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Review Article

The Importance of Soil Conditions for the Growth of Cultivated Plants in the Aral Sea Region

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Abstract: The article discusses the importance of soil conditions for the growth of cultivated plants in the Aral Sea region. Cultivated fruit plants are sensitive to growing conditions. The best development and highest productivity of fruit plants is achieved with an optimal combination of key growth factors. When allocating land for orchards, it is necessary to determine the level of groundwater and salinity.

Keywords: *Priaralye, soil conditions, ecological processes, fruit crops, groundwater, moisture, soil structure*

Introduction

The drying up of the Aral Sea is accompanied by an increase in summer temperature, a deficit in saturation with air vapor, and increased evaporation of plant transpiration. Climatologists believe that the frequency of dry winds and dust storms has also increased soil salinity and groundwater mineralization have increased (Aimbetov, N.K. *et al*., 2017).

The Aral Sea problem has acquired a planetary character, since the Aral Sea plays an important role in the preservation of the Earth's biosphere. Economic and social development, reorganization of the political structure of society is the most important components of the general strategy of tactics of the government and the entire population of the Republic of Uzbekistan (Aimbetov, N.K. *et al*., 2017).

Currently, the priority area is the solution of the food problem. Its successful solution envisages, in particular, the intensification and development of agricultural production, and, accordingly, an increase in horticultural production. Successful fulfillment and implementation of the tasks set presuppose the solution of applied production issues, as well as the formulation and appropriate development of certain general biological principles that directly affect the efficiency of the national economy (Gnedenko V.V. and Obushchenko S.V. 2013; Zhollybekov, B. 1987).

Findings and Results

It is possible to solve the problem of full provision and production of horticultural products only on the basis of an optimal combination of general biological research with simultaneous in-depth development of modern methods and progressive technologies, with their widespread introduction into industrial fruit growing.

The development of horticulture requires a comprehensive study of soil and climatic characteristics, the relationship of the breed and variety to various degrees of soil salinity to the height of the groundwater, as well as to winter cold in some years and spring frosts both from the tree side and from the fruit buds (Gnedenko V.V. and Obushchenko S.V. 2013; Zhollybekov, B. 1987).

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In the last years of the new century, global climate change is noted, an increase in the total technogenic load on agrobiocenoses. The range of fruit crops turned out to be insufficiently adapted to the ongoing climatic changes, the role of various stress factors increased, and the functioning of phytopathogens changed. The technologies used in agricultural production and horticulture turned out to be unadapted to the changed agro-climatic conditions (Gnedenko V.V. and Obushchenko S.V. 2013; Zhollybekov, B. 1987; Kachinsky, N.A. 1965).

Cultivated fruit plants are sensitive to growing conditions. Climate, soils, underlying soils, relief, agricultural technology and other environmental conditions determine the supply of the main factors necessary for the growth and development of fruit plants, heat, light, water and nutrients. The best development and the highest productivity of fruit plants are achieved with an optimal combination of the main growth factors. Cultivation of fruit plants is possible almost everywhere. However, industrial fruit growing can develop successfully only in areas that best meet the biological requirements of the cultivated fruit plant (Dudkin G.I. 2004; Dudkin G.I. and Grokhovatskiy, I.A. 2001).

Until recently, soils and relief occupied a subordinate position in assessing the possibility of developing industrial fruit growing. Nowadays, when it is necessary to produce fruits with a low cost, the importance of these factors is increasing.

In Uzbekistan G.I. Dudkin (2004) found that the soils of Karakalpakstan are quite fertile, clays and loams make up 52.9% here, sandy loam occupies 14.2%, yellow sand - 21.2%, gray sand - 11.7% (Dudkin G.I. 2004).

Thus, bedding is a typical phenomenon in the soil-forming process of Karakalpakstan, associated with the deposits of river silt deposits on cultural lands in the lower reaches of the Amu Darya. In the lower reaches of the Amu Darya, from the moment the garden was laid until the period of full fruiting of trees (17 years), 0.4 m thick fluff on light soils and 0.55 m thick on heavy soils accumulates, which contributes to the preservation of the root system from soil freezing in certain years.

Much attention has been paid to the mechanical composition of the soil, which determines, along with the structure, physical properties. The permeability of the soil and especially the subsoil is an important indicator of the suitability of the site for an orchard. It consists of the properties of the soil to absorb and filter water. Fruit plants grow better provided that the main root layers of the soil absorb water well, and the lower ones filter it (Zelensky N.A. and Lugantsev E.P. 2005).

Growth conditions are less favorable if the root layers store little moisture. This issue relates directly to the water-air regime, and we will highlight it below. Growth conditions for fruit plants are less favorable even if the lower layers of the soil and subsoil have insufficient or excessive filtration capacity. The latter also affects the water-air regime of the root zone (Asmus A.A. 2013).

A significant decrease in the water permeability of the lower horizons of the soil and subsoil negatively affects the growth and development of fruit plants in all climatic zones, as it impairs aeration, causes waterlogging, exposure, deterioration of the nutritional regime and chemical properties of the soil.

The stock of available moisture depends on the mechanical composition, constitution, structure of the soil, on the level of soil and groundwater. According to A.A. Rode (1955), who uses the term range of active moisture, the latter is 2.8-5.7% for sands, 5.7-9.0% for sandy loams, 9.0-11.0% for loams %, for clays 9.0-8.0%. A decrease in the range of active moisture in clays is explained by the fact that with an increase in the mechanical composition, the wilting moisture, which depends almost on the mechanical composition, increases faster than the lowest moisture capacity (Negovelov S.Yu. 1960).

