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EFFECTS OF THE HERBICIDE NAPROPAMIDE ON THE SOIL MICROFLORA IN TOBACCO BEDS

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ABSTRACT

Using herbicides has a significant effect on different microbial processes in the soil and, depending on the type of soil and on the used dose, they may modify the quantity of their biomass for a certain period of time.

The aim of this investigation was to trace and identify the effects of the herbicide napropamide on the principal groups of microorganisms in the soil during the production of seedlings for broad-leaf tobacco, as well as the impact of weather conditions on this process.

Soil samples were taken on the 1-st, 7-th, 15-th, 30-th and 60-th days after input of the product. It was found out that Devrinol 4F has a direct influence on major groups of soil microorganisms. Thirty days after treatment this effect is insignificant.

Key words: herbicides, soil, tobacco, Devrinol 4F

ВЛИЈАНИЕТО НА ХЕРБИЦИДОТ НАПРОПАМИД ВРЗ ПОЧВЕНАТА МИКРОФЛОРА ВО ТУТУНСКИТЕ ЛЕИ

Употребата на хербицидите има значително влијание врз различните микробиолошки процеси во почвата. Во зависност од типот на почвата и применетата концентрација, тие можат да ја изменат количината на микрофлората за одреден временски период.

Целта на ова истражување беше да се утврди влијанието од хербицидот напропамид врз поважните групи на микроорганизми во почвата за време на производството на расад од крупнолисни тутуни, како и влијанието на временските услови врз овој процес.

Примероци од почвата се земани на 1-, 7-, 15-, 30- и 60-от ден по внесувањето на препаратот.

Констатирано е дека Девринол 4Ф има директно влијание врз главните групи на почвени микроорганизми. По 30 дена од третирањето со препаратот, влијанието на хербицидот е незначително.

Клучни зборови: хербициди, почва, тутун, Девринол 4Ф

INTRODUCTION

Tobacco is a traditional crop of social importance that has been grown in our country for centuries. Considering climate conditions and relief, there are several tobacco growing regions in Bulgaria under different types and varieties of tobacco.

The production of tobacco depends on the production of high quality and healthy seedlings. The application of herbicides is a compulsory measure in the production of tobacco seedlings. The high rate of weeds in seedling beds is determined by various factors such as; use of manure, limited use of herbicides, limited planting areas, and so on. Napropamide is one of the selective herbicides approved for use in tobacco seedlings (marketed as Devrinol 4F). As a selective systematic herbicide, napropamide is efficient against a number of annual wheat weeds and some dycotyledons. The herbicide is absorbed by the roots and works by inhibiting root development and growth.

Napropamide is resistant to drought. In most soils of mineral composition, it is degraded by microorganisms at a much slower rate (8). Furthermore, it has been determined that half of the initial input dose in soils of light mechanical composition degrades under the influence of biotic and abiotic factors between day 9 and day 17. In higher doses, the herbicide's activity remains for more than six months. In some cases, it leads to initial slowing down in the growth of the next crop in the crop rotation.

Research in our country and abroad has proved that herbicides have an impact on different microbial processes in the soil and, depending on the type of soil and on the used dose, they may modify the quantity of their biomass for a certain period of time. It has been established that the use of pesticides (herbicides) has a selective inhibition effect on the microorganisms which are responsible for nitrogen fixation and nitrification from 4 to 12 weeks. The use of herbicides reduces the total microbial population in the soil (5), whereas this can be due to reduced input of organic waste as a result of the fight against weeds. Pesticides are decomposed faster in soils with higher organic matter content, probably due to higher microbial activity.

The main microorganisms that take part in the decomposition of herbicides are bacteria, actinomycetes and microscopic fungi.

The purpose of this study was to trace and identify the effects of the herbicide napropamide on the major groups of microorganisms in the soil during the production of seedlings for broad-leaf tobacco, as well as the impact of weather conditions on this process.

MATERIAL AND METHODS

The field experiment was conducted in 2007 and 2008 on tobacco beds within the experimental field of the Tobacco and Tobacco Products Institute in the village of Markovo, the region of Plovdiv. The trial was planted according to the iambic standard scheme in 5 repetitions of 1m^2 experimental lots on humus-carbonated soil. The pH of the soil was 7.7, the humus content – 2.32% (Turin), total nitrogen – 0.182 mg, phosphorus - 2.68 mg/100 g and potassium - 42.79 mg/100 g.

