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Improving Soil Efficiency Based On The Destructive Properties Of Lactobacillus.

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ABSTRACT

The article presents the results of the study of the destructive properties of bacteria Lactobacillus, their role in increasing soil fertility for the cultivation of plants, including medicinal plants. Agricultural production is based on land, using it as a means and object of labor. The main characteristic of the land is its fertility. There are natural fertility, which is a consequence of long-term soil-forming processes, and economic fertility, which is the result of human impact on the properties of the earth. Natural fertility is considered as a potential quality of land. Economic fertility depends on the level of development of productive forces. Soil fertility is determined by its ability to meet the needs of plants in nutrients, water, provide their root systems with sufficient air and heat and a favorable physical and chemical environment for normal growth and development. One of the indicators characterizing soil fertility is the content of humus, with an increase in the content of which the soil improves its physical and chemical properties. The reasons for the decrease in humus content in the soil include low crop cultivation, intensive tillage using heavy machinery, wind and water erosion, and others. Modern agriculture is aimed at preserving and improving soil fertility, which will ensure progressive and sustainable growth of agricultural production. The development of agriculture provides for the rational use of land through the development and implementation of zonal systems of agriculture, intensive and other advanced technologies of cultivation of crops and medicinal plants.

Keywords: Lactobacillus, destructive properties of Lactobacillus, destruction of plant tissues.

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INTRODUCTION

One of the directions of development of agricultural production is the use of biological and microbiological preparations. Microbiological preparations represent living cells atzelektronik on the beneficial properties of the microorganisms that are or in the culture fluid or adsorbed on neutral media [9]. This drug allows you to create a huge concentration of beneficial forms of microorganisms (1 milliliter or gram of the drug contains up to 1-5 billion CFU) in the right place and at the right time. Due to this, the introduced forms can successfully compete with the native microflora and capture the ecological niches provided by the plant.

MATERIALS AND METHODS

The study was conducted on the lands of the Ryazan region Russian Federation. Study of the degradation of the straw was carried out using 5 strains of Lactobacillus from the collection of microorganisms, Department of Microbiology, Virology and biotechnology, Odessa national University im. I. I. Mechnikov: Lactobacillus paracasei ONU 520 (L15), Lactobacillus brevis ONU 521 (L21), Lactobacillus plantarum ONU 522 (L24), Lactobacillus plantarum ONU 523 (L26), Lactobacillus rhamnosus ONU 524 (L27). The working names of microorganisms are given in brackets. The crops were originally sown in the MRS liquid medium. Continue to use the experienced environment: the modified GMS (hydrolysate–dairy environment) (SanPiN 42-123-49-40-88 p.5.2. and 7.2.): hydrolysate of milk 500 ml/l, pepton 2 g/l, agar-agar 0.75 g/l, NaCl 3.5 g / l; MDS (dairy and yeast environment) (Dzerzhinsky, 2006) and MRS-broth (Tkachenko, 2006).

RESULTS AND DISCUSSION

The main directions of application of biological products in agriculture are:

- increased germination of seeds and plant biomass;
- improvement of mineral nutrition of plants;
- suppression of the development of phytopathogenic microorganisms, ensuring the reduction of plant diseases;
- strengthening of plant resistance to adverse conditions (drought, frost);
- increase utilization of fertilizers and nutrients from soil;
- regulation of accumulation in plants of heavy metals, radionuclides, nitrates and other harmful compounds.

The role of microorganisms in solving environmental problems is increasing. Microorganisms are used in filtration and disinfection of waste water, which is safer for the environment than chlorine treatment, hypochlorite, ozonation. Methane-forming bacteria contribute to biogas production. Lactic acid bacteria can be used in soil sterilization and removal of by-products that can accumulate in it and create harmful conditions. However, in fact, these are only the first steps in using the potential of microorganisms. One of the promising microorganisms are bacteria of the genus Lactobacillus. In such areas as the food industry and medicine, this kind of bacteria has been used for a long time. But their use in agriculture, crop production, and environmental cleaning is still very small [1].

One of the most interesting properties of lactic acid bacteria is the antimicrobial effect. This property is due to the ability of lactobacilli to produce organic acids with a further decrease in the pH of the medium, bacteriocins having a bactericidal effect on specific groups of microorganisms, including pathogenic forms, as well as to form biofilms that can prevent and prevent the colonization of any surface by pathogenic and opportunistic bacteria [7].

One of the problems faced by farmers is straw left after harvesting crops such as wheat, barley, corn. It can not be burned, since the burning of crop residues causes loss of soil fertility, humus burns, the content of mineral nitrogen in the soil decreases, etc. [10]. It is possible during harvesting to form a roll, which will be selected by the baler and then used for animal feed, for heating of premises and farms in the cold period or for sale. However, even in this case, part of the straw remains in the fields and complicates its further processing, retains latent pests and pathogens of agricultural plants [2].

