International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 6 Issue 1, November-December 2021 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Results of the Study of Microbiological Processes in the Soil during the Cultivation of Cotton, Soybeans and Rye

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ABSTRACT

This article provides data on the results of the study of microbiological processes in the soil during the cultivation of cotton, soybeans and rye in crop rotation. Microbiological studies have established that crop rotation crops have a positive effect on the microbiological activity of the soil. The best results were obtained in the variants of soybeans with rhizotorfin + winter rye and the second year of soybeans with rhizotorfin (first year of soybeans + winter rye) in comparison with the control and other variants of the experiment. The number of antagonistic mushrooms has noticeably accumulated in the soil under soybeans.

How to cite this paper: Kuchkorov Astonakul Musurmankulovich "Results of the Study of Microbiological Processes in the Soil during the Cultivation of Cotton, Soybeans and Rye" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-6 | Issue-1, December 2021, pp.1589-1593, URL: www.ijtsrd.com/papers/ijtsrd49108.pdf

IJTSRD49108

Relevance of the topic. In recent years, the sown area of high-protein (depending on the varieties, the protein content in the grain is up to 55%) soybeans has been expanding in Uzbekistan. Homeland of soybeans South Asian countries. In production, cultivated soybeans (Glysine hispida L.) with an annual herb from the legume family (Fabaceae).

In Uzbekistan, breeders have created a number of soybean varieties, such as "Dustlik", "Uzbek-2", "Uzbek-6", "Genetic" and "Orzu".

On March 14, 2017, a special resolution of the President of the Republic of Uzbekistan "On measures to increase the sown area and grow the harvest of soybeans in 2017-2021 in the Republic" was adopted. Based on this resolution, the study of soybeans as a crop rotation crop is a very topical issue and, in turn, it is of great theoretical and practical importance.

In 2017, 20,000 hectares of irrigated land were occupied in the republic under soybeans, and grain yields were on average 2.0-2.5 tons per hectare. For example, only in Surkhandarya region in 2020 soybeans (variety "Orzu") were sown on an area of more than 1000 hectares. Soybean acreage is growing rapidly in all regions of the Republic every year.

For the cultivation of soybeans in large dedicated cotton fields, it is important to explore the possibilities of using soybeans in a cotton crop rotation.

Research methodology and materials.

Research methodology.

Vegetation (in lysimeters) and small-plot experiments were carried out at the experimental base of the Uzbek Research Institute for Plant Protection (UzNIIZR).

To collect soil samples, a Malkov soil sampler-drill was used. Analyzes were performed immediately after sampling. Sowing of soil suspensions for microbiological analyzes was carried out by the method of serial dilutions (Lazarev, 1963):

1. Bacteria were sown -5- dilution on MPA (Methods of Experimental Mycology, Kiev, 1973).
2. Actinomycetes -4- dilution at UAN.
3. The total number of mushrooms -3- cultivation on Czapek's medium with a pH of 4.5-5.0.

After inoculation, the Petri dishes were incubated in a thermostat at a temperature of 24-260 C. Counting of colonies of fungi, bacteria and actinomycetes in Petri dishes was carried out on the 3rd, 5th and 7th days. The total number of isolated fungal colonies was taken into account, with the division into Trichoderma, Aspergillius, Penicillium, Fusarium, Mucor and other fungi were

determined to the genus. In all experiments, cotton varieties "S-6524" and soybean "Dustlik" were sown. After harvesting soybeans, the following sowing was carried out of the early maturing, frost-resistant and high-yielding promising winter rye variety "Vakhshskaya-116". Before sowing, soybean seeds were treated with the bacterial preparation "Rizotorfin" at the rate of 200 grams per 80 kg / ha. The bacterial preparation "Rizotorfin" is used to enhance nitrogen fixation of nodule bacteria on soybean roots.

Research results. It is known from the literature that plant roots secrete amino acids, sugars, glucosides, carbohydrates, phosphatides, organic acids, vitamins, enzymes, alkaloids and nucleotides into the soil. There is a definite relationship between root exudates (exudates) and microbial activity in the rhizosphere (Rao, 1959; Shrot and Hildebrant, 1964; Karadzhova, 1989).

According to A.A. Vasiliev (1965) in the USA, the change of crops is explained by the accumulation of antagonistic microflora in the soil, which lyses the soil phytopathogenic fungus Verticillium dahlia Kleb. - the causative agent of cotton wilt.

Many researchers believe that the presence of antagonist microorganisms in the soil with fungistatic and fungicidal properties is a decisive factor in suppressing the pathogen (Sidorova, 1983; Grishechkina, 1986). The most active antagonists of the causative agent of wilt are actinomycetes and fungi (Kublanovskaya, 1953; Babushkina, 1974).

