FACTORS LIMITING FERTILITY IN ARZIQ SOILS AND THEIR EFFECT ON COTTON YIELD

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Abstract: This article studies the agrophysical and agrochemical properties of *arziq* (gypsiferous hardpan) soils distributed in the lower part of the Shohimardon alluvial fan, as well as their influence on the growth and development of cotton. During the research, soils were divided into three groups based on the depth of the *arziq* layer: shallow (30-60 cm), medium deep (60-100 cm), and deep *arziq* soils (below 100 cm). Analyses indicate that increased soil bulk density (1.7-1.8 g/cm³), reduced porosity (32-34%), and nutrient deficiency within the *arziq* layer are the main factors limiting the development of the cotton root system. It was determined that in shallow *arziq* soils, cotton roots become deformed, and the yield averages 25 centners per hectare, whereas in deep *arziq* soils, the root system develops well, and the yield reaches 35 centners. The article presents scientific conclusions on improving the meliorative state of these soils.

Keywords: *arziq* soils, Shohimardon alluvial fan, soil fertility, cotton yield, *arziq* layer, root system, agrophysical properties.

Introduction: Although increasing soil fertility depends on the correct application of a system of measures—such as applying organic and mineral fertilizers and establishing proper crop rotation systems—the effectiveness of these measures also depends on the soil environment, specifically its chemical and physical indicators. Accordingly, resolving issues related to improving the soil environment and its meliorative state is considered one of the critical factors in solving the problem of increasing fertility directly. Therefore, solving these problems is a pressing issue.

Methodology and Soil Classification

Our research was conducted in the lower regions of the Shohimardon alluvial fan to study the levels of soil fertility (agrochemical indicators) in relation to the noted indicators and, correspondingly, the growth and yield of cotton. In the research area, based on the "Classification of Saline Soils" (V.V. Yegorov, N.G. Minashina, 1975) and supplementing it with the Group VIII classification developed by O.K. Komilov and V.V. Yegorov, the following soil varieties were distinguished:

1. **Shallow *arziq* meadow soils:** The *arziq* layer is located at 30-60 cm in the soil profile.

2. **Medium deep *arziq* meadow-saz soils:** The *arziq* layer is located at 60-100 cm in the soil profile.

3. **Deep *arziq* soils:** The *arziq* layer is located below 100 cm in the soil profile.

Physical and Chemical Properties

The physical property indicators of the supra-*arziq* (above the *arziq*) layers of the soil profile are in a relatively satisfactory state; their bulk density is around 1.3-1.4 g/cm³, and aeration porosity is high, reaching 50%. However, upon reaching the *arziq* layer, these indicators become unsatisfactory; the layer is compacted to a cemented degree (aeration porosity 32-34%), and accordingly, the soil bulk density indicator increases, reaching 1.7-1.8 g/cm³.

The amount of water-soluble salts in the soil profile averages around 0.3-1%, distributed in increasing order from top to bottom, reaching the highest values in the *arziq* layers. Sulfate ions constitute the main part of the salt composition (0.35-0.70%). The amounts of hydrocarbonate and chlorine ions are less than 0.01%, increasing slightly in the *arziq* layers (0.015%; 0.018%).

Our research determined that due to the aforementioned property indicators, the *arziq* layer itself is low in nutrients and also directly restricts the nutritional area of plants.

Impact on Cotton Growth and Yield by Soil Type

1. Shallow *Arziq* Soils In shallow *arziq* soils, the mobile forms of nutrients are accumulated mainly in the supra-*arziq* layer (40 cm). Humus content is 1.650%, total nitrogen 0.080-0.100%, total phosphorus 0.140%, mobile phosphorus 0.27 mg/kg, total potassium 0.9%, and mobile potassium around 170 mg/kg. In the *arziq* layers, these indicators decrease sharply, falling to the lowest level of provision.

Due to unsatisfactory physical and chemical property indicators, the shallow location of the *arziq* layer has a direct impact on the root system of cotton plants grown here. The main root could not pierce through the *arziq* layer and grew sideways. As a result, it appeared twisted and short (33-37 cm). Accordingly, first-order lateral roots were few (25-30), and their length was also short (80 cm). They were more numerous in the 0-10 cm soil layer (15-20 units) and very few in the lower layers (5-7 units).

The shallow placement of the *arziq* layer was also reflected in the stem structure of cotton plants. Due to unsatisfactory agrochemical indicators consistent with soil physical properties, the main stem height of cotton plants grown here was small (73 cm), fruiting branches and elements were few (8-9 units), and the mass of cotton in the boll was light (3.34 g). Therefore, the yield indicator in these soils constitutes at most 25 centners.

2. Medium Deep *Arziq* Soils In medium deep *arziq* soils, the direct influence of the *arziq* layer is reduced. A sharp decrease in nutrients in the sub-plow layers is not

observed. In the supra-*arziq* layers, humus content reaches 1.800-1.000%, total nitrogen 0.180-0.090%, mobile phosphorus 35-14 mg/kg, and exchangeable potassium 145 mg/kg. In the underlying *arziq* layers, these indicators drop sharply: humus to 0.300%, total nitrogen to 0.040%, mobile phosphorus to 5 mg/kg, and exchangeable potassium to 24 mg/kg.

The *arziq* layer had a direct impact on the plant root system here as well; unlike in shallow *arziq* soils, the main root was slightly longer (55 cm), lateral roots were few (37-42 units) and short (88 cm), with the main part distributed in the 0-30 cm plow layer of the soil. It was determined that the main stem height of the cotton stalk was relatively high (75 cm), fruiting branches (7 units) and elements were few (10 units), and the mass of cotton in the boll was 3.42 g. Cotton yield in these soils reaches an average of 26-27 c/ha.

3. Deep *Arziq* Soils In deep *arziq* soils, the direct influence of the *arziq* layer on the plant was not expressed. The nutritional area is wide (100 cm), and nutrients are distributed in a gradually decreasing order toward the lower layers of the profile. In the supra-*arziq* layers, the total amount of humus is around 1.750-1.000%, total nitrogen 0.170-0.100%, mobile phosphorus 28-15 mg/kg, and exchangeable potassium 166-100 mg/kg.

The development status of the plant root system has positive indicators compared to other soil varieties. The main root is long (75 cm) and grew vertically straight. The main part of the lateral roots (54 units) branched in the 0-40 cm soil layer, and the rest in the 40-80 cm layer. The above-ground organs of the plant also developed well. The main stem was tall (98 cm), fruiting branches (12 units) and elements were numerous (17 units), the cotton in the boll was heavy (3.60 g), and accordingly, the yield averaged 35 centners per hectare.

Conclusion

Thus, increasing fertility in *arziq* soils and increasing the volume of the crop grown directly depends on the soil's agrophysical properties and, partially, on the chemical property indicators formed under its influence. Developing and implementing additional measures to improve these properties serves as a significant basis for increasing the fertility of *arziq* soils, and conducting research in this regard holds important practical significance.

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