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Reduction of the Content of Total Nitrogen in the Soil in the Permanent Sowing of Cotton

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Abstract: This article presents analytical scientific data on the change in the content of total nitrogen over 96 years in some variants of the experiment with cotton monoculture, conducted since 1926 for 96 years at the Research Institute of Breeding, Seed Production and Agricultural Technology of Cotton Cultivation, located in the Kibrai district of the Tashkent region. In the 20th year of the study, the nitrogen content in the 1st variant was 0.129%, which, in terms of hectare, it decreased by 0.15 t/ha, in the 2nd variant with the application of mineral fertilizers NPK-250:175:125 kg/ha its content was 0.092% or 0.75 t/ha per hectare; in the 3rd control variant, these figures were 0.087% and 0.96 t/ha, respectively.
This process was also observed during subsequent years, after 40 years these indicators in variants 1, 2 and 3 respectively decreased by 0.18, 1.09 and 1.71 t/ha, after 60 years, respectively, by 0.93, 1.39 and 2.12 t/ha, after 80 years by 1.56, 1.99 and 2.46 t/ha and after 96 years by 1.82, 1.35 and 2.40 t/ha.
In the 1st option, with an annual application of 30 t/ha of manure + 25 kg/ha P_2O_5 in the 40th year of the study, the nitrogen content in the soil decreased much more slowly, but in subsequent years a sharp decrease was observed and over 96 years it decreased by 1.82 t/ha compared to the initial value.
In the 2nd variant, with the annual application of mineral fertilizers at the rate of NPK-250:175:125 kg/ha, the nitrogen content in the soil over 96 years decreased by 32.7% or 1.35 t/ha compared to the initial content, and on the control in the variant without fertilization, the decrease in nitrogen over 96 years was 56.6% or 1.82 t/ha.

Keywords: total nitrogen, nitrate nitrogen, typical sierozem soils, soil fertility, organic fertilizer, plant, fruit elements, cotton monoculture, crop rotation.

1. Introduction

One of the important foundations of scientific agriculture is soil fertility. Although soil fertility is a natural property, it depends on the nutrients accumulated in the process of soil formation, the physical properties of the soil and climatic conditions.
It is known that one of the nutrients needed by the plant in the soil is nitrogen. Nitrogen is one of the most mobile and important plant nutrients. Plant roots absorb nitrogen from the soil in the form of nitrate ions ($N0_2$, $N0_3$) and ammonium ion (NH_4), which are important sources of nutrition. For normal plant growth, the amount of mobile nitrogen in the soil must be sufficient. The amount of mobile nitrogen in the soil is regulated by the application of organic and mineral fertilizers. It is also known that the process of decomposition of organic matter with the formation of ammonia is called ammonification, and the process of oxidation of ammonia to nitrite and nitric acid is called nitrification. It is these processes that affect the dynamics of nitrogen content in the soil.
Reliable data on changes in nitrogenous nutrients in the soil over the years, to one degree or another, can be obtained from studies conducted over many years. One of them is research conducted at the Research Institute of Selection, Seed Production and Agrotechnology of Cotton Growing for 96 years since 1926.
It is known that the natural growth of soil fertility depends only on crop rotation on a scientific basis. The inclusion of cereal legumes as an intermediate, main and secondary crop in the link cotton: cereals with a short rotation scheme of sowing agricultural crops in many cases optimizes the content of humus and nitrogen in the soil, with the passage of years and with the repetition of them, their content increases. This positive process in the southern zone of the Republic, under the conditions of takyr soils, proceeds normally, and in the northern zone, under the conditions of meadow-alluvial soils, it proceeds slowly (Khalikov and Namozov, 2016).
According to A.S. Bashkov, T.Yu. Bortnik et al. (2012), the use of only chemical fertilizers in agriculture for many years leads to a decrease in soil fertility, which ultimately causes serious damage to crop yields. Therefore, in order to maintain a high level of soil fertility, it is necessary to create scientifically based systems for the application of mineral fertilizers for agricultural crops, as well as carefully study their digestibility by plants.

