THE INFLUENCE OF MICROBIAL PREPARATIONS ON THE ECOLOGICAL STATE OF SALINE SOILS

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ABSTRACT

The rational use of a wide range of microbial biological products in ecological farming is of great importance. Due to the activation and modification of natural control mechanisms with such preparations, it is possible to control the processes of regulation of increasing or optimizing indicators important for agriculture. In particular, the use of complex microbial preparations has great prospects in ecological farming. One of these drugs are microbial preparations "Bist" and "Bist-M".

KEYWORDS: *Ecological, Microbial Biological Product, Salinity, Soil, Cotton, "Bist" And "Bist-M" Biological Products, Reducers (Destructors).*

INTRODUCTION

Various external products according to the results of microbiological studies: mineral fertilizers, chemical pesticides, microbiological preparations, etc., show peculiar changes in microbiological processes occurring in soils under their influence: denitrification, nitrogen fixation, biological immobilization, etc.[143, c 78-79].

For this purpose, we first tried to study the effect of biological preparations "Bist" and "Bist-M" on the ecological state (microbiological composition) of saline soils.

We repeated the field trials on cotton 3 times based on the following scheme.

Scheme of field experiments:

1. Control (dried seeds), N_{250} P_{180} K_{100} -100%
2. Experiment -1: N_{250} P_{180} K_{100} +"Bist" (10^8 КОЕ/мл)
3. Experiment-2: N_{250} P_{180} K_{100} +"Bist-M" (10^8 КОЕ/мл).

The study of the microbiological composition of the experimental field showed that when saline soils were washed with saline, their microbiological composition changed significantly (Fig. 3.1).

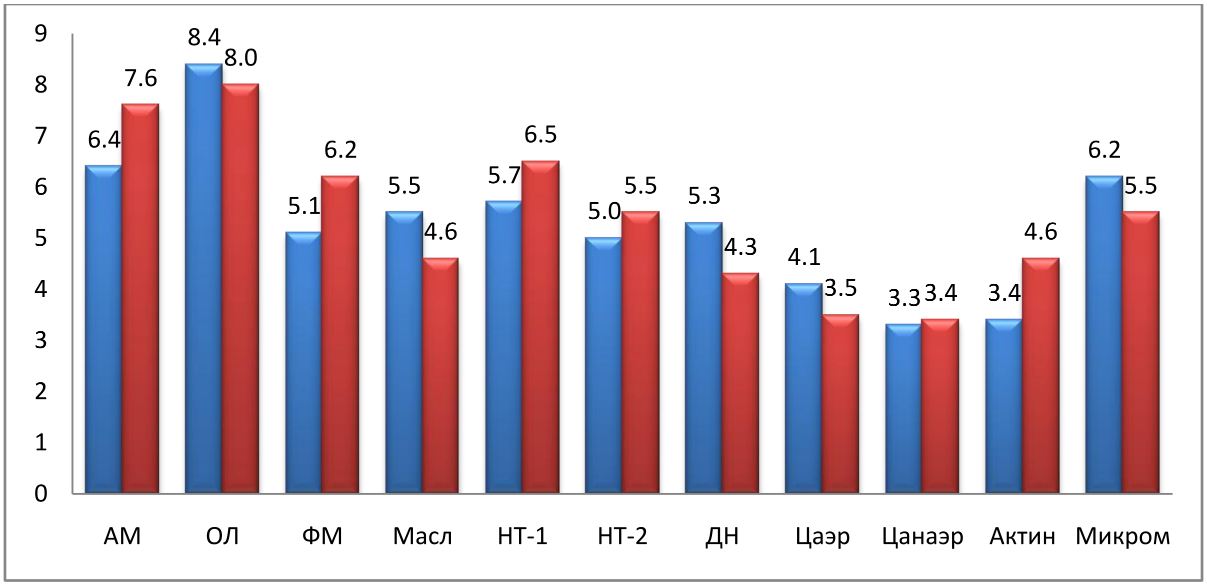

Fig. 3.1. The state of microorganisms of moderately saline soils in the washed (1) and non-washed (2) ecological state **(**Soils of the farm "Kalandar Yakhshibaev" of the Khorezm region, Tupraqqala district, 2018. Soil at a depth of 0-30 cm).

