ISSN: 2181-3337 | SCIENTISTS.UZ
INTERNATIONAL SCIENTIFIC JOURNAL SCIENCE AND INNOVATION
ISSUE DEDICATED TO THE 80TH ANNIVERSARY OF THE ACADEMY OF SCIENCES OF THE REPUBLIC OF UZBEKISTAN

INFLUENCE OF THE HERBICIDE PENDIMETHALIN ON THE POPULATION OF MICROORGANISMS AND THE BIOLOGICAL ACTIVITY OF SOILS

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https://doi.org/10.5281/zenodo.8368234

Abstract. *The impact of herbicide A-STOMP (Pendimethalin 330 g/l) on dynamics and viability of microorganisms of serozyom soils was studied. It was established that treatment of serozyom soils with herbicide A-STOPM before planting potato leads to insignificant suppression of a number of soil-borne microorganisms (mainly actynomycetes and filamentous fungi), which is observed on 7th day after sprinkling. After 30 days, the viability of microorganisms of the ammonifier group and spore bacteria is restored. At the same time, the number of weeds in potato crops after herbicide treatment was 2.5–3 times lower compared to the control.*

Keywords: *microorganisms, herbicide, serozyom soil, pollution, bioremediation.*

Аннотация. *Статья посвящена изучению влияния препарата А-СТОМП (пендименталин 330 г/л) на динамику и жизнеспособность микроорганизмов в сероземных почвах. Установлено, что обработка сероземных почв перед посевом картофеля гербицидом А-СТОМП (пендименталин 330 г/л) приводит к незначительному угнетению ряда групп почвенных микроорганизмов, в основном актиномицетов и микромицетов, которе наблюдается на 7 сутки после опрыскивания. Через 30 суток жизнеспособность микроорганизмов группы аммонификаторов и споровых бактерий восстанавливается. Численность сорняков в посевах картофеля после обработки гербицидом была в 2,5–3 раза ниже по сравнению с контролем.*

Ключевые слова: *микроорганизмы, гербициды, сероземная почва, загрязнение, биоремедиация.*

Annotasiya. *Maqolada A-STOMP (pendimentalin 330 g/l) preparatini tipik bo’z tuproqlarda qo’lanilganda mikroorganizmlarning dinamikasi va yashovchanligiga ta'sirini o'rganishga bag'ishlangan. Olingan natijalarga ko’ra, kartoshka ekishdan oldin bo‘z tuproqlarni A-STOMP (pendimentalin 330 g/l) gerbitsidi bilan ishlov berilishi tuproq mikroorganizmlarining bir qator guruhlarini, 7-kundan so’ng, asosan, aktinomitsetalar va mikromitsetlarning kamayishiga olib keldi. Shuningdek, 30 kundan keyin ammonifikatorlar va spora hosil qiluvchi bakteriyalarining yashovchanligi qayta tiklandi. Gerbisid bilan ishlov berilganda kartoshka ekinlarida begona o'tlar soni nazoratga nisbatan 2,5-3 marta kamaygani kuzatildi.*

Kalit so’zlar: *mikroorganizmlar, gerbisidlar, tipik bo’z tuproq, ifloshlanishi, bioremediasiya*

Modern agriculture uses a wide range of chemicals, including herbicides, fungicides, insecticides, without which it is impossible to manage the phytosanitary state of agroecosystems now [1-3]. Herbicides are chemicals that are used to protect agricultural plants from the spread of dangerous perennial rhizomatous and quarantine weeds [4, 5]. The long-term effect of the herbicide application has a positive effect – the weediness at the field is reduced. But, at the same time, they may negatively influence plant-microbial interactions through their effects on the pathogen or other soil biota. It is known that soil-borne microorganisms are characterized by a certain selective sensitivity to herbicides and pesticides.

There are controversial data on the effect of pesticides on soil microbiota. According to some data, herbicides have no effect on soil microorganisms, others indicate their significant effect [6-8]. Soil-borne microorganisms, in their turn as a biological factor, affect soil fertility, which is characterized by biological and enzymatic activity [9]. The detailed study of the microbiological processes in the soil is necessary to secure and improve soil fertility, the effective use of applied fertilizers and the correct use of pesticides [10, 11].

