Study on the Influence of Sideration on Soil Microbiological Activity

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Abstract. In the fall, siderate is used in cotton fields in its pure state; 7.81-31.38 t/ha of biomass was accumulated per heke when rapeseed and rapeseed + rapeseed were planted in a mixed state. When this biomass is crushed in siderate quality and buried in the soil, the microbiological activity increases along with the improvement of the soil properties, and the rapid and short retention of the biomass in the soil accelerates the decay, as a result, it has a positive effect on the increase in the amount of nutrients in the soil.

1. Introduction

Today, the cultivation of organic agricultural products is one of the most important issues in the world, and it is based on the use of organic fertilizers. Including; which can be achieved by using siderates. From this point of view, it is possible to meet the need for organic fertilizers by cultivating siderate crops, achieving high biomass, crushing the cultivated biomass, spreading evenly on the field, plowing the land, taking into account the natural soil and climate conditions. However, the importance of microorganisms in converting organic fertilizers into a form absorbed by plants is incomparable, and their study is one of the urgent tasks.

Cultivation of siderate crops improves soil water and air regimes. This situation is especially evident when crops with spikes are grown. Also, if the siderate crops are plowed into the ground in autumn and early spring with the biomass crushed, they perform a sanitary role in the soil and create a basis for a slight decrease in cotton diseases and pests [1, 2].

Siderates play an important role in improving soil fertility and in microbiological processes in the soil. According to data, soil microorganisms include bacteria, actinomycetes and fungi, about 70% of them are bacteria, about 27-30% are actinomycetes, and about 1-3% are fungi [3, 4, 5, 6].

If the agrophysical, water-physical properties of the soil are in moderation, the microorganisms in it are activated, as a result, soil fertility increases. Therefore, knowledge of soil microflora and biology, assessment of various agrotechnological activities is a very important issue. In particular, the use of siderates in fields freed from cotton in short-row cotton-cereal rotation affects not only the agrophysical properties of the soil, but also all the life processes occurring in the plant, as well as the microbiological activity of the soil, and therefore its study is one of the urgent issues.

It is known from the sources that siderate crops have a significant positive effect on soil fertility, including soil properties and microflora, of the land cleared from the areas where cotton, winter wheat and other crops were grown. However, in the conditions of the old irrigated meadow-alluvial soils of Samarkand region, the effect of pure and mixed cultivation of siderate crops, cultivation of biomass and application of the resulting biomass to the soil on soil microbiological activity has been determined not sufficiently studied.

Therefore, the research was conducted in 2019-2020 in the conditions of the irrigated meadow-alluvial soils of the farm "Nurmon Abdullaev", Ishtikhon district, Samarkand region, based on the short rotation.

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2. Materials and Methods

Cultivation of siderate crops, analysis and observation of them were carried out on the basis of manuals such as "Methodology for state variety testing of agricultural crops" [7], "Methodology for conducting field and vegetative experiments with fodder crops" [8].

Methodological manuals entitled "Methods of agrochemical, agrophysical and microbial studies in irrigated cotton areas" [9] were used to conduct microbiological analyzes in the experiment. Bacteria were detected in meat peptone agar (GPA), fungi in Chapek's medium (Sreda Chapeka), and actinomycetes in starch-ammonia agar (KAA).

To study the efficiency of siderat crops in cotton cultivation, after harvesting the cotton crop, the selected area was watered and prepared for planting in the fall (on October 10). Care of siderate crops was carried out according to existing recommendations [10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31]. Field experiments were conducted on old irrigated meadow-alluvial soils of Ishtikhon district, the mechanical composition of the arable layer is medium sand, the volume mass with pore structure is 1.35-1.37 g/cm^3. The experiment was carried out in 4 variants, 3 replicates in one tier, according to the following system, i.e. variants - 1-control-without siderate, 2-peas, 3-rapeseed, 4-peas+rapeseed. The surface of each plot was 240 m^2 (length 50 m, width 4.8 m), the area to be considered was 120 m^2. The statistical analysis of the experimental results was carried out according to B. A. Dospekhov [32].