1-washed soil, 2 unwashed soil: AM-ammonifiers; OL - oligonitrophils; FM-phosphorus mobilizing bacteria; oil-fatty acidifiers (butyric); HT-1-phase nitrifiers; HT-2-phase nitrifiers; Dn-denitrifiers; Цаэр -aerobic cellulose breakers; Цанаер - anaerobic cellulose breakers; actin-actinomycetes; Microm-Micromycetes. (Microbiological analysis performed in the scientific laboratory of the Department of Microbiology and Biotechnology of the Faculty of Biology of the National University of Uzbekistan).

As a result of washing, it was noticed that ammonifiers, phosphorus-mobilizing bacteria, nitrifiers of the 1st and 2nd phases, actinomycetes, which serve to increase soil fertility and determine the ecological state of the soil, are washed out with water, an increase in the number of fatty acid microorganisms, denitrifiers, aerobic cellulose destroyers and micromycetes, and the number of anaerobic cellulose decomposers and oligonitrophic microorganisms remained almost unchanged (Fig. 3.1).

Organic substances containing less than 2% nitrogen in their composition are immobilized to the maximum extent in the cells of microorganisms, and a greater amount of nitrogen-containing substances are dissimilated and converted into ammonia [144, c 186-188].

When studying the effect of biological preparations "Bist" and "Bist-M" on the number of ammonifying microorganisms in washed and not washed soils, an increase in their number was noted in washed soils compared to non-washed soils.

Based on the results obtained, it can be concluded that in the phase of cotton budding, the biological preparations "Bist" and "Bist-M" contribute to the mineralization of easily decomposable nitrogen-containing organic matter in the soil, and this improves the ecological state of the soil. The reason for this conclusion is the increase in the amount of ammonifiers in washed soils.

A decrease in the number of ammonifiers was noted in the phases of flowering fruiting and fruit ripening (in the control it was 5.2x10 KOE /g, in the experiment this figure was 3.9x10 KOE /g). This indicates that in the variants of the experiment, nitrogen-fixing organic compounds in the soil are actively decomposed and ammonia is formed. This, in turn, indicates that cotton is provided with organic forms of nitrogen in a timely manner.

In the experimental variant of unwashed soils (3.9×10^8 KOE/g), a significantly increased amount of ammonifiers was observed than in the control (2.7×10^7KOE/g). In other phases of the cotton vegetation, the amount of ammonifiers gradually decreased. This indicates that the biological preparations “Bist” and “Bist-M” processed nitrogen compounds in mineral fertilizers without using nitrogen reserves in the soil.

When checking the action of biological preparations “Bist” and “Bist-M” in separate experiments, it was observed that the amount of ammonifiers in soils with the use of “Bist” is 10-12% higher than in soils with the use of the biological preparation “Bist-M”. This indicates that the biological product “Bist-M” had a 10-12% stronger effect on the ammonification process than the biological product “Bist”.

Oligonitrophilic bacteria have the ability to absorb atmospheric nitrogen and convert carbon into a form suitable for plants, i.e., into humus. This group accumulates microorganisms in the soil, enriching the soil and plant with carbon in an easily digestible form. Therefore, a versatile study of microorganisms belonging to the group of oligonitrophils serves to increase soil fertility and improve its ecological state. In variants with the use of biological preparations, oligotrophic microorganisms are able to grow even on a nutrient medium with a very low nitrogen content, which allows them to grow in an environment unfavorable for other microorganisms, this allows them to participate in certain stressful situations [145, c 151-153]. These properties also explain the participation of microorganisms belonging to this group in increasing the amount of humus in the soil.

The number of oligotrophic bacteria in soils when using the biological product “Bist-M” is 3.5×10^6 - 4.9×10^6KOE/g, and this shows that it almost doubled compared to the control variant (1.7×10^6 - 2.5×10^6KOE/g) . These results show that in the experimental variant, the plant is better provided with easily digestible forms of carbon formed during the mineralization of humic substances. Another indicator that allows assessing the ecological state and fertility of the soil is the process of nitrification, since the rate of nitrate formation is an important indicator of soil activity [146, p. 3092-3094].

Field experiments have shown that the nitrification process proceeds differently in eroded and non-washed soils.

