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CHANGES IN THE AGROPHYSICAL PROPERTIES OF LIGHT SEROZEM
SOILS UNDER THE INFLUENCE OF DOUBLE CROPPING

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Abstract; The scientific article presents data on the effect of applying mineral fertilizers at different rates and times to mung bean and white bean grown under light serozem soil conditions on the agrophysical properties of the soil. The studies revealed a positive effect of double crops on the agrophysical properties of soil layers. By the end of the growing season, an increase in soil bulk density was observed in all treatments, reaching 1.33 and 1.42 g/cm³; however, compared with the control, this indicator in the optimal treatments was lower by 0.06 and 0.05 g/cm³, respectively, at the end of the season.

Keywords: double crop, mung bean, white bean, bulk density, agrophysical properties, end of the growing season.

Introduction. The agrophysical properties of soil are among the most important indicators of soil fertility. These include soil texture, aggregation or structure, bulk density or compaction, porosity, water permeability, and water-holding capacity.

For the intensive development of the root systems of agricultural crops, favorable soil metabolism, air exchange, and microbiological processes, soil moisture capacity and water-retention ability, as well as the soil water, air, thermal, and nutrient regimes in general, must be optimal.

As scientifically substantiated in numerous studies, when the arable soil layer is well supplied with air, moisture, and nutrients, microbial activity proceeds more effectively. A favorable environment for microorganisms is restored in the soil and their activity increases, thereby improving the physical fertility of the soil. Different nutrient rates that accelerate the transformation of organic matter into active humus play an important role in creating such conditions. Improvement of soil structure, in turn, has a specific effect on changes in soil bulk density.

Studies of soil subtypes with different textures have concluded that fertility indicators are closely related to soil texture and that agricultural crops grow and develop more intensively in soils with a heavy loamy texture [2].

According to data accumulated from long-term scientific research, agrotechnical measures applied to soil can alter soil density, while an optimal bulk density has a positive effect on plant growth and development, soil aeration, nutrient and microbiological conditions, and improvement of the soil water regime [3].

It has been noted that favorable conditions for the optimal growth and development of mung bean and white bean occur when soil bulk density is approximately 1.1–1.3 g/cm³. At this bulk density, adequate air and matter exchange and microbiological activity are



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ensured, together with increased uptake of nutrients. Capillary uptake of nutrients that are otherwise difficult for plants to absorb is also improved [1].

Research methods. All observations, analyses, and calculations in the study were carried out in accordance with the methodological manuals “Methods for Conducting Field Experiments” and “Methods of Agrochemical, Agrophysical and Microbiological Research in Irrigated Cotton-Growing Regions” (1963), including determinations of soil nutrient contents and agrophysical analyses.

Results. Our research investigated the effects of growing double crops on the agrophysical and agrochemical properties of soil in fields vacated after winter wheat. In particular, the influence of different mineral fertilizer rates on changes in soil bulk density was studied. These fertilizer rates were applied to the soil before plowing for winter wheat in 2022 and during the growing season, and their effects were studied in 2022–2024.

The double crops used in the study, owing to their natural ameliorative and nutritional properties, affected the agrophysical and water-physical characteristics of the soil layers. Changes in the macroaggregate fraction of the soil texture contributed particularly to improvements in bulk density in the plow and sub-plow layers.

In the first year of the experiment, in control treatment 1, soil bulk density at the beginning of the season was 1.35 and 1.39 g/cm³ in the plow layer (0–30 cm) and sub-plow layer (30–50 cm), respectively. By the end of the season in October, these values increased to 1.39 and 1.44 g/cm³.

In treatments 2–6, where mineral fertilizers were applied at N₀P₆₀K₄₀ kg/ha, soil bulk density in the 0–30 and 30–50 cm layers at the beginning of the season was 1.34–1.35 and 1.38–1.39 g/cm³, respectively, and was 0.01 and 0.02 g/cm³ lower than in the control. This was because the mineral nutrients had been applied before plowing.

In treatments 3–7, where mineral fertilizers were applied at N₂₀P₈₀K₆₀ kg/ha, soil bulk density at the beginning of the season was 1.33–1.34 and 1.38–1.37 g/cm³ in the 0–30 and 30–50 cm layers, respectively, representing decreases of 0.02–0.01 and 0.05 g/cm³ compared with the control. By the end of the season, the corresponding values were 1.39–1.38 and 1.42–1.41 g/cm³, which were 0.02–0.03 and 0.06–0.05 g/cm³ lower than the control, respectively.

In treatments 4–8, where N₂₀P₄₀K₂₀ kg/ha was applied as plant nutrition during the growing season of mung bean and white bean, changes in soil bulk density were observed from the beginning of the season. By the end of the season, bulk density was 1.33–1.38 and 1.39–1.42 g/cm³, which was 0.05–0.06 and 0.05–0.02 g/cm³ lower than in the control, respectively.

Appendix 3

Effect of double crops on changes in soil bulk density (g/cm³), 2022



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No.	Treatments	Before sowing, 18.07.2022					End of season, 14.10.2022				
		0-10	10-20	20-30	0-30	30-50	0-10	10-20	20-30	0-30	30-50
1	Control	1,34	1,35	1,36	1,35	1,39	1,39	1,40	1,40	1,39	1,44
2	Mung bean	1,33	1,34	1,35	1,34	1,38	1,38	1,39	1,39	1,39	1,43
3		1,33	1,33	1,34	1,33	1,38	1,38	1,39	1,39	1,39	1,42
4		1,29	1,30	1,32	1,30	1,37	1,33	1,33	1,34	1,33	1,39
5		1,33	1,34	1,35	1,34	1,38	1,38	1,39	1,39	1,39	1,43
6	White bean	1,34	1,35	1,36	1,35	1,39	1,39	1,40	1,40	1,39	1,44
7		1,33	1,34	1,35	1,34	1,37	1,38	1,39	1,39	1,38	1,41
8		1,33	1,34	1,35	1,34	1,37	1,38	1,38	1,39	1,38	1,42
9		1,29	1,30	1,31	1,30	1,36	1,33	1,33	1,34	1,33	1,39

In treatments 5–9, where mineral fertilizers were applied at $N_{40}P_{60}K_{40}$ kg/ha, soil bulk density at the beginning of the season was 1.34–1.30 and 1.38–1.36 g/cm³ in the 0–30 and 30–50 cm layers, respectively, which was 0.05–0.01 and 0.02–0.03 g/cm³ lower than in the control. By the end of the season, the corresponding values were 1.39–1.33 and 1.43–1.39 g/cm³, representing decreases of 0.05–0.01 and 0.05–0.02 g/cm³ compared with the control.

Conclusion. The study showed that the cultivated double crops, due to their natural ameliorative and nutritional properties, affected the agrophysical characteristics of the soil layers and led to an improvement in bulk density in both the plow and sub-plow layers.

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