3. Results and Discussion

For the experiment, the biological autumn Loris variety of one-year rapeseed belonging to the cabbage family and Asia-2001 variety of the peas plant belonging to the legume family were selected as siderate crops. On the basis of experimental schemes, peas - 40 kg/ha, rapeseed - 13 kg/ha were planted separately, and their mixtures were reduced to half. Rapeseed seeds were planted at a depth of 1.5-2 cm, and peas seeds at a depth of 6-7 cm. After planting, it was irrigated at the rate of 500-600 m^3/ha.

Fertilization of siderate crops using NRU-1.5 fertilizer spreader, 50 kg/ha of nitrogen fertilizer was applied in two periods when the plant height was 8-10 cm and close to entering the period of intensive growth. After putting the fertilizer on the ground, it was irrigated at the rate of 700-800 m^3/ha. In autumn, irrigation was carried out every 17-20 days in October-November, and 20-25 days in March-April.

Table 1. Growth, development and yield of siderate crops, 2019-2020

Variants of experience	Number of plants, thousand units/ha	Plant height, cm	Biomass, g/m^2			Ratio of parts (top/bottom)	Biomass yield, t/ha
			over the ground	undergr ound	Total		
Control without sideration	-	-	-	-	-	-	-
Peas	194,5	83,6	6407	1406	7813*	1 : 0,18	7,81
Rape	2702,2	98,2	1942	370	2312	1 : 0,16	23,12
Peas+rape	4550,0	73,9+87,3	2730	408	3138	1 : 0,13	31,38

Note: *The crop marked with * was grown in 1.6 linear meters.*

Biomass productivity of siderate crops was determined by the mass of above-ground and below-ground parts of 1 m^2 and 1.6 linear meters in the flowering phase. The above-ground green mass of siderate crop species varied from 1942 g to 2730 g per 1 m2 with a large difference. In this case, it was found that the above-ground mass was 1942 g in the case of pure rapeseed, while the highest value was 2730 g in the case of peas + rapeseed.

Biomass productivity of siderate crops was 7.81 - 31.38 tons per hectare according to crop types.

The highest biomass yield (31.38 t/ha) was recorded in the option of mixed planting of peas+rapeseed for siderate, while the lowest biomass yield (7.81 t/ha) was observed when pure peas was planted for siderate crop (Table 1).

Burying the green biomass produced by siderate crops into the ground, during the flowering and fruiting phases of rapeseed and their mixtures, crushing it with a heavy disc harrow (BDT-2,2) and burying it in a double-layer plow (PD-3-35) was carried out and the effect on the change of soil microflora was studied.

The use of siderates in the field of short-row cotton-cereal rotation in fields free from cotton affects not only the properties of the soil, but also the microbiological activity of the soil, and its study is one of the urgent issues today.

Taking into account the importance of the issue, the effect of siderate crop species on the microflora of the soil of the experimental field was studied, and the results of microbiological analysis are presented in Table 2.

After sideration at the beginning of the growing season, the amount of bacteria in the soil of the experimental field was close to each other in all options, and 4.43 - 7.26 million piece bacteria were formed in 1 g of soil in two years. At this time, it was found that the number of bacteria in the soil was influenced by the biomass left by siderates in the soil. For example, in the experiment, at the beginning and end of the cotton growth period, the number of

bacteria decreased by 0.10 million (4.32 million) 1 g of soil in the control-without siderate option. The number of bacteria in the peas+rapeseed variant is 7.26 - 7.30 million. grain increased. However, it was observed that it was 1,40 – 2,83 million and 1.60 - 2.98 million more than the control variant.

Also, in the options where siderates were used, the amount of bacteria in the soil of the experimental area was 1.60 - 2.98 million from the initial amount at the end of the vegetation period. it was determined based on the analysis that there was a lot per grain. The number of bacteria in the experimental area was the highest (7.30 million in 1 g of soil) in the peas+rapeseed variant.