According to numerous studies, the main factors of herbicide decomposition depend on the physicochemical properties of the soil, hydrolysis under the influence of soil moisture, and the activity of soil-borne microorganisms [12-14]. Many microorganisms are capable to cleanse the polluted environment and may be used as bioremediation means [15, 16]. However, the effect of herbicides on microbiological processes in serozyom soils, the abundance of the main groups of soil microorganisms and the biological activity of soils has been little studied in our region.

In these regards, the aim of the work was to evaluate the effect of the herbicide Pendimethalin on the main groups of soil-borne microorganisms and to determine their taxonomic structure.

Objects and methods of study. The herbicide A-STOMP (Pendimethalin 330 g/l (3,4-dimethyl-2,6-dinitro-N-pentan-3-ylaniline ($C_{13}H_{19}N_3O_4$)) was used in this study. Pendimethalin is characterized as a moderately resistant herbicide [17]. The herbicide A-STOMP is used to control a wide range of monocotyledonous and dicotyledonous weeds of vegetable crops and sunflower.

The studies were carried out on serozyom soils on the experimental fields of the Research Institute of Plant Protection. Herbicides can be applied in two ways, by spraying vegetative plants or directly into the soil. In our experiment, the soil was treated with the herbicide just before the planting potato tubers. Herbicide-free soils were used as control. Samples were taken from a depth of 0-5 cm, 0-20 cm. The weather conditions during the vegetation season were very tense in terms of moisture supply (rainy weather).

Microbiological analysis of soils was carried out by conventional methods: the number of ammonifiers was determined on the medium of Beef Extract Peptone (BEP) agar and BEP broth; spore bacteria on wort agar medium (1:1), oligonitrophils on Ashby medium, actinomycetes on ammonium starch agar (ASA); micromycetes on Czapek agar [18].

The number of microorganisms was determined in the original soil and 7 and 30 days after the introduction of A-STOMP (Pendimethalin). Sowing was carried out in triplicate from dilutions up to 10^7. Petri dishes were incubated in thermostat at 28-30°C. Identification of bacterial cultures was carried out according to Bergey [19], microscopic fungi were identified according to Gerhardt [20].

Results and discussion. It should be noted that the use of the herbicide A-STOMP (Pendimethalin 330 g/l) for weed control had a positive effect on improving the phytosanitary situation in the experiment. A microbiological examination of soils treated with herbicide revealed that 7 days after herbicide (A-STOMP) application there was a slight decrease in the number of microorganisms compared to the control. The decrease in the number occured mainly in groups of actinomycetes and micromycetes (the number of actinomycetes was within 3.0-5.0x10^4 CFU/g, and fungi 2.0-3.0x10^3 CFU/g.).

The highest number of oligonitrophilic bacteria was noted in the control variant $1.03x10^8$ and $7.5x10^6$ CFU/g, soil layers 0-5 cm and 0-20 cm, respectively. At the same time, their number in the experiment (against the background of the herbicide) was 1.3 times less. It was established that the number of spore bacteria growing on BEPA + wort was greater than in the control variant (7^{th} day after herbicide application). There was a significant decrease in the number of ammonifiers: control – $8.9\text{-}10.5x10^7$ CFU / g and experiment – $5.2\text{-}7.1x10^6$ (Fig. 1).