For example, in phase 1, which oxidizes ammonia (ammonium) to nitrite anions, the number of nitrifying bacteria in the soil in the variant with KOE-100% (6.7×10^5 - 1.1×10^7KOE/g) was observed to increase almost 10 times in the first three phases development of plants that the maturation phase decreased by the same amount (1.7x101 KOE/g). In unwashed soils, the number of nitrifying bacteria in the 1st phase decreased by 2.5-3.0 times in the experimental variant (in the phase where the plant formed 3-4 true leaves), increases almost 2 times in the flowering phase of the plant (3.7x102 - 4.0x102 KOE/g), however, it was observed that the number of these bacteria decreased again during the maturation stage of the cotton fiber. Phase II

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nitrifying bacteria (these bacteria convert nitrite anions into nitrate anions - $NO_2^- \rightarrow NO_3^-$) and we observed that in the washed soils, the amount remained almost the same in the first 3 variants of plant vegetation in the experimental (with "Bist-M") and control (without biological preparation) variants (1.8x101 KOE/g and 1.7x101 KOE/g). Interestingly, in the phase of cotton fiber maturation, their number was less than in the control (3.8x102 KOE/g).

Although the number of nitrifying bacteria in washed soils in phase II (when 3-4 true leaves appear) and in the flowering and maturation phases is somewhat lower than in the control variant, much more is observed in the budding phase. The obtained results and their analysis show that in plants treated with the biological product throughout the growing season, nitrogen nutrition is much better than in the control.

Under anaerobic conditions and when the content of nitrates in the soil is above the norm, denitrifying microorganisms reduce them to molecular nitrogen. It is known from the literature that the process of denitrification manifests itself in many strains of bacteria belonging to the genera *Bacillus, Pseudomonas, Micrococcus, Achromobacter* [147, p. 287].

It is shown that the influence of biological preparations "Bist" and "Bist-M" on the development of denitrifying bacteria also depends on the ecological state of the soil. For example, in washed soils, the action of biological preparations additionally differs depending on the phases of plant development. If the number of denitrifying bacteria decreases in the phases that gave 3–4 true leaves and fruiting (1.8x102 - 3.7x104 KOE /g), it was noticed that their number increased in the budding phase (1.1x107 KOE /g), however, in phase of flowering and fruiting, no difference was observed between the control and experimental variants.

Observation of the development of denitrifying bacteria in unwashed soil showed the following results:

– in the phase of formation of true 3-4 leaves, the difference between the experimental and experimental variants is practically absent;

– In the phases of budding, flowering and fruiting, maturation, the number of denitrifying bacteria in soils where cotton was sown decreased ($2.2x10^5$-$1.1x10^7$KOE /g) compared to the control.

It is known that phosphorus-mobilizing bacteria are useful microorganisms for plants. The ability to mineralize insoluble or, rather, poorly soluble phosphorus compounds into organophosphorus compounds has led to a growing interest in the study of these bacterial species [148, P.2].

The action of the biological product "Bist-M" is somewhat different from the biological product "Bist" due to the addition of the phosphorus-mobilizing bacterium *Bacillus subtilis*, a salt-resistant bacterium. In the soil sown with seeds treated with the Bist-M biological product, phosphorus mobilizing bacteria enter the soil along with the seeds and multiply in the root rhizosphere in accordance with the ecological state of the soil. Reproduction continues throughout the growing season of cotton.

During the vital activity of these types of bacteria, plants get the opportunity to feed [149, p 2-4] with phosphorus in a form convenient for them.

In the experiments carried out in the initial 2 phases of cotton vegetation on washed soils, the following was observed: an increase in the number of phosphate-mobilizing bacteria, in phases that give 3-4 true leaves and observed in the budding phase, and amounted to (2.1x10^6KOE / g). In the maturation phase, the number of phosphate-mobilizing bacteria (.7x10^6-2.1x10^7KOE /g) in the control and experimental variants was much higher than in the control variants (1.7x10^6-4.2x10^6KOE /g). It is interesting to note that such a ratio between the experimental and a control variant was preserved in almost all phases of cotton development.

From the latest literature data, it is known that the decomposition of complex natural polymeric compounds, especially non-nitrogenous compounds such as cellulose, starch, lignin in the soil, occurs under the influence of cellulose-decomposing bacteria, actinomycetes and microscopic fungi (micromycetes) [150, p. 119].