The trial period included years with different average temperature and quantity of precipitations, unevenly distributed throughout the vegetation period. The periods of seedling production over the two years differed significantly by the quantity of precipitations (see Table 1).

Devrinol 4F was applied in the soil using portable sprayer in doses of 400 ml/da twenty-four hours before planting the tobacco seeds. Soil samples were taken for microbiologic analyses on day 1, day 7, day 15, day 30 and day 60 after the product application. The mass of each sample ranged between 600 and 800 g; the samples consisted of 5 to 7 extracts randomly taken from the soil at a depth between 0 and 15 cm.

Microorganisms were measured according to the dilution method and by planting on selective nutrient media. Their quantity is represented as column forming units. The total biological activity was studied as well by measuring the emissions of CO_2 (9). Determination was made on the relation between the number of microorganisms and the time of treatment.

Table 1 Precipitations in mm

Precipitations in mm	2007			2008		
	April	May	June	April	May	June
1-10	13.2	9.5	139.8	46.8	20.9	26.2
11-20	0.9	6.9	3.4	12.9	0	34.9
21-31	1.2	122.1	0	20.6	29.7	1.4
Σ mm^2	15.3	138.5	143.2	80.3	50.6	62.5

RESULTS AND DISCUSSION

Since herbicides are biocide substances, they have an impact on microorganisms manifested in increasing their productivity and adaptation capacity. Therefore, the dynamics of changes in soil microflora is the main parameter for evaluation of the importance of main environmental components in agro-biocenosis after the use of herbicides.

Amonifying bacteria are indicators of the activity of mineralization of the organic substances in the soil. They are distinguished among bacteria developing on mesopeptonic agar for being the most resistant to the composition of the soil. The data in Fig. 1 show the changes in population dynamics of the studied group under the influence of herbicide. Their quantity is inhibited on day 7 after input of Devrinol 4F, which is believed to be due to direct toxic effect on bacteria.

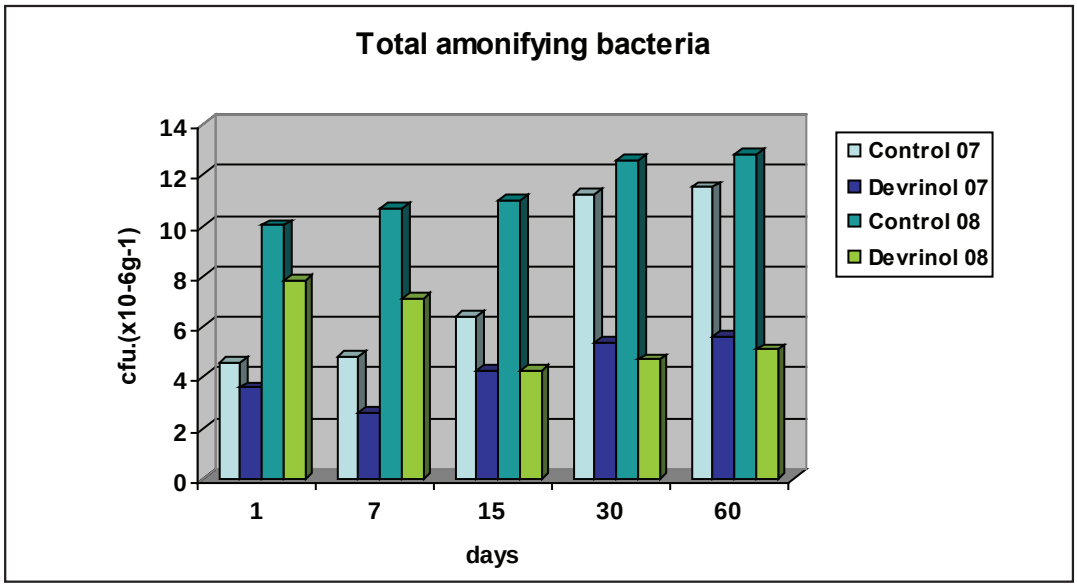

Fig. 1: Number of bacteria that degrade organic nitrogen compounds

This effect is gradually overcome and their number increases at every subsequent stage of the study. The trend remains the same over the two years of the experiment.