At the beginning of the growing season, in the control option (in 1 g of soil) 1.18 million, if there is a piece of actinomycete, this indicator is 1.53 in the options where sideration is used; 1.28; 1.56 mln. formed a piece. The number of actinomycetes, the increase of plant biomass, that is, with the increase of soil moisture, compared to the control option, 0.1 - 0.36 million. increased to pieces.

At the end of the growth period, the number of actinomycetes in the options with siderates was multiplied compared 0.12 - 0.48 million piece to the control option (1.20 million units) increased. In this case, the number of actinomycetes in the peas+rapeseed option is 0.48 million more than in the control. it was found that there was a lot of piece. However, if the amount of actinomycetes at the beginning of the growing season and at the end of the growing season is compared, these indicators will definitely be higher than the initial amount.

At the beginning of vegetation, the number of fungi in the control variant was 20.2 thousand pieces per 1 g of soil. With the increase of the biomass accumulated in the soil, the amount of fungi in the soil increased by 21.2 - 24.5 thousand piece compared to the control option. At the end of the growing season, the amount of fungi in the soil was 20.9 thousand/g in the control option, and it was 21.6-24.3 thousand more than the amount of fungi in the siderate-applied options (Table 2).

Table 2. Effect of sideration on soil microflora (0-40 cm), 2019-2020

Variants of experience	At the beginning of the growing season			At the end of the growing season		
	bacteria, million/g in soil	actinomycetes, million/g in soil	fungi, thousand/g	bacteria, million/g in soil	actinomycetes, million/g in soil	fungi, thousand/g
Control without sideration	4,43	1,18	20,2	4,32	1,20	20,9
Peas	6,12	1,53	42,6	6,24	1,60	43,3
Rape	5,83	1,28	41,4	5,92	1,32	42,5
Peas+rape	7,26	1,56	44,7	7,30	1,68	45,2

When the relationship between the yield of siderate crops (peas, rape and their mixtures) and the bacteria in the soil is statistically analyzed, there is an inverse relationship according to the change in direction, and according to its analytical expression, there is a linear relationship, and their regression equation obeys the expression y = a – bx and the correlation coefficient r It was found to be <0.91. This situation is noted at the beginning of the growing season. It can be seen that when the plants are grown for the purpose of sidercia, it is statistically proven that the productivity and yield increase as a result of planting the crop species in pure and mixed form (Fig. 1).

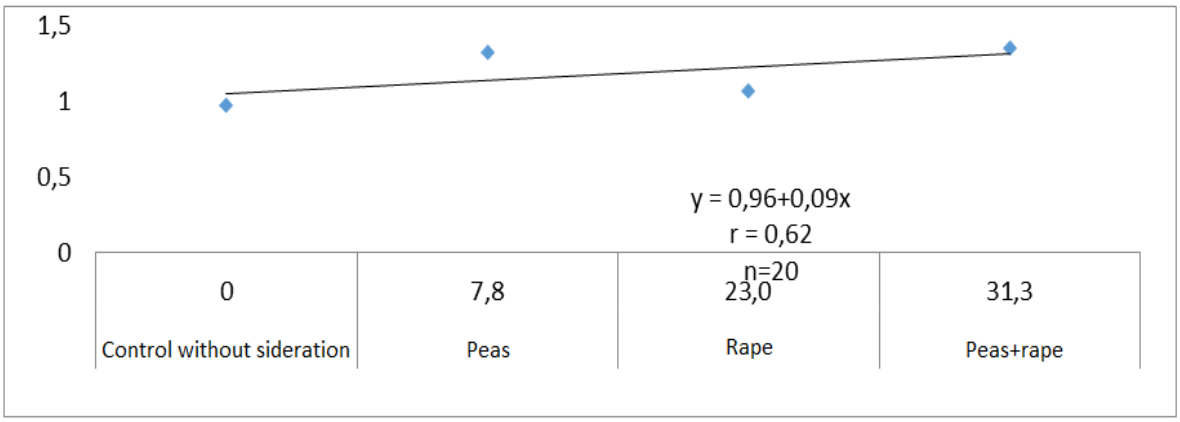

Fig. 1. Dependence of the number of bacteria in the soil on the biomass of siderate crops at the beginning of the growing season

The correlation between the number of actinomycetes and the biomass of siderate crops at the beginning of the vegetation period is 0.62. This, in turn, expresses the above-mentioned relationship (Figure 2).

