. The microbiological product based on A. oligospora has better results when the soil humidity reaches a saturation of 80%. On land with insufficient humidity, the results decline.

Key words**:** *tuber nematode, harvest, humidity*

INTRODUCTION

Starting with 2003, infections with the nematode Ditylenchus destructor [6] spread dramatically in Romania as a result of massive imports of planting stock from the European Community. The infection spread in several ways, such as feeding animals with infected potatoes and using the manure for fertilisation, selling non-certified seed potatoes, grazing sheep on land where potatoes had been cultivated, after the harvest, and moving farm equipment from one plot to the other, etc.

Monoculture and intensive crop rotation led to huge damages caused by this pest year on year, on considerable surfaces. [1] A frequent situation is having the farmer leave half of the yield on the field at harvest time. On the experiment surface, based on the yield records, around 15-16 tons of potatoes were left on the field.

MATERIALS AND METHODS

A technological application experiment /2008-2009/ on an area infected with Ditylenchus destructor took place near Sfantu Gheorghe, Campul Frumos region, in Transylvania, Covasna County, Romania. The area was a 10 ha non-irrigated field.

The composition of the microbiological product AO is the following [2]:

It doesn't contain any dangerous substances.

Ingredients: Active substance: approx. 5% w/w

Conidia of Arthrobotrys oligospora fungi in min. concentration $2x10^8$ conidium/g

Carrier: Perlite: approx. 85-95% w/w

Water content: max. 5% w/w

The formulation is sensitive to fungicides, acids and alkali, and agents attacking organic substances. The quality of this formulation is decreased by storing it in humid conditions and at a temperature over 30 °C.

The quantity of water used to dissolve the AO product was 400 l/ ha.

The formulation can be applied using any kind of sprayer, provided that the mixer is in good functioning condition, the formulation being prone to settle. The equipment must be well cleaned of any chemical traces, because antifungal solutions and certain herbicides prevent the germination of the AO fungus or hinder its growth.

The objective of the experiment is to determine the optimum date and dosage for the application of the fungic formulation Arthrobotrys oligospora /AO/ against the potato nematode Ditylenchus destructor. [7]

In choosing the surface we considered the fact that in the year 2007, the potatoes grown on this surface were infected with Ditylenchus to a considerable extent. This pest is widely spread in Transylvania, and potatoes can hardly be grown without disinfecting the soil. [3]

Table 1. Treatments applied during the experiment:

No	Treatment	Surface
1.	00 control, / the soil was not disinfected/.	0.24 ha.
2.	Nemathorin disinfectant 10G 30 kg/ha, at the time of the sowing [6]	1.00 ha.
3.	Nemathorin 10 G 18 kg/ha + AO 1.5 kg/ha, at the time of the sowing	1.00 ha.
4.	AO 1.5 kg/autumn, + AO 1.5 kg/spring, applied during soil preparation	4.76 ha.
5.	AO 1.5 kg/spring, applied during soil preparation	1.00 ha.
6.	AO 1.5 kg/autumn, applied before land cultivation	1.00 ha.
7.	AO 3 kg/spring, mixed in during soil preparation	1.00 ha.

Note: Sowing date: 08-09-10 April 2009.
Source: Own experiment.

Before emergence it received 18 mm precipitation, in May it rained 22 mm, in June 12 mm, in July 16 mm.

Harvest: between September 26 and October 08.

RESULTS AND DISCUSSIONS

As shown in Table 2, the smallest crop was obtained on the control plot where no anti-nematode substance was applied, as well as the biggest crop infected at a 43.2% ratio. The lowest level of infection, i.e. 1.4 % was obtained on the plot where the AO quantity was applied in a differentiated system, both in autumn and in spring.

By comparison with the plot where the application of 1.5 kg/ha was only made in spring, we can conclude that AO is effective when the soil humidity is higher, having sufficient time to infiltrate the soil in depth and destroy the nematodes. In dry springs, such as 2009, when the precipitation was insufficient for emergence and growth, we find that the AO fungus was not effective in capturing nematodes because the water scarcity didn't create a proper environment for its survival and action.

Table 2. Treatments applied by crop type

No.	Treatments kg/ha	Gross crop kg/ha	Healthy crop kg/ha	Infected crop kg/ha	Infected crop %.
1.	00 control	27,120	15,404	11,716	43.2
2.	Nemathorin 10G 30 kg/ha	32,640	30,453	2,187	6.7
3.	Nemathorin 10G 30 kg/ha + AO 1.5 kg/ha	30,420	24,884	5,536	18.2
4.	**AO 1.5 kg/autumn, + AO 1.5 kg/spring**	**33,170**	**32,706**	**464**	**1.4**
5.	AO 1.5 kg/spring	29,100	19,963	9137	31.4
6.	AO 1.5 kg/autumn	30,860	25,830	5,030	16.3
7.	AO 3 kg/spring	29,890	21,909	7,981	26.7

Source: [7]

When soil humidity is insufficient, the nematodes are searching for a source of water to survive, and in the absence of water, they enter the tuber through the umbilical area, where the potato skin is very thin. [9] This is why is was found that big tubers have higher chances of being infected by nematodes, from the first appearance of new tubers.