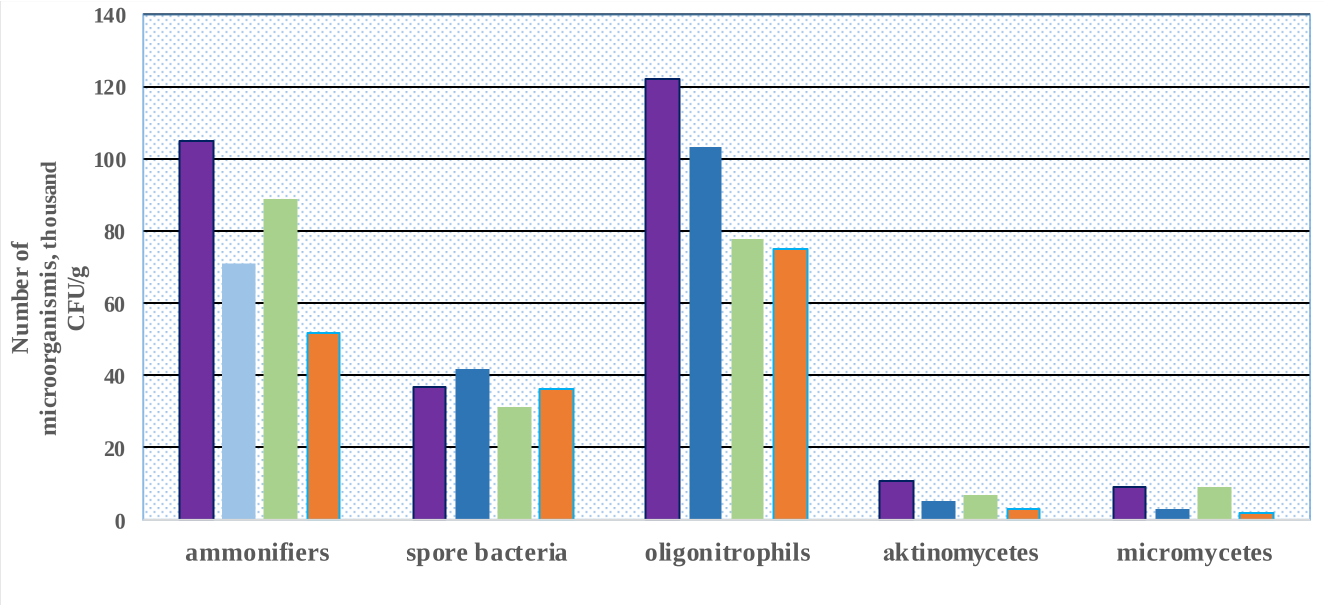

Figure 1. Quantitative content of microorganisms on the 7^{th} day after herbicide application

It was determined that 30 days after herbicide application, the total number of microorganisms in the experiment (against the background of the herbicide) exceeded the control variant, mainly due to the better development of the group of ammonifiers and spore bacteria. In the control variant (without the use of herbicide), the total number of spore bacteria was $3.8\text{-}4.6x10^4$ CFU/g, in the experiment (with the use of herbicides) – $3.7\text{-}4.2x10^4$ CFU/g. At the same time, there was no decrease in the group of oligonitrophils. There was also a recovery in the number of actinomycetes and micromycetes (Fig. 2).

