Innovative Irrigation Technology

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ABSTRACT
In this article we are talking about the research carried out on the effect of water availability of plants with suction (osmotic) pressures of soils and plants. When irrigation with this method of irrigation of intensive gardens will save 30-35% of irrigation water than irrigation with a system of drip irrigation.

KEYWORDS: *osmotic pressure, plant, soil, intensive garden, suction pressure of the soil, irrigation technique and technology, wick, knitted rope, conductor, hose, soil solution.*

Introduction
Water is one of the most important life factors for living organisms. Currently, when science and technology are rapidly developing, several new technologies for growing plants have been created (hydroponics, aeroponics, etc.), they have proven the possibility of growing plants without soil, and this technology is widely used mainly in greenhouses. Increasing the world's population requires careful, efficient and rational use of natural resources. Over the past 30 years, climate change and an increase in temperature on the planet have had a very large negative impact on humans and nature. That is why, first of all, we must rationally use land and natural resources, develop measures against their irrational use, and increase, as far as possible, the effectiveness of their use in growing agricultural products.

Existing problems and measures for their elimination. A large volume of such expenses is spent mainly to provide agricultural crops grown on the irrigated lands of our republic. As you know, about 70% of the irrigated areas of the republic are supplied with water by means of pumps. This means that the main task facing us is to find a solution to the problems of widespread introduction of irrigation techniques and technologies that guarantee water saving in agricultural production, promote their use at the maximum level.

One of the new water-saving methods serving the cultivation of orchards on low-water lands with limited possibilities of using known irrigation methods is the method we recommend for providing the root layer of soil with moisture under the influence of osmotic pressure. When using this method, the soil, by the power of moisture absorption, provides the plant with the moisture necessary for its biological growth, and this, in turn, protects the plant from death and creates the necessary conditions for its development. At the same time, when using this method, such negative phenomena as water loss, evaporation in large quantities, water supply of an unnecessary soil layer are not observed. Relatively, this method is similar to the method of drip irrigation inside the soil, only in this case the water is not supplied to the plant under pressure, on the contrary, the soil receives the necessary moisture by the force of suction.

The proposed irrigation method. When applying this method, polyethylene tubes with a diameter of 10 mm are used, equipped with a cotton cloth (knitted threads or a wick), which provide the root system of the plant with special water and supply water to the inside of the root system. This process can be compared to the mechanism of an oil lamp (with a wick).

In our research, we relied on the following methods to select irrigation methods and technical parameters, taking into account the mechanical composition of the soil, its hydrogeological and geological conditions [1-2].

As a result of research by S.S. Kolotova, it was found that the osmotic pressure of the soil solution on the sown areas is 1.37, and on saline lands 24.39 atm. It has been established that if on non-saline gray soils the pressure of soil solution is 2.27 atm in spring, then in July and August it reaches up to 3.29 atm. In soils with a heavy texture, it is even higher. During the watering of the plants, the pressure of the solution decreases markedly. According to the author, the osmotic pressure in saline soils in spring is about 8.54; in summer 12.7-15.4 atm, sometimes it increased to 24.39 atm. At a solution pressure of 2-3 atm, a good condition is created for the normal development of plants.

However, there is little information in the law of osmotic pressure about the effect of osmotic pressure on crops, in particular on the suction power of the soil. Most of such studies were carried out in the fields of medicine and plant physiology, and in them the Van't Hoff's law and the Mendeleev-Cliperon equations were widely used.

The proportionality of water in plants and in the soil turgor and plasmolysis, cyttorisation phenomenon, absorption force, osmotic pressure - all these are the methods of N.A. Maksimov. D.A.Sabinin and V.S.Shardokov (1925-1935).

There are methods of DA Sabinin, VP Dadikin, II Tumanov on the mechanisms of water movement in a plant; by the intensity of transpiration, the methods of A.A. Ivanov (1950), by the lack of water, the method of I. Chatsky (1960), the ability to retain moisture, the method of A.A. Nechiporovich (1926), the method of weighing the moisture content in the leaves of plants Baslovskaya, Trubetskov (1964) [4-6]. In an in-depth analysis of the properties of water exchange in plants, the methods of their study are also of great importance. A number of these methods include methods of the intensity of transpiration, the amount of free and bound water in the composition of plants, the rate of water entering the plant organism, the lack of water in the composition of plants, etc. Using these methods, it is possible to determine the activity of physiological processes occurring in the plant organism. The uptake of water from the soil by plants depends on the state of the water, on the activity of taking water from the root system. In turn, the soil consists of a combination of large and small soil particles, plant humus and inorganic colloids. Water is bound to soil particles with varying degrees of strength. The ability of the soil to retain moisture depends on the type of soil, the amount of plant humus elements in it, and its structure. In the summer, when the air temperature is high, some plants withered due to lack of moisture. Until the morning, at night, plants restore water deficiency in their bodies. According to the authors, the flow of water into plant cells occurs mainly on the basis of the osmosis mechanism. However, there are also other ways for water to enter the cells. One such route is the electroosmotic route [7-8]. This is based on the ion-transmitting properties of the plasmolemma and tonoplast layers. In this case, the electric potentials differ in the inner and outer boundaries of the protoplasm. As the data of L.S. Litvinova show, the movement of water upward through the grooves under the influence of some known force is called the force of root pressure. The force of root pressure can vary depending on the living conditions and the type of plant. If in annual plants the force of root pressure is 1-3 atm, then in trees it is about 10 atm. According to E.V. Skazkin, one of the factors affecting the rate of water absorption by plant roots is the temperature of the soil. This can be shown by simple experiments. For example, if the pots in which plants such as tobacco, beans, pumpkin grow with ice, then these plants begin to wither, but when the pots are heated, the plants return to their original state.