In this regard, a study of the destructive properties of bacteria of the genus Lactobacillus was conducted. Properties of lactobacilli are diverse in biochemical and physiological properties. They are united by the metabolism of the fermentation type, as a result of which in the final fermentation products half or more carbohydrates are lactate.

Lactobacillus according to the theory of T. Higa refer to «effective microorganisms» (EM, Effective Microorganisms), which have a positive effect on plants and contribute to higher yields [3]. It was found that some strains of lactic acid bacteria exhibit high antagonistic activity against sanitary-indicative microorganisms, such as Staphylococcus aureus, Proteus vulgaris, Escherichia coli, Pseudomonas aerogenosa, Salmonella typhimurium [5]. Bacteria of the genus Lactobacillus limit the growth of undesirable microorganisms in the soil. They can help to remove from the soil the waste products of microorganisms that accumulate and adversely affect the growth of plants [4]. Lactic acid bacteria contribute to the decomposition of plant residues and the formation of humus, which increases soil fertility [6].

Study of the degradation of the straw was carried out using 5 strains of Lactobacillus from the collection of microorganisms, Department of Microbiology, Virology and biotechnology, Odessa national University im. I. I. Mechnikov: Lactobacillus paracasei ONU 520 (L15), Lactobacillus brevis ONU 521 (L21), Lactobacillus plantarum ONU 522 (L24), Lactobacillus plantarum ONU 523 (L26), Lactobacillus rhamnosus ONU 524 (L27). The working names of microorganisms are given in brackets.

The crops were originally sown in the MRS liquid medium. Continue to use the experienced environment: the modified GMS (hydrolysate–dairy environment) (SanPiN 42-123-49-40-88 p.5.2. and 7.2.): hydrolysate of milk 500 ml/l, pepton 2 g/l, agar-agar 0.75 g/l, NaCl 3.5 g / l; MDS (dairy and yeast environment) (Dzerzhinsky, 2006) and MRS-broth (Tkachenko, 2006).

The study was carried out with 1% and 2% sample content. In the first case the straw of motley grass was used, in the second – straw from corn, sunflower and wheat. The sample was placed in penicillin bottles and sterilized at 1 ATM. After sterilization, 10 ml of the corresponding medium and 200 µl of suspension of daily cultures of lactobacilli were added to penicillin bottles with straw. In the control variants of the culture of microorganisms were not introduced.

The pH value of culture liquid of lactic acid bacteria were tested for 5, 10 and 15 days.

In the first experiment, the viability of the strains was tested by seeding 10 µl of the suspension from the test samples to the dense nutrient medium MRS on day 5, 10 and 15. In the second experiment was performed seeding lactic acid bacteria in the GMR to determine the growth activity of microorganisms in the environment.
On the 15th day straw was extracted from the bottles and washed in distilled water. Then dried in a laminar flow Cabinet for 2-3 hours and in a thermostat during the day (until the straw weight in the control samples corresponds to the initial or lower) and weighed.

Was carried out statistical processing of data on the ability of bacteria of the genus Lactobacillus to the destruction of the nutrient balances of plants. For this purpose straw of wheat, corn, sunflower and herbs was weighed before the experiment and after removal of the experiment. The average weight of each type of straw for each of the three strains and controls was calculated, the standard deviation of the weight value and the confidence interval were determined. Comparison of the confidence interval and standard deviation allows to determine the possibility of using the results. In this case, if the confidence interval was greater than the standard deviation, the experiment is considered to be delivered correctly [8].

According to the literature, the optimal destruction of plant tissues by microorganisms is carried out within two weeks.

The pH value was measured due to the fact that a strong increase in the acidity of the medium can lead to a decrease in the viability of lactobacilli and inhibition of their growth. According to the results of the experiment, the pH values of the culture medium of lactobacilli decreased by 2-3 units compared to the control for the first 1-2 days and remained throughout the experiment (Table 1).

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Table 1: Data measurement pH of culture liquid of lactic acid bacteria

Strains	Measurement pH of culture liquid								
	5 day			10 day			15 day		
	MDS	GMS	MRS	MDS	GMS	MRS	MDS	GMS	MRS
L. paracasei ONU 520	5	5	4	5	4	4	5	5	4
L. brevis ONU 521	5	5	3	5	4	4	4	4	4
L. plantarum ONU 522	5	4	4	4	3	4	4	3	4
L. plantarum ONU 523	4	4	4	4	3	4	4	3	4
L. rhamnosus ONU 524	4	3	4	4	3	4	4	4	4
Control	6	6	6	6	7	6	7	6	6

The most pronounced decrease in the pH value was observed in the strains of L. plantarum ONU 522, L. plantarum ONU 523 and L. rhamnosus ONU 524. The strains L. paracasei ONU 520 and L. brevis ONU 521 the pH change was less pronounced.