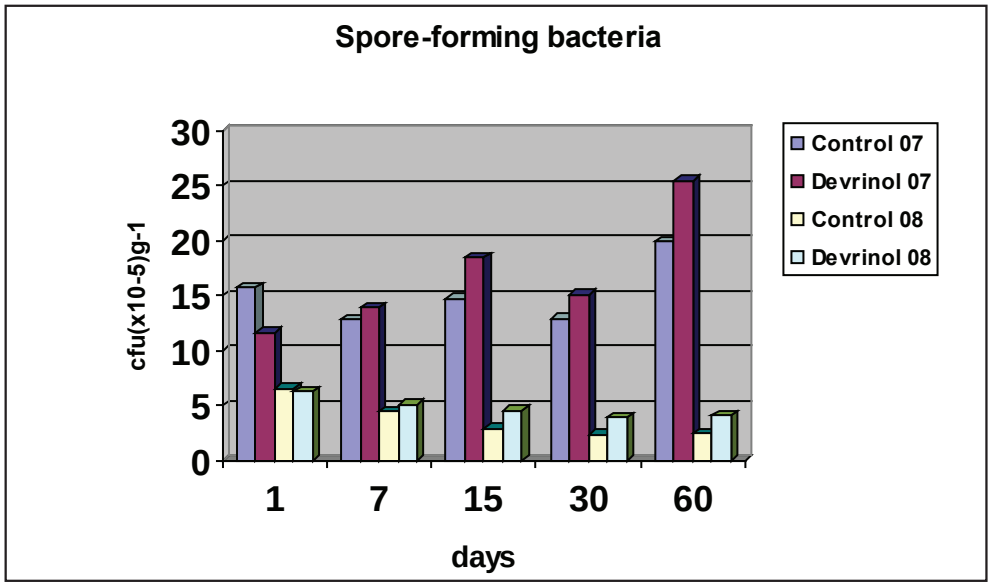

Fig. 2: Number of spore-forming bacteria

The results shown in Fig. 2 demonstrate the dynamics of variation of the number of spore-forming bacteria. Their quantitative expression results from the intensity of mineralization processes in the soil. The tendency of decreasing the number of spores up to day 7 proves that Devrinol 4F in doses of 400 ml/da has a positive effect on this group of bacteria. Over the following periods, it was established that spore formation is stimulated, which means that the decomposition of the herbicide was not complete at the time of the last sampling, i.e. 60 days after its input. The number of spores varied within a wide range in 2007 when spore formation reached higher values. On its part, this leads to decelerating the transformation of some organic compounds in the soil and slower mineralization processes.