Agricultural crops absorb a large amount of nitrogen from the soil during the period of growth and development. Part of the absorbed substances returns to the soil through the roots, stems and other organs of the plant. The removal of nutrients from the soil by the crop and the return of a certain part of them to the soil in the form of organic residues play an important role in increasing the efficiency of agriculture. The cycle of nitrogen by a plant with a high content (from soil to plant from plant to soil) corresponds to alfalfa, clover, lupine (227-397 kg/ha), followed by potatoes, carrots, rutabaga, sugar beet (113-159 kg/ha) , and indicators of a smaller amount (192.2-150 kg/ha) are observed on leguminous and grain crops (Nikopchik, 2012).

According to M.A. Mazirov (2010), the use of organic and mineral fertilizers for a long time significantly affects the content of humus and nitrogen. In the variant with an annual application of 35 t/ha of manure for 100 years, compared with the control variant without the use of fertilizers, a twofold increase in the content of humus and nitrogen in the soil was observed. In the control variant, the amount of humus did not change for 80 years, and in the variant with the full application of mineral fertilizers, the amount of humus and nitrogen was higher than in the control. However, their decrease was observed after 50 years with the annual application of nitrogen fertilizers. Although a significant decrease in the nitrogen content in the experimental crop rotation options in the first 30 years of experience compared to the control option was not observed, however, in the next 20 years, the decrease was more significant. As a result, both in the variant with monoculture and in the variant with crop rotation, the preservation of the same nitrogen content for 50 years was established.

From this many years of experience, we can conclude that with long-term cultivation of plants without fertilizers in the same area, the amount of humus and nitrogen in the soil, as well as the yield, decreased. In the variants with the full application of mineral fertilizers, the amount of humus and nitrogen in the soil remains insignificant compared to the control, and the yield is high.

From the above sources, it can be concluded that regular analysis of the nutrient content of the soil, taking into account the plant biology and the amount of nutrients in the soil when applying fertilizers, which will serve as the basis for sustainable soil fertility for the future.

2. Materials And Methods

This experiment on the study of soil fertility is carried out in the conditions of old-irrigated typical sierozem soils in the Tashkent region, medium loamy in texture with a groundwater level of 18-20 m. The duration of the experiment is 96 years and is carried out without repetition. The experiment consists of 8 options - 1-option monoculture with an annual application of manure 30 t/ha + phosphorus 30 kg/ha, 2-option monoculture with an annual application of NPK 250:175:125 kg/ha, 3-option monoculture with absolutely no fertilizers, control, 4-variant monoculture with an annual application of NPK 150:100:50 kg/ha, 5-variant crop rotation 3:7 alfalfa-cotton with the introduction of NPK 150:100:50 kg/ha, 6-variant crop rotation 3:7 alfalfa -cotton with application of NPK 150:100:50 kg/ha + manure 30 t/ha, 7-variant crop rotation 3:7 alfalfa-cotton, no fertilizer, control, 8-variant crop rotation 3:7 alfalfa-cotton + manure application 10 t/ha every year. The area of each option is 2000 m2, and the total area of the experiment is 1.6 hectares.

The volumetric mass of the soil and the content of total nitrogen in the soil were determined in all variants at the beginning and end of the growing season in soil samples from layers of 0-30 and 30-50 cm, while the volumetric mass was determined by the Kachinsky method, and the total nitrogen content was determined by the method of I.M. Maltseva , L.N. Gritsenko. Calculations of the content of total nitrogen in the soil per ton were carried out based on the mass of soil in 1 cm^3 in a 0-30 cm soil layer with the calculation of a volume unit in a certain area.