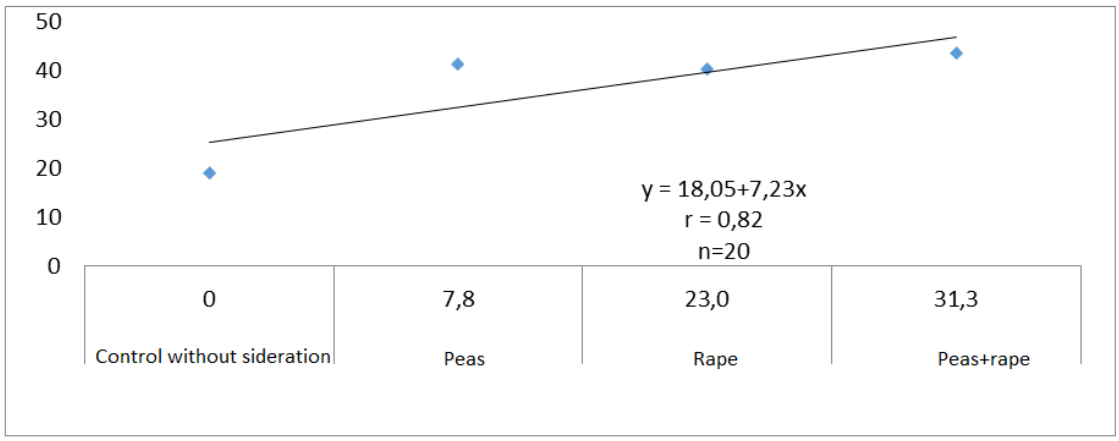

Fig. 2. Dependence of the number of actinomycetes in the soil on the biomass of siderate crops at the beginning of the growing season

Our next statistical analysis is about the dependence of the number of fungi on the biomass of siderate crops (at the beginning of vegetation). In this case, it obeys the correlative equation u=a+bx and is r=0.82. This once again proves the dependence of the number of microorganisms in the soil on the organic content, which is presented in scientific sources (Figure 3).

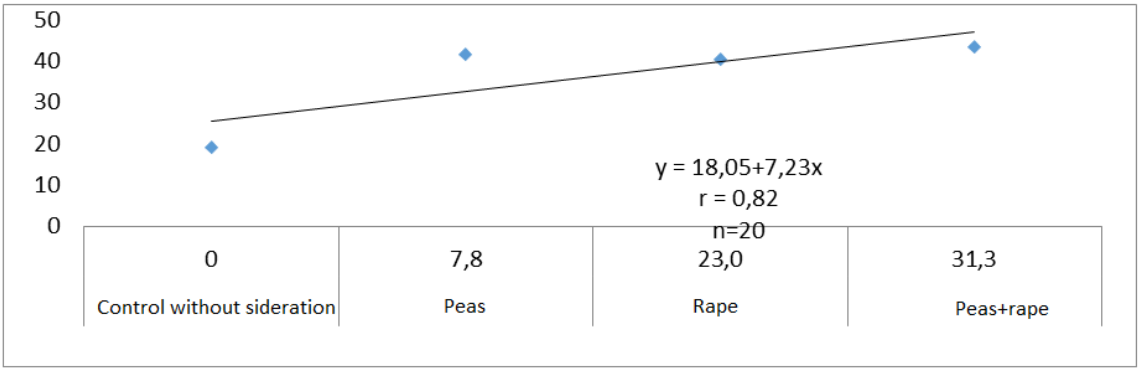

Fig. 3. Dependence of the number of fungi in the soil on the biomass of siderate crops at the beginning of the growing season