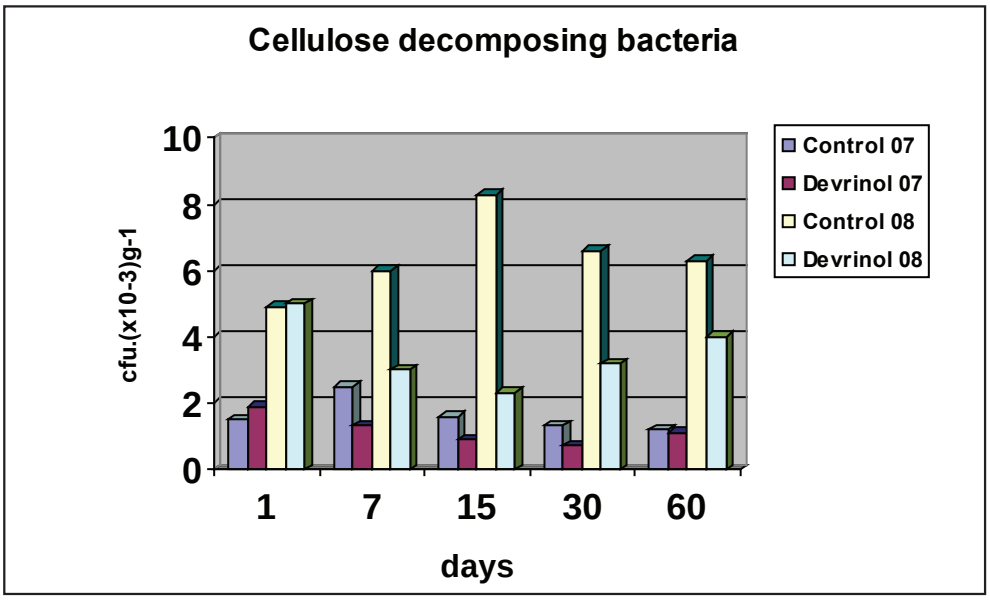

Fig. 3: Cellulose decomposing bacteria

In experimental conditions Devrinol 4F had a direct impact on the number of cellulose decomposing bacteria in the soil (see Fig. 3). In both years of the experiment, it had inhibiting effect after day 7 whereas the strongest manifestation was observed fifteen days after the input. Some convergence between the values of herbicide treated beds and the controls was observed during the first year, which was probably due to the drought that occurred that year. Larger number in the controls compared to the treated beds was discovered during the second year of the study. This was due to the more even distribution of precipitations over the whole period of the study. In 2007, there were periods with alternating higher and lower precipitations, which decreased the total number of the cellulose decomposing bacteria in both treated beds and controls.

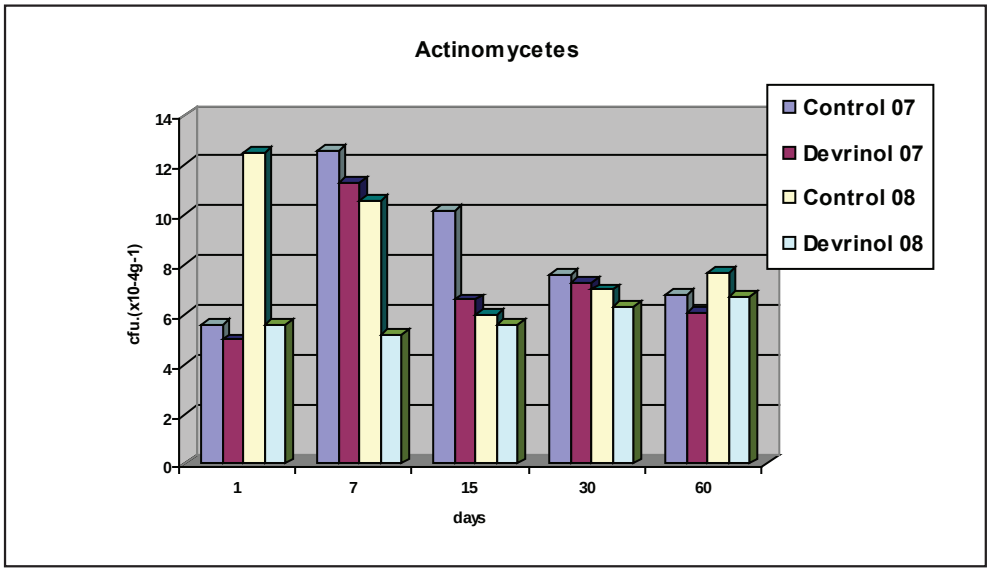

Fig. 4: Number of actinomycetes

Actinomycetes are widely spread in the soil and they are present in greater numbers than spore-forming bacteria (see Fig. 4).