In the experiments carried out, it was found that the number of microorganisms with this property has different values in both washed and non-washed soils. For example, it was found that in the washed soil in the experimental variant (1.1x106 KOE /g), the content of cellulose-destroying aerobic bacteria is significantly higher than in the control (1.3x102 KOE /g). However, such a change was observed only in the initial 3 phases of the cotton vegetation: in the phase of 3-4 true leaves, the phase of bud formation and flowering, and in the maturation phase, there were practically no differences between the control and experimental variants. In unwashed soils, the number of aerobic bacteria that break down cellulose increased in the first 2 phases (3.4x105-0.9x106 KOE /g), while the amount of the flowering-harvest phase slightly decreased (5.1x105 KOE /g), and in the control and experimentation in the maturation phase, it was noticed that there is no difference between the variants.

Reducing the number of anaerobic bacteria that break down cellulose under the influence of "Bist-M", in the phase of formation of true leaves and flowering-fruiting, in washed soils, in the experimental version (6.1x103-9.7x103 KOE / g), in the stage of budding and ripening, the yield increased by almost 2 stages (5.8x103-4.7x105 KOE /g) compared to the control.

Cellulose-destroying bacteria in unwashed soils showed that in the experimental variant (3.8x102-4.1x105 KOE /g) there was one stage (0.9x102-4.9x104 KOE /g) more than in the control at all stages of cotton development. Based on the above experimental data, it has been shown that the processes of decomposition of cellulose-containing compounds of complex structure in the experimental variants proceed faster and more intensively than in the control groups.

In the experimental variant on washed soils with butyric acid bacteria in the initial stage of cotton development (at the stage of formation of 3-4 true leaves) and in the maturation phase, a number of low (2.9x102-3.1x104 KOE /g) were noted, at the budding and flowering phases, fruiting was observed 1 level higher than in the control (1.3x106-1.6x107 KOE /g).

It was noted that the number of oil-fermenting bacteria in unwashed soils was higher than in the control (1.8*105-1.9*106 KOE /g) in all phases of the cotton vegetation. It is known that these bacteria have the ability to create conditions for plant nutrition with nitrogen.

The fact is that the provision of soils with mineral nutrients, and hence their ecological state, largely depends on the number and quality of actinomycetes. Because actinomycetes have the ability to break down various carbon-containing compounds. In particular, it was revealed the role of actinomycetes and their metabolites in the decomposition of difficult-to-decompose compounds of plant and animal tissues, as well as the cyclic nucleus of humic acids [151, p. 68-69].

The degree of decomposition of organic matter also depends on the number of actinomycetes involved in this process. In our experiments, the following results were obtained:

- in the washed soils, in the phase of appearance of 3–4 true leaves, a decrease in the number of actinomycetes in the experimental variant (1.9x104 КОЕ /g);
- An increase in their number (3.4x104-2.1x105 КОЕ /g) was noted in the phases of budding, flowering and maturation.

In the washed soils, the number of actinomycetes at all phases of cotton development was higher in the experimental variant than in the control.

Micromycetes in the soil perform very important functions. Firstly, a large number of phytopathogenic micromycetes are found in the soil; secondly, micromycetes of a saprotrophic type of nutrition, actively participating in the destruction (decomposition) of various plant residues, contribute to a decrease in the reserve of infection in the soil; thirdly, antagonistic fungi provide the antiphytopotogenic potential of the soil [152, p 107-108].

It is shown that the use of biological preparations “Bist” and “Bist-M” reduces the number of micromycetes relative to control at all stages of cotton development, both on washed and non-washed soils and under various environmental conditions.

Thus, based on the results of the study, the following conclusions can be drawn:

- Biological preparations “Bist” and “Bist-M” to a certain extent increase the number of microorganisms useful for plants in the soil, regardless of the ecological state of saline soils (washed and unwashed);
- biological preparations “Bist” and “Bist-M” lead to a decrease in the number of micromycetes and denitrifiers in the soil;
- the influence of biological preparations “Bist” and “Bist-M” on the number of micromycetes and denitrifiers, depending on the ecological state of the soil in washed soils, was faster than in unwashed ones.

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