No significant changes in growth activity were observed throughout the study. For example, in MDS strains of L. paracasei ONU 520 and L. plantarum ONU 523 on day 5 formed at 900 and 600 CFU/ml, respectively, for 10 days – 600 and 400 CFU/ml, for 15 days with 400 and 300 CFU/ml. the strains of L. brevis, ONU 521, L. plantarum ONU 522 and L. rhamnosus ONU on day 5 was observed the formation of 300 CFU/ml, on the 10 day 200 CFU/ml, strain, L. plantarum ONU 522 growth was not observed, on day 15 all three strains, the growth was not detected.

At the HMS the most actively growing strains of L. paracasei ONU 520, L. plantarum ONU 523 and L. rhamnosus ONU 524 – on the 5th day was observed at the 900, 800 and 500 CFU/ml, respectively, for 10 days – 600, 500 and 400 CFU/ml, for 15 days – 700, 100, and 100 CFU/ml, respectively. The growth of the strain of ONU 521 and ONU 522 was less active, so on the 5th day was observed at 200 CFU/ml, on the 10th day – at 100 CFU/ml, on the 15th day, the growth of microorganisms was not detected.

On the liquid medium of MRS all strains showed very weak growth, so on the 5th day there were 100 and 200 CFU / ml, and on the 10th and 15th day the growth of microorganisms was not detected.

When checking the control samples for sterility in all media, the growth of microorganisms was not detected.

The study found that HMS is most suitable for studying the ability of strains to destruction, as in all samples there was a decrease in the mass of straw. So the strain L. Paracasei ONU 520 the decrease in the mass of plant tissue made up 10.67%, the strain L. brevis ONU 521 – of 8.37%, L. plantarum ONU 522 – 10,55%, L. plantarum ONU 523 – 10,78%, L. rhamnosus ONU 524 – of 5.76%. The average decrease in straw weight per HMS was 9.10% (Table 2).

Table 2: Assessment of the ability of Lactobacillus strains to degrade plant tissues in different nutrient media

Strains	Indicators of changes in the mass of the straw relative to the original values, %		
	MDS	GMS	MRS-broth
L. paracasei ONU 520	107,54	89,33	99,63
L. brevis ONU 521	106,03	91,63	103,66
L. plantarum ONU 522	108,35	89,45	97,19
L. plantarum ONU 523	104,87	89,22	108,17
L. rhamnosus ONU 524	102,63	94,84	112,19
Control	100,00	100,00	100,00

According to the experiment, the other two media, MDS and MRS, are not suitable for the detection of the destructive properties of Lactobacilli, since almost all samples showed an increase in the mass of straw. On average, it was 5.88% on MDS and 6.42% on MRS.

According to the data it can be judged that the most active destruction of plant residues occurred with the use of GMR, and the most active destructors were the strains of the plant ONU 520, The ONU 522, the ONU 522, the ONU 523, the ONU 5, the ONU 520, the plant residues.

Growth of Lactobacillus on the GMS were very active, only for 10 day L. brevis ONU 521 and L. plantarum ONU 522 began to grow less active. On day 14, growth was not observed in any strain.

At the end of the study in the visual assessment of plant residues straw was less structured, disintegrated into individual fibers, as a possible consequence of degradation by microorganisms, leading to a decrease in weight. The increase in the mass of straw in some prototypes could be due to the fact that lactobacilli settled on the surface of plant tissues and were not removed by washing the straw in distilled water.

Thus, according to the obtained data, it can be judged that the destruction of plant residues most actively occurred with the use of GMR, and the most active destructors were the strains of the L. paracasei ONU 520, the L. plantarum ONU 522, the L. plantarum ONU 523. The use of biological products is a new stage in the development of agriculture and contributes to the formation of conditions for the development of organic farming.

CONCLUSION

The results of the experiments allow us to conclude about the possibility of using bacteria of the genus Lactobacillus in the destruction of straw and stubble. It should be noted that the decomposition of straw by lactobacilli helps to enrich the soil with phosphorus, potassium and nitrogen, which reduces the dose of these fertilizers in the soil and even satisfies them completely. The introduction of lactobacilli in agriculture can be achieved by eliminating the use of chemical fertilizers, and, consequently, the production of environmentally friendly products and medicinal plants. The withdrawal from the use of chemical fertilizers will have a beneficial effect on the soil, which will not be contaminated by the products of their decomposition, while there will be no pollution of water, which contributes to its recovery and restoration.

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