The lowest moisture content depends mainly on the texture and composition of the soil. In sands it is 3-5%, in sandy loams 10-12%, and in loams and clays it reaches 12-22%. It is usually higher in the upper, looser soil horizons. Therefore, the supply of available moisture in the upper horizons is greater. If the soil has a homogeneous texture, then bulk samples of the same volumetric weight have the same lowest moisture capacity (Dorozhko, G.R. and Borodin, D.Yu. 2010).

Fruit plants react differently to weakening aeration and oxygen supply to the roots. According to Boynton and Compton (Boynton, Compton, 1943), plum (rootstock - microblanc) proved to be the most sensitive among those tested in aquatic cultures aerated with various gas mixtures of three species of peach, plum and apple. With a decrease in oxygen concentration from 20 to 15%, the number of new roots decreased from 50 to several pieces per 1 tree, and the average weight of leaves decreased by half. In the compared experiment, the number of new roots in the apple tree decreased by only 38%, and the weight of leaves by 22%. At an oxygen concentration of 15% in the aerating mixture, the peach did not form new roots (Dudkin G.I. 2004; Dudkin G.I. and Grokhovatskiy, I.A. 2001).

To assess the reaction of fruit plants to soil conditions, it is always important to know the physicochemical properties of the soil, determined by the soil absorbing complex and the nature of its exchange reactions with the soil solution. As you know, the absorbing complex consists of water-insoluble soil colloids, represented by aluminosilicate, organic and organo-mineral compounds. With a negative electric charge, this complex absorbs cations from the soil solution. Instead of absorbed cations, an equivalent amount of other exchangeable ions passes from the solid phase into the soil solution. The absorption capacity depends on the amount of humus and the texture. The works of Soviet soil scientists have shown that the absorption capacity is not constant. The highest absorption capacity is possessed by chernozems developed on loess, the least - poorly formed sandy soils.

The absorption capacity affects the diet. As a result of the absorption of cations from the applied fertilizers, they are protected from leaching, the concentration of the soil solution does not increase to a harmful level, and the ratio of individual ions in it remains relatively stable.

Exchange reactions in the soil are very fast. Although an increase in the absorption capacity is usually accompanied by an increase in fertility, nevertheless, the absorption capacity does not have much effect on the life of fruit plants. Very often soils with a high absorption capacity are less suitable than those with a slightly reduced one, if in the latter case the soils have a lighter texture (Zelensky N.A. and Lugantsev E.P. 2005; Kachinsky, N.A. 1965; Rode, A.A.1952).

Soil-groundwater and groundwater have a direct and indirect impact on fruit trees. The direct influence of these waters lies in their effect on the water supply (the amount of available moisture, its availability depending on osmotic pressure, temperature), aeration, food regime and vital activity depending on chemical properties. The indirect influence of soil-groundwater and groundwater is manifested in the fact that they change the physical and physicochemical properties of the soil, their microbiological activity, food and thermal conditions, etc. The direct and indirect influence of soil-groundwater and groundwater on fruit plants may not coincide in time.

Fruit plants react negatively to the strong compaction of both the upper and lower horizons of the soil and subsoil. However, if the structure of the upper horizons can be radically improved even before planting the garden, then the structure of the lower horizons and subsoil can hardly be reclaimed.

The compaction of the lower horizons of the soil and subsoil also depends on their structure, however, since the water-air regime and mechanical properties are determined by greater compaction as a property that depends on a wide range of factors, since compaction to the greatest extent can characterize the living conditions of the root system.

Until recently, the compaction characterization was not accepted as one of the main measures in determining the suitability of the soil for horticultural plantings. This was due to the variation in the volume of the soil depending on its moisture content. S.F. Negovelov (1960) originally solved this problem by constructing a drill, which cuts out soil columns with a cross section of 1 cm 2. The determination of the volumetric weight is made after the columns are dried. This excludes the influence of soil moisture, which is especially significant with loamy and clayey texture (Naumkin V.N. *et al*., 2005).

The soils of the lower reaches of the Amu Darya are represented by two types: alluvial-meadow and meadow-takyr. The unfavorable properties of the alluvial meadow soil should be considered very low humus content, a low level of provision with total nitrogen and mobile forms of phosphorus and potassium, high alkalinity, especially from a depth of 60 cm. The unfavorable properties of the meadow-takyr soil are high volumetric weight, a reduced degree of porosity, low humus content, a low level of provision with total nitrogen and mobile forms of phosphorus and potassium, a high specific gravity of absorbed sodium (from the sum of absorbed bases), a high content of harmful neutral salts in the upper horizons and high alkalinity at a depth of 100 cm. Considering the low humus content of the soil and their low content of mobile forms and potassium, it should be considered that the rates of application of organic and mineral fertilizers used on farms are extremely insufficient.

Conclusion

In short, for the growth and development of fruit plants, the most favorable soil conditions are those that are characterized by a reserve of available moisture of at least 65-70% of the lowest moisture capacity with aeration porosity (non-capillary porosity) of at least 10%. When allocating land for laying fruit orchards, it is necessary to determine the height of the groundwater, the degree of salinity. If groundwater is located close to the soil surface (1-1.5 m) care must be taken to lay deep horizontal drainage. Before laying out a garden, the area must be well planned. This condition ensures uniformity and sufficient moisture.

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