3. Results And Discussions

For plants, nitrogen is one of the necessary fruit elements. It is included in all compositions of simple and complex proteins, nucleic acids, chlorophylls, phosphatides, alkaloids, some drugs and enzymes. When feeding plants, ammonium salts serve as a source of nitrogen. The greatest amount of nitrogen assimilation in the soil is observed during the period of intensive development of plants. At the same time, protein breakdown occurs, with protein synthesis predominating in young, growing organs, while protein breakdown is more pronounced in older and stunted organs. In conditions of nitrogen deficiency, plant growth slows down sharply. With a balanced nitrogen supply, proteins are quickly synthesized in plants, which leads to an increase in yield and protein content.

These analyzes indicate the importance of nitrogen in plants, that its changes under various conditions depend on the environment, and more accurate and reliable information about the activity of nitrogenous nutrients in the soil can only be obtained on the basis of many years of experience.

The experiment with cotton monoculture, carried out since 1926 at the Research Institute of Cotton Breeding, Seed Growing and Agricultural Technology, has shed light on the activity of nitrogenous elements in the soil at different levels for many years.

This experiment consists of 8 options, the article includes three options in the experiment, the first option is applied 30 t/ha of manure + 25 kg/ha R2O per year of continuous cotton, the rate of mineral fertilizers NPK 250:175:125 kg/ha is applied annually 2nd variant and without fertilizers (control), analysis of data obtained according to the 3rd variant

The mentioned experience consists of 8 options, the article provides an analysis of the data obtained from three options: 1-option monoculture of cotton with an annual application of manure 30 t/ha + phosphorus 25 kg/ha, 2-option monoculture with an annual application of NPK 250:175:125 kg/ha and 3-variant monoculture without fertilization (control).

According to the data obtained in the first year of the study, i.e. in 1926, the initial content of total nitrogen in the soil layer of 0-30 cm in the 1st variant with the annual application of manure 30 t/ha + phosphorus 25 kg/ha was 0.133% or 4.95 tons per hectare, and in the 2nd and 3 options 0.113% or 4.20 tons.

For the 20th year of the study, i.e. in 1946 this indicator in the 1st variant was 0.129% or decreased by 0.15 t/ha, in the 2nd variant with the annual use of mineral fertilizers NPK 250:175:125 kg/ha it was 0.092% or decreased by 0.75 t/ha, in the 3rd control variant, respectively, it was 0.087% or decreased by 0.96 t/ha. A decrease in the content of total nitrogen was also observed in subsequent years of research, where after 40 years, i.e. in 1966, this indicator in variants 1, 2, 3 respectively decreased by 0.18 t/ha, 1.09 t/ha, 1.17 t/ha, after 60 years by 0.93 t/ha, 1.39 t/ha, 2.12 t/ha and after 80 years decreased by 1.56 t/ha 1.99 t/ha, 2.46 t/ha. According to the data obtained for the year 96 (2022) of the research work, the content of total nitrogen by options decreased by 1.82 t/ha, 1.35 t/ha, 2.40 t/ha, respectively.

The results of the analysis show that the decrease in the amount of nitrogen in the soil in the 1st variant, where 30 t/ha of manure + 25 kg/ha of P2O5 were applied annually, was very slow, where in the 40th year of the experiment it decreased by 3.0-3. 7% compared with the initial content, in the 60th year of the experiment, the nitrogen content decreased sharply (by 18.8%) compared to the initial data, this decrease persisted in the 80th year of the research (decreased by 31.5%), which continued in subsequent years and the decrease was 36.8%, i.e. for 96 years in the soil, the decrease in nitrogen content amounted to 1.82 t/ha.

In the 2nd variant with the annual application of mineral fertilizers at the rate of NPK 250:175:125 kg/ha, although this is a relatively high rate of mineral fertilizers (NPK 250:175:125 kg/ha) when cultivating cotton, however, for the 20th year study, there was a sharp decrease in the nitrogen content by 18.5% (0.75 tons per hectare) compared to the baseline. This process continued over the next years of research, where in the 40th year in the experiment the decrease in the nitrogen content in the soil was 26.5% (1.09 tons per hectare), in the 60th year it decreased by 33.6% (1. 39 tons per hectare), for the 80th year of experience by 47.7% (1.99 tons per hectare), however, in subsequent years, i.e. in the 96th year of the study, a relative slowdown in the decrease in the nitrogen content in the soil was revealed. In general, in this variant, a decrease in the nitrogen content in the soil over 96 years by 32.7% or 1.35 t/ha compared with the baseline was revealed.