The extent of the damages continues to increase in storage, being possible for most of the yield to rot if stored at warm temperature. It is recommended to cool stored potatoes by ventilation. [4]

The cost of Nemathorin 10 G per ha is 800 Euros, a considerable amount, especially when compared to the volume/quantity

obtained on untreated surfaces.

Photo 1. Infested potatoes
Source: Own source

CONCLUSIONS

Based on the data obtained, we can conclude that with respect to AO, **differentiated treatment in autumn-spring** has the best results. The infection ratio is obviously lower for this treatment, and the yield is over 20% bigger. [10]

The yield increase is probably stimulated as well by the fact that besides nematodes, AO also greatly decreases the number of root mites.

Increasing the AO dosage doesn't necessarily have a positive effect, in the spring the soil temperature is probably still too low for fungus activity while later on, dry weather doesn't encourage reproduction.

On surfaces extensively infected with Ditylenchus destructor it is recommended to apply the differentiated treatment. Differentiated treatment provides sufficient time for fungus reproduction and this is the season when natural precipitation create favourable soil conditions.

The recommended AO dose is 1.5 kg/ha autumn and 1.5 kg/ha spring. It is important to apply and process it at the right time.

Adjustment of other experiments, to determine whether AO-type soil disinfectants and Nemathorin 10 G can be applied together. [5]

Laboratory analyses confirmed the compatibility of the two substances, but after application on the selected area, the results were not positive.

It is appropriate to analyse the subsequent life of surfaces treated with AO. We anticipate that Ditylenchus destructor will disappear in the following year from the surface treated effectively with AO. The field remains clean until the pest is introduced on the surface with infected seed potatoes.

It would be interesting to make this experiment on an area that was optimally irrigated, to receive an answer to the question to what extent is fungus activity influenced by uniform soil irrigation.

International literature focused for a long time on using fungi to control pests and diseases since some of these species have a fungicide and insecticide effect.

Chemicals used in plant protection have a secondary effect on production and are retained in the soil, causing health problems to people, by absorption. This is why some pesticides were withdrawn from the market, replaced with other less toxic pesticides or microbiological products.

The properties of these hyperparasite and antagonist fungi have good effects on increasing production and maintaining soil fertility.

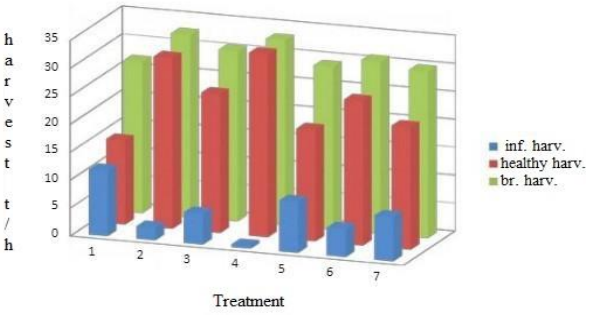

Fig. 1. Quantities according to treatments
Source: Own design based on own results.

This fungus species - Arthrobotrys oligospora – creates unfavourable conditions in the soil, after treatment, for insects to reproduce and cause harm. It has such effect on nematodes, wire worms, caterpillars and thrips larvae and on other insects living in the soil, without affecting the earthworm. This behaviour gives Arthrobotrys an important place in biological culture.[8].

In storing the fungus product, attention should be paid to keep the temperature in cool and dry spaces under (20-25 C). In this case storage should not exceed 3 months. During the application, the sprayer pressure is not relevant. A superficial incorporation or irrigation is recommended after application, as it helps achieve the desired effect. If the application uses the drip irrigation system, the fine filters must be removed to avoid clogging as a result of sedimentation. It can be applied mixed with soluble fertiliser and other bacteria-based products which condition the soil. It should not be applied together or mixed with products containing Trichoderma, which consumes it, being an antagonist. The recommended dosage is 1,5-3 kg/ha or in concentration of 1%, applied to the soil surface and superficially incorporated before sowing or seeding, and it can be applied both before and after emergence. Benefits of the Arthrobotrys fungus: - biologic product with a wide-ranging effect on pests living in the soil, it is a growth stimulant which can be applied to all vegetable crops, small dosage at minimum costs, encourages the growth of the undamaged root and diminishes the effect of nocuous fungi and bacteria on the root, solid plant growth with multiple yields, healthy root which can better process nutrients. Natural break down causes a significant amount of gibberellin, which has a positive effect on the plant's generative stages - florescence, fertility, vegetation.

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