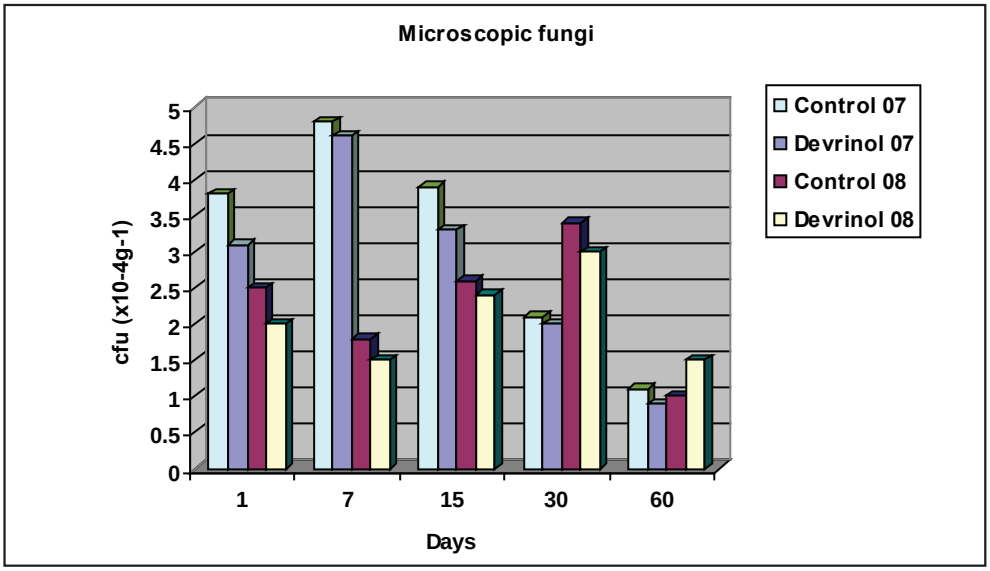

Fig. 5: Number of microscopic fungi

The analysis of the presented data shows that the reduction in the number of actinomycetes is overcome on the thirtieth day. The soil moisture as a factor is sufficient to overcoming the negative effect of the herbicide. As a result, the processes of mineralization are accelerated and access to nutrients in the soil is provided.

Along with other groups of microorganisms, microscopic fungi take part in the decomposition of various remains and in the synthesis of organic compounds. The effect of napropamide on this physiological group is shown in Fig. 5. The seasonal variations both in the treated beds and the controls are very clear up to day 60. At the last reading, the quantitative manifestation is similar in both parts, probably again due to the drought, which has negative impact on them.

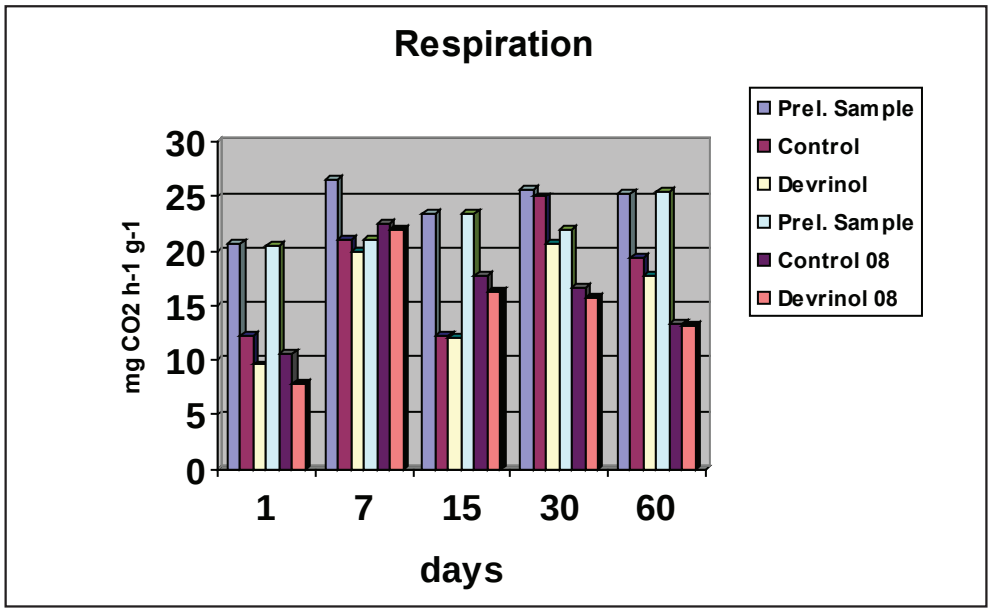

Fig. 6: Total biological activity in the soil

This study shows the impact of Devrinol F on the total biological activity in the soil (Fig 6). It reveals that the herbicide causes troubles in the metabolism but to an insignificant extent. The largest reduction of CO_2 emissions was observed on day 1 after treatment, and up to day 60 this effect is overcome thank to the great adaptation capacity of microorganisms to different habitats.

CONCLUSION

The study conducted to establish the effect of the soil herbicide Devrinol 4F on some essential physiological groups of microorganisms has revealed that the herbicide inhibits these groups. The results we obtained confirm the conclusions drawn from other studies that a major part of the active substance in the herbicide is decomposed within 20 days. Thirty days after the treatment, the quantities of microorganisms in the treated beds and the controls are insignificant.

The use of the herbicide Devrinol 4F in the production of tobacco seedlings inhibits to an insignificant extent some essential physiological groups of microorganisms. The negative effect is overcome sixty days after treatment and the quantities of microorganisms in the treated material and in the controls are similar.

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