Positive effect on soil microflora when planted in a mixture with peas+rapeseed as a siderate, that is, at the beginning and end of the vegetation (in the control option, bacteria, 4.43 - 4.32 million/g, actinomycetes, 1.18 - 1.20 million/g, and fungi , 20.2 - 20.9 thousand/g of soil) compared to the control option, bacteria in 1 g of soil are 2.83-2.98 million, actinomycetes 0.36 - 0.48 million, fungi 24.5 - 24.3 thousand was found to have increased. Due to this, the biomass of siderates decomposed quickly and in a short period of time in the soil. As a result, soil fertility has improved significantly.

The number of microorganisms is significantly affected by the biomass of plants that are plowed into the ground as siderate.

Thus, when the biomass of siderate crops is plowed into the ground, the number of microorganisms in the soil is 2.83 - 2.98 million bacteria per 1 g of soil compared to the control option without siderate; actinomycetes 0.36 - 0.48 million; fungi increased by 24.5 - 24.3 thousand pieces. As a result, its microbiological activity increased and had a positive effect on soil fertility and the development and yield of agricultural crops.

4. Conclusions

1. Pure peas (7.81 t/ha) as a siderate to fields cleared of cotton in autumn (October 10); When rapeseed (23 t/ha) and peas + rapeseed (31 t/ha) were planted and cared for, the highest biomass yield was 31.38 t/ha in the option of using

peas + rapeseed, the lowest yield (7.81 t/ha) it was found to be a peas variant. The resulting biomass was comminuted as siderate in early April and buried in the soil.

2. In order to increase the fertility of the soil, the use of peas and rapeseed in their pure form and their mixtures as a siderate allows to increase the number of microorganisms in the soil. In particular, the number of bacteria at the beginning and end of the growth period of the cotton plant compared to the control was 2.83-2.98 million/g, actinomycetes 0.36-0.48 million/g, the number of fungi 24, 3 - 24,5 thousand/g increased a result, its microbiological activity increased, and as a result of rapid and short-term decay and decomposition of soil biomass, it led to a significant increase in the amount of nutrients in the soil.