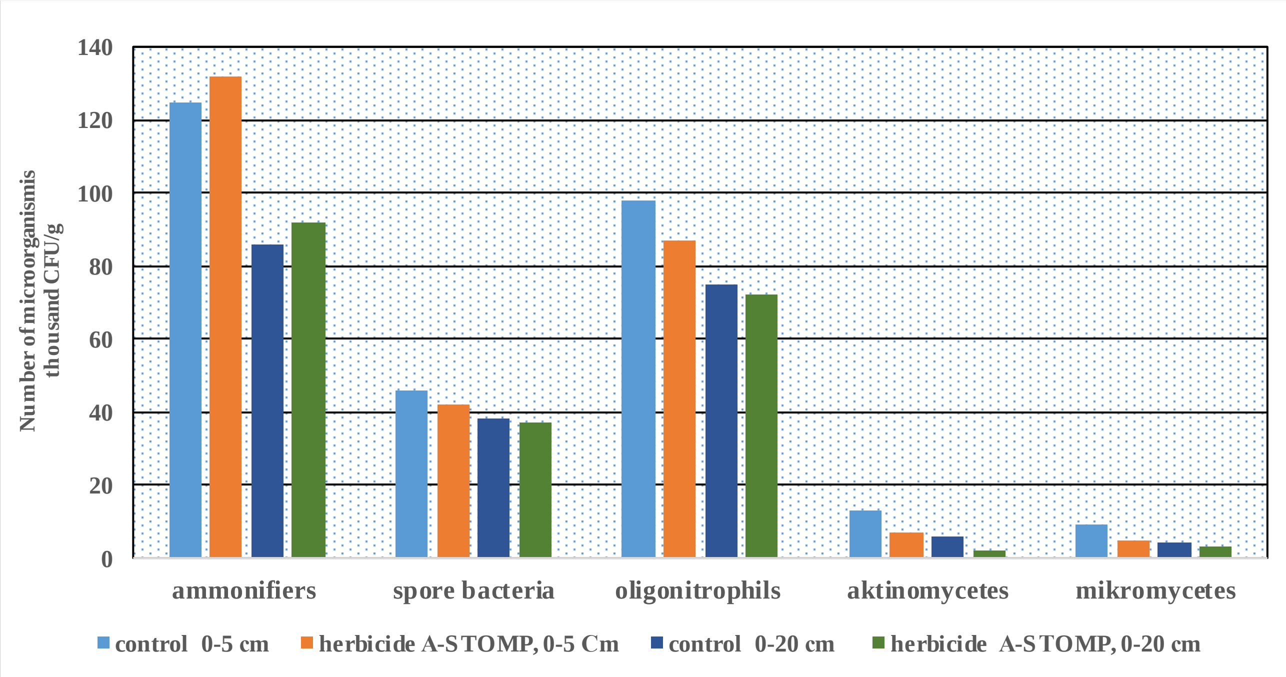

Figure 2. Quantitative content of microorganisms on the 30th day after herbicide application

The study of the taxonomic composition of the microbial community of the soil showed that both in the control variant and the experimental variant, the diversity of microorganisms was similar. Among the identified strains isolated from soils treated with herbicide, following bacterial species were widely represented: *Bacillus, Pseudomonas, Arthrobacter*, coryneform bacteria, cocci, *Streptomycetes*. At the same time, the prevailing species related to spore-forming soil-borne bacteria *Bacillus subtilis, B. cereus, Bacillus* sp. The fungal community was represented by species relate mainly to *Mucor, Alternaria, Penicillium, Trichoderma* genera.

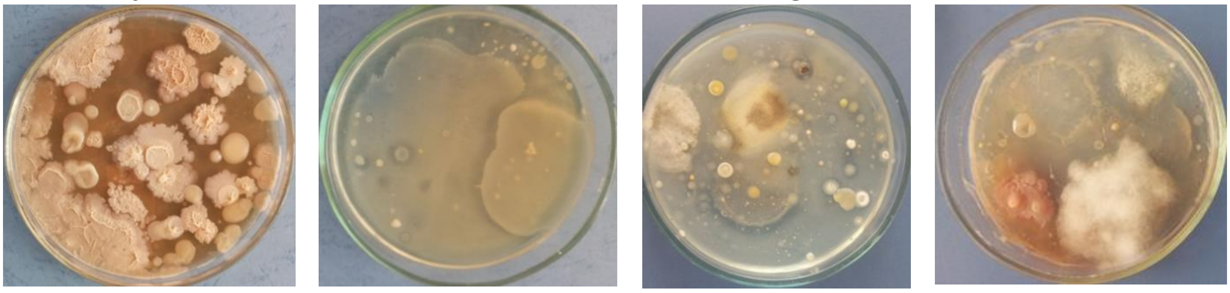

Figure 3. Microbiological landscapes on the 30th day after herbicide application

Observations revealed that herbicide after application to soil reduced weed infestation throughout the year. Thus, the number of weeds in potato crops after herbicide application was 2.5-3 times lower compared to the control. At the same time, the use of the preparation did not have a visible negative effect on the physiological state of potato plants.

Thus, on the basis of the conducted research, the conclusion may be made that the application of the herbicide A-STOMP (Pendimethalin 330 g/l) on potato crops has a temporary negative effect, leading to a decrease in the studied groups of microorganisms in the soil, which is restored after some time, while it does not significantly affect the biological activity of soils.

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