It should be noted that soil enrichment with active antagonists is one of the ways to successfully combat cotton verticillium wilt.

In our research, we have studied and analyzed microbiological processes in the soil under soybeans, rye and cotton.

The results of microbiological analyzes of soil samples taken from the rhizosphere of plant lysimeters are shown in Table 1.

Table 1 The total number of microorganisms in the rhizosphere of soybeans, rye and cotton by the stages of development after their predecessors (pcs. In the 1st year of soil). Vegetation experience (lysimeters). Average data for 3 years.

Variants	Before sowing			Budding-bloom			Maturation		
	mushrooms, thousand / y	bacteria, mln / g.	actino-mycetes, mln / g.	mushrooms, thousand / y	bacteria, mln / g.	actin-mycetes, mln / g	mushrooms, thousand / year	bacterium mln / g.	actin-mycetes, mln / g
Cotton plant over cotton plant (control)	27,1	48,8	15,9	19,3	48,8	21,3	16,1	49,5	20,7
Soybeans (after cotton)	24,3	43,1	15,2	30,1	37,2	23,1	23,7	64,7	34,3
Soybean with Rhizotorfin (after cotton)	21,3	48,9	23,8	17,8	55,4	22,1	24,1	61,3	24,9
Second year soybeans with risotorfin (first year soybeans + winter rye)	32,0	43,9	24,2	32,5	60,9	24,6	34,5	73,5	25,4
Cotton on soybeans and rye	24,5	67,9	26,7	19,3	84,0	26,5	17,7	78,5	17,9

Soybean Cotton with Rhizotorfin	29,1	99,4	26,9	7,8	115,3	36,6	12,4	100,3	19,75
Cotton plant for 2-year-old soybeans and rye (1st year soybeans + rye, 2nd year with rizorfin)	30,5	86,3	37,3	12,0	134,0	47,0	11,3	87,5	22,25
2nd year cotton on soybeans and rye	25,3	83,3	27,3	11,2	118,6	36,7	13,4	89,6	23,6
2nd year cotton plant on soybeans	19,0	83,2	37,1	10,6	135,1	32,5	17,1	89,0	20,8

As can be seen from Table 1, in the variants of soybeans with and without rhizotorfin, as well as in the second year of soybeans with rhizotorfin, a significant increase in the number of microorganisms in the phases of plant development was observed in the soil. Of all the variants of the experiment, the best one in terms of the number of microbiological groups of organisms turned out to be the variant where soybeans were sown for 2 years in a row, followed by sowing of winter rye. In this variant, the rapid development of microorganisms was noted, especially during the budding period - flowering and filling of soybean grain, and the propagule of the fungus Verticillium dahliae was emitted less, therefore, a decrease in the stock of wilt infection affects. In the soil of the lysimeters, the number of fungi - antagonists of Trichoderma, Renicillium and Aspergillius was less before planting. Their number increased with the growth and development of plants. During the budding period - flowering and ripening, the number of fungi of the genera Penicillium, Aspergellius and Trichoderma increased, especially in variants with soybeans, in comparison with cotton.Analyzing the results of isolating the total amount of fungi, bacteria and actinomycetes, it can be said that in soybeans, the amount of fungi, bacteria and actinomycetes is higher in comparison with the monoculture of cotton (control).

The smallest number of fungi, bacteria, and actinomycetes was noted after the repeated sowing of cotton, and their number began to decrease in the phases of development. After the predecessors when growing cotton in the budding phase - flowering and ripening, the number of fungi, bacteria and actinomycetes gradually decreases. Fungi from the genus Fusarium, Mucor, dark-colored and other fungi were isolated from soil samples.Microbiological studies of the soil of experiments in subsequent years confirmed the data obtained from lysimeters in the field.

Microbiological studies of the soil have established that in the soil under soybeans there is a natural accumulation of microorganisms - antagonists of the causative agent of wilt. This phenomenon is closely related to the root secretions of soybean plants.

In small-plot experiments with soybeans, the number of fungi, actinomycetes and bacteria in the soil increased, the development of microorganisms continued until the end of the growing season. And in the variant with cotton, the number of fungi, bacteria, actinomycetes decreased, in the first case (before sowing) there were 11.2; 67.0; 10.3; and at the end of the growing season was - 10.9; 65.6 and 19.4 (table 2).In experiments, variants with soy showed similar good results, so during the budding period - flowering, the number of bacteria decreased, and by the ripening phase it began to increase. The smallest amount of fungi, bacteria and actinomycetes was noted in the cotton monoculture. During the budding period - flowering of cotton, the number of mushrooms increased and amounted to 11.5 thousand / year. soil. In the variant of soybean with rhizotorphin, the number of actinomycetes before sowing was less than in other variants, and during the growing season their number increased to 22.9 million / g. soil, in the first case (before sowing) was 18.6 million / g. soil. In monoculture, the number of microorganisms began to decrease according to the phases of cotton development.

