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Effect of Siderate Crops on Soil Volume and Porosity

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Abstract: This article is devoted to the current issues of increasing soil fertility. All over the world, measures are being developed to effectively use green manures, increase plant biomass, and increase the demand for soil fertility. Green manures are of great importance in enriching the soil with organic matter and thereby improving the physical properties of the soil. These crops improve the physical properties of the soil, increase soil porosity, and as a result, reduce the bulk density of the soil.

Keywords: Siderate crops, soil volume mass, mineralization, vetch, radish, oats, biomass, nutrients.

Introduction:

The decline in soil fertility on a global scale is associated with the intensification of mineralization and erosion processes, as well as the loss of biomass. Using soil fertility to return part of the biomass generated during the process of collecting solar energy to the biological cycle is a way to implement one of the basic laws of sustainable and efficient functioning of agroecosystems, preservation and increase of organic matter, and improvement of biological status.

Plant residues perform many important ecosystem functions: they are a trophic and energy source for soil biota, especially microorganisms and earthworms, provide additional nutrients and carbon to the biological cycle, improve soil, water and air quality, increase productivity and agronomic profitability; and reduces the risk of erosion and nutrient loss.

Measures are being developed around the world to effectively use green manures, increase plant biomass, and increase the demand for soil fertility.

General physical, water-physical properties of irrigated soils are important in increasing soil fertility. Movement of soil moisture and utilization of nutrients depends on physical and water-physical properties.

One of the main limiting factors in ensuring a high yield of crops is the unfavorable agrophysical properties of agricultural soils. One of the favorable conditions for improving soil agrophysical properties

is improving soil biomass.

The specific gravity of soils is a relatively stable unit that can vary depending on the chemical and mineralogical composition of the soil, and its humus content.

According to Komilov [2], before irrigation in the Central Massif of Mirzachul, the groundwater level was at a depth of 15-20 m, and the mineralization level was 10-20 g/l. As a result of the start of irrigation, the average groundwater level rose by more than 2 m per year. As a result, groundwater is located at a critical depth above the surface. One of the reasons for soil salinization in Mirzachul was considered to be the rise of mineralized groundwater.

In the main irrigated grassland soils of the region, the relative density varies between 2.60-2.73 g/cm3 for all geomorphological regions, regardless of the irrigation frequency. The almost closeness of the relative density in irrigated soils is due not only to the similarity of the geomorphological regions, but also to the fact that they all formed on loess deposits, and its increase or decrease may be a result of the development of irrigation works and land reclamation measures.

It should also be noted that even though soils have the same mechanical composition, they may differ slightly in terms of mineralogical composition. L. Tursunov [3] explained this difference in the following way: he gave a scientific justification for the accumulation of large dispersed particles in old irrigated soils and in the middle layer of heavy minerals, magnetite, limonite, hematite, garnet, epidote with a specific mass above -2.9 g/cm3.

A. Akhmedov [4] as a land reclamation soil scientist carried out a large-scale scientific research in Uzbekistan, including in the Mirzachul region. As a result of his research, the author provided extensive scientific information on the factors causing salinization of the soils of this region, the level of seepage waters, and the degree of their mineralization. Also, as a result of his scientific research, a classification of irrigated soils by the degree of salinity was developed.

In newly irrigated grassland soils, the specific gravity is somewhat lower, 2.52-2.61 g/cm3, which indicates that the irrigation period began somewhat later. Since in most irrigated soils, the specific gravity is lower in the upper layers than in the lower layers, this may be due to the transition of soils from one type or group to another.

N.I. Zimina [1] states that the bulk density of light gray soils is not very high. However, during the development process, it was observed that the bulk density of these soils increases as the conditions for soil formation change.

In order to eliminate the compaction of the subsoil and lower layers of irrigated grassland soils under the influence of irrigation and agrotechnical measures, we believe that it is advisable to first loosen the land as deeply as possible and plant perennial grasses and legumes.

Planting of siderate crops is one of the best ways to improve soil fertility, but it is not very widespread. Green manures are important in enriching the soil with organic matter and thereby improving the physical properties of the soil. When studying the soil bulk density in the experimental variants before planting and after green manure, we can see that the bulk density of the experimental plot was on average 1.36-1.41 g/cm3, and after planting green manure, the soil bulk density changed to 1.26-1.33 g/cm3. Among the experimental variants, the best bulk density difference can be seen in the variant with a root crop of 0.11% (Table 1).

Table 1

Changes in soil volume weight under the influence of siderates

(2023-2024 years)

№	Experience options	Layer depth, cm	Volume weight, g/cm^3		
			Before planting	After siderates	Difference (±)
1	Without control-siderate	0-30	1,32		
		30-50	1,41		
2	Rapeseed	0-30	1,36	1,28	0,08
		30-50	1,39	1,31	0,08
3	Vetch	0-30	1,38	1,29	0,09

		30-50	1,41	1,31	0,10
4	Radish	0-30	1,37	1,26	0,11
		30-50	1,39	1,28	0,11
5	Oats	0-30	1,38	1,31	0,07
		30-50	1,39	1,33	0,06

Siderate crops also affect the physical and physical-mechanical properties of the soil. The physical properties of the soil improve, the porosity of the soil increases, as a result, the volume mass of the soil decreases. In the experiment, we can see that the soil porosity in the 0-30 cm layer of the fields where siderat was planted was 49.26-51.41%, and after planting siderat crops, the porosity increased to 52.36-54.67% in the fields of the experimental options (Table 2).

In conclusion, it can be said that siderate crops such as rapeseed, vetch, radish, oat planted in the experimental options have a positive effect on several properties of the soil. It can be seen that the highest soil biomass was accumulated in rapeseed, an average of 16.9 t/ha, which also had a positive effect on soil bulk density and soil porosity, improving the physical properties of the soil. The best index of soil density was observed in radish plant, which was 1.37 g/cm3 in khaydov layer before planting, and 1.26 g/cm3 after siderates. The difference in the change of soil porosity under the effect of siderates is around 2.15-4.07%, and the best porosity is 3.99-4.07% observed in siderate of radish plant.

Table 2

Changes in soil porosity under the influence of siderates

(2023-2024 years)

T/p	Experience options	Layer depth, cm	General porosity, %		
			Before planting	After siderates	Difference (±)
1	Without control-siderate	0-30	47,4		
		30-50	45,6		
2	Rapeseed	0-30	49,82	52,77	2,95
		30-50	50,71	53,55	2,84
3	Vetch	0-30	51,41	54,58	3,17
		30-50	51,21	54,67	3,46
4	Radish	0-30	49,26	53,33	4,07
		30-50	49,64	53,62	3,99
5	Oats	0-30	49,82	52,36	2,55
		30-50	50,18	52,33	2,15

In general, the use of siderate crops as green manure improves the general physical properties of the soil, reduces soil salinity, their roots serve as drainage, reduces the amount of tillage, weeds, diseases and insects, softens the soil, prevents erosion and increases the fertility of the land with other positive properties.

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