References

1. I. Bobokho'jaev, P. Uzokov, Soil structure, Soil science (textbook), Teacher, Tashkent (1995)
2. V.G. Lareshin, N.N. Bushuev, V.T. Skorikov, A.V. Shuravilin, The use of stubble green manure crops and stravoma for the reproduction of soil organic matter, In: Preservation and improvement of the fertility of agricultural land, Moscow (2008)
3. J. Voynova-Raykova, V. Rankov, G. Ampova, Microorganisms and fertility, Agropromizdat, Moscow (1986)
4. E.N. Mishustin, V.T. Emtsov, Microbiology, Kolos, Moscow (1987)
5. I.A. Sutin, G.R. Finn, L.N. Zelenskaya, Microbiology, Medicine, Moscow (1973)
6. N. Tillakhodjaeva, Preservation of soil microflora, *Agricultural science application of Uzbekistan* **3**, 7 (2007)
7. MASRU, Methodology of the State variety testing of agricultural crops, Kolos, Moscow (1971)
8. Metnods of conducting field and vegetation experiments with fodder crops, VIK, Moscow (1983)
9. MASRU, Metnods of Agrochemical, Agrofisikal and Microbiological Research and Irrigated Cotton Areas, Moscow (1963)
10. Yu.Ch. Kenjaev, Effects of Sideration on Soil Fertility and Cotton Yield in Short Rotation Cropping, Ph.D. Dissertation in Agriculture, NUU, Tashkent (2010)
11. Yu.Ch. Kenjaev, The effect of the green manure on soil aggregates, *Int. J. Innovations in Engineering Research and Technology* **142056**, 58- 70 (2020)
12. Yu. Kenjaev, A.B. Tursunkulova, A. Khalilov, Growth, development and biomass productivity of intermediate (siderat) crops planted in different periods, *O'zmu Khabarlari* **3**, 108-111 (2022)
13. Yu. Kenjaev, A. Tursunkulova, Changes in soil physical properties under the effect of irrigation, *IOP Conf. Series: Earth and Environmental Science* **939**, 012081 (2021)
14. Yu.Ch. Kenjaev, The effect of the green manure on the mass of soil (density) and porosity, Actual problems of modern science, Moscow (2019)
15. Y. Kenjaev, R. Aripov, The Influence of Different Sowing Dates on the Production of Green Biomass of Green Manure, *AIP Conference Proceedings* **2432**, 235-246 (2022)
16. Yu. Kenjaev, A. Tursunkulova, Changes in soil physical properties under the effect of irrigation, *IOP Conference Series: Earth and Environmental Science* **939**, 012081 (2021)
17. I. Onal, E. Aykas, H. Yalcin, Cotton production of main and second crop established from seedlings in Aegean Region, *Journal of Agricultural Machinery Science* **5**, 323-336 (2009)
18. Yu. Kenjaev, F. Davronova, Study on the effect of green manure application on soil fertility, *IOP Conf. Ser.: Earth Environ. Sci.* **1142**, 012112 (2023)
19. Y. Kenjaev, Changes in the granulometric composition of Zarafshan river soils under irrigation and comparative analysis, *E3S Web of Conferences* **377**, 03006 (2023)
20. Yu.Ch. Kenjaev, D.U. Turdibaev, Effect of Cotton Yield of Siderites Used at Different Times in the Short-Quality Cotton-Cropping System, *International Journals of Sciences and High Technologies* 9–12 (2020)
21. Yu.Ch. Kenjaev, The Influence of Applied Green Manure in Various Terms on the Cotton Productivity, *Int J Bio-Science and Bio-Technology* **11**, 31–36 (2019)
22. Yu.Ch. Kenjaev, Effect of different planting periods on green biomass yield of siderate crops, *Science and education* **1**, 64–69 (2020)
23. Yu.Ch. Kenjaev, The influence of green manure on getting infected of cotton plant with verticilliosis wilt, *Science, research, development* **29**, 11-15 (2019)
24. Yu.Ch. Kenjaev, R. Oripov, Monograph on the cultivation of siderate crops, their impact on soil fertility and cotton yield, Turon-Iqbal, Tashkent (2020)
25. Yu. Kenjaev, Z. Jabbarov, S. Makhammadiev, D. Makhkamova, D. Turdibaev, R. Oripov, Green Manure Crops Effects on Cotton Growth, Development and Productivity at Different Terms, *European Journal of Molecular & Clinical Medicine* **8**, 235–246 (2021)

26. R.O. Oripov, Prospects of intermediate crops in agriculture of Uzbekistan (Methodical recommendation), Samarkand (1985)
27. A. Tursunkulova, Growth, development and biomass yield of siderate crops, *Agro Science - Agriculture and Water Management of Uzbekistan* **1**, 38-39 (2022)
28. R. Oripov, Prospects of winter intercrops in the agriculture of Uzbekistan, International Scientific and Practical Conference on Improving soil fertility, Tashkent (2007)
29. E.P. Gorelov, R.O. Oripov, Siderates in the fight against weediness of fields, *Agriculture of Uzbekistan* **8**, 15–17 (1968)
30. B.M. Khalikov, Scientific and practical basis for maintaining and increasing soil fertility in the rotation of cotton and cottonseed crops in irrigated areas of Uzbekistan, Doctor of Agricultural Sciences Dissertation, Tashkent (2007)
31. A.P. Gorelik, Water is the key to a good harvest, Uzbekistan, Tashkent (1969)
32. B.A. Dospekhov, Methodology of field experience, Kolos, Moscow (1985)