It should be noted that in small-plot experiments, the comparative excretion of the total amount of fungi, bacteria, and actinomycetes was in favor of soy + rye, soy with and without rhizotorphin. In addition, the total amount of fungi in the soil was counted. Antagonist fungi were isolated from the genera Trichoderma, Penicillium, Aspergillius, as well as Fusarium, mucor and other fungi.

Table 2 The total number of microorganisms in the rhizosphere of cotton and soybeans (pcs. In 1 g of soil). Small-plot experiments. Experimental base UzNIIZR. (Average data for 3 years)

Variants	Development phases of cotton and soybeans:								
	Before sowing			Budding - bloom			Ripening-phase of grain filling		
	mushrooms, thousand / g	bacteria, mln / g	actinomycetes mln / g	mushrooms, thousand / g	bacterium mln / g	actinomycetes mln / g	mushrooms, thousand / g	bacteria, mln / g	actinomycetes mln / g
Cotton plant (monoculture) control	11,2	67,0	10,3	10,7	73,5	28,9	10,9	65,6	19,4
Soybean with Rhizotorfin (after cotton)	13,3	60,7	10,2	20,5	52,5	16,0	23,9	75,4	18,7
Soybean with rizorfin + winter rye (after cotton)	15,2	67,5	14,9	14,7	66,9	25,6	18,9	81,1	20,7
Soybean Cotton with Rhizotorfin	18,8	68,8	19,8	16,1	112,4	33,6	12,3	64,1	27,3
Soybean Cotton with Rhizotorfin and Rye	14,1	71,0	32,3	8,9	101,1	44,0	10,6	65,1	29,8
2nd year cotton plant on soybeans	18,3	59,4	20,0	10,3	93,1	35,8	11,1	87,4	32,6
2nd year cotton on soybeans and winter rye	12,0	72,5	28,9	14,5	98,6	50,3	11,9	95,9	34,0

In small-plot experiments in variants with sowing soybeans and using rhizotorfin, good results of soil enrichment with antagonist fungi were also obtained. In small-plot experiments in the soil under cotton, the secretion of fungi of the genus Trichoderma was observed and until the end of the growing season their number remained at the level before planting. In other variants, an increase in this type of fungi was noted.

In experiments in cotton monoculture before sowing and until the end of the growing season, fungi of the genus Trichoderma were not isolated. The best development of antagonist fungi was observed in the variant where soybeans with rhizotorfin were sown after cotton. The highest secretion of fungi - antagonists was noted in the phase of grain filling and ripening of soybeans.

The occurrence of fungi of the genus Fusarium was noted in the soil for all variants. The largest number of them was isolated in variants with cotton, especially in monoculture. A decrease in the number of fungi of the genus Fusarium was observed in soybean variants with and without rhizotorfin.

It should be noted that antagonist fungi, bacteria and actinomycetes stand out well in the budding phase - flowering, fruiting and ripening.

The numerical composition of microorganisms - antagonists in the soil was in favor of the variant with soybeans, especially where soybeans and rye were sown for two years in a row, as well as soybeans with rhizorfin compared to cotton.

In crop rotation variants, cotton was cultivated in lysimeters and small-plot experiments after the predecessors and microbiological processes in the rhizosphere were studied.

Studies have shown that the cultivation of soybeans and rye significantly increased the microbiological activity of the soil. Two-year cultivation of soybeans, followed by sowing of winter rye, significantly

influenced the development of microbes - antagonists, increasing their activity.

Consequently, the cultivation of soybeans in a cotton field for 1 and 2 years significantly improves soil conditions, increases the fertility and vital activity of antagonistic microbes.

Conclusions

Microbiological studies of the soil of the experiments established that the predecessors of soybeans and winter rye significantly influenced the microbiological activity of the soil not only in the first year, but also in the second year of cotton cultivation in the crop rotation. Based on the data obtained from microbiological analyzes of the soil, we believe that soybeans enrich the soil with active antagonists of the causative agents of wilt and other soil pathogens.Microorganisms-antagonists significantly improved the phytosanitary condition of the soil and reduced the amount of V.dahliae infection.

Thus, the cultivation of soybeans in the crop rotation as a precursor of cotton contributes to the development of beneficial microflora in the soil, this reduces the infestation of cotton with wilt, preserving the yield of raw cotton.

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