In the control variant of the experiment without the use of fertilizers, the nitrogen content reduction rate was higher relative to the above two options, where in the 20th year of the experiment, the reduction rate was 23.0% or 0.96 tons per hectare. A sharp decrease in nitrogen content was also observed over 40 years of experience, with a decrease in nitrogen content of 40.7% (1.71 t/ha). A slowdown in the decline process was observed only in recent years, in the 60th year it was 50.4% (2.12 t/ha), in the 80th year 57.5% (2.46 t/ha) and in the 96th year 56.6% (2.40 t/ha).

It should be noted that the average annual decrease in the nitrogen content in the soil was 0.38% (0.018 t/ha) in the 1st variant using 30 t/ha of manure + 25 kg/ha P2O5, 0.34% (0.014 t/ha) in the 2nd variant with the use of NPK 250:175:125 kg/ha, in the control variant without the use of fertilizers 0.59% (0.025 t/ha). Where between the 1st and 2nd options there is a slight significant difference. All this means that this pattern indicates the high importance of nitrogen in the composition of manure in the formation of the crop in cotton.

Table 1**.** Decrease in total nitrogen compared to the initial content in the fields with permanent cultivation of cotton, %, t/ha.(in 0-30 cm layer)

№	Options	Initial nitrogen content, (1926)	In 20 years, (1946)	After 40 years (1966)	After 60 years (1986)	After 80 years (2006)	After 96 years (2022)	Average decline per year

		%	t/ha	%	%	t/ha	%	%	t/ha	%	%	t/ha	%	%	t/ha	%	%	t/ha	%	%	t/ha
1	Annual application of manure 30 t/ha +25 kg/ha P_2O_5	0,133	4,95	100	0,129	0,15	3,0	0,128	0,18	3,7	0,108	0,93	18,8	0,091	1,56	31,5	0,084	1,82	36,8	0,38	0,018
2	NPK 250:175:125 kg/ha	0,113	4,20	100	0,092	0,75	18,5	0,083	1,09	26,5	0,075	1,39	33,6	0,059	1,99	47,7	0,076	1,35	32,7	0,34	0,014
3	Without fertilizer (control)	0,113	4,20	100	0,087	0,96	23,0	0,067	1,71	40,7	0,056	2,12	50,4	0,048	2,46	57,5	0,049	2,40	56,6	0,59	0,025

4. Conclusion

1. With the annual application of manure 30 t / ha + phosphorus 25 kg / ha for many years (96 years) with permanent cultivation of cotton in one place due to the nitrogen substance in the composition of manure, the degree of nitrogen reduction in the soil is 35-40% lower relative to the option without the use of fertilizers.
2. With regular (96 years) annual application of 30 t/ha of manure + 25 kg/ha of phosphate fertilizers, the decrease in nitrogen in the soil is very slow in the first 40 years, and accelerates in subsequent years.
3. With the permanent cultivation of cotton in one place for many years (96 years) with the annual use of manure 30 t/ha + phosphorus 25 kg/ha, as well as the use of mineral fertilizers with the norm NPK 250:175:125 kg/ha, the dynamics of reducing the amount nitrogen in the soil was almost the same.
4. With the permanent cultivation of cotton in one place for many years (96 years) with the annual use of mineral fertilizers at a rate of NPK 250:175:125 kg/ha, the nitrogen content is intensively reduced in the first years.
5. With the permanent cultivation of cotton in one field without the use of fertilizers for many years (96 years), the nitrogen content in the soil relative to the annual application of manure 30 t/ha + phosphorus 25 kg/ha is reduced by 35% and relative to the annual application of mineral fertilizers by the NPK norm 250:175:125 kg/ha is reduced by 42%.

5. References

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