Yu.I.Shirokova, N.Sh. Sharafutdinov, G.K. Paluashov (2010) having studied the effect of irrigation rates on lands with saline soil on plant productivity, on the change in the suction pressure of the soil, two methods of calculating soil pressure are recommended.

Pc = P + Po; (1)

Here: Pc - total potential of soil moisture;

P is the capillary absorption potential of the soil;

Ro is the osmotic potential of water in the soil, reflecting the amount of salts in the soil solution. The authors, noting that there are inaccuracies in the permissible degrees of soil salinity adopted by FAO for cotton, that is, they do not indicate the type of soil, cotton variety and soil moisture, calculated the changes in osmotic pressure depending on soil moisture (1-table).

Table 1. Calculation of the critically permissible salinity EC_e at different soil moisture (relative to PPV).

Critical sum of pressure, $P_{atm} = P_{matr} + \psi_{osm}$	Soil moisture in fractions of a percentage of PPV	Matrix pressure P matr, atm	Permissible EC value $_e$, dS / m (at critical pressure)	Osmotic pressure, Ψ, atm
4	0.6	1.7	3.8	2,3
	0.7	0.6	6.5	3.4
	0.8	0.3	8.1	3.7
5	0.6	1.7	5.4	3.3
	0.7	0.6	8.4	4.4
	0.8	0.3	10.3	4.7
6	0.6	1.7	7.1	4.3
	0.7	0.6	10.3	5.4
	0.8	0.3	12.5	5.7

Research results. To substantiate the method of irrigation based on osmotic pressure, we carried out practical work at home (laboratory) conditions. In our research, several scientific observations were analyzed, aimed at the scientific justification of the above law. In the first part of the research, a tube (medical dropper) with a diameter of 4 mm was used as a water transmitter, and one end of the tube was placed in a vessel with water with a volume of 1.5 liters, and the other was placed in the root layer of soil soil 30 cm high to a depth of 10 cm. Calculations were made of the time that passed when the water rose to 30 cm in the height of the soil (in laboratory conditions) through a tube 60 cm long and reached the root layer of the soil. It was found that the water gradually rose upward, and after 7 hours and 45 minutes it reached the root layer of the soil. Then, observations were made on how during the elapsed time (hours) how much water penetrated into the root layer of the soil under the influence of the suction forces of the soil [8-9].

According to our observations, it was found that in order for the water to completely overflow into a vessel with soil, in which the upper diameter $Ф_1$ = 30 cm, the lower diameter $Ф_2$ = 20 cm, as well as the height h = 28 cm, the total volume of 0.130 m^3 was required 78 hours (1-fig.). In this case, we can determine the intensity of water absorption into the soil in the following way: In the second part of the study, a vessel with a volume of 1 liter was filled with water, then a tube was installed in it in order to study the conductivity of a tube filled with a special water-permeable fabric 10 mm in diameter (hose, length 60 cm). With this method, it took 4 hours and 20 minutes for the water in the vessel moving up the tube to reach the root layer of the soil. The observations, which were carried out under laboratory conditions, were carried out over two vessels with identical plants. As can be seen from the results, the water, without any external force, moved up the tube. This means that under the influence of the suction power of the soil, it is possible to provide the plant with the necessary moisture (water) [10-14].

$\mathrm{Cj} = \frac{Vc}{t} = \frac{1000}{234}$=4,3 ml/hour (3)

Conclusions and offers. During the analysis of the above studies, the following conclusions were made: the suction power of the soil is a physical process that depends on its mechanical composition, type and degree of salinity.

It should be emphasized that before this experiment, the soil moisture content was 75%. If the initial moisture content of the soil was about 70%, then we could observe a higher suction force of the soil or a higher osmotic pressure. If the moisture content of the soil decreases to 60%, there is a decrease in the suction power of the soil. This pattern was confirmed in the studies conducted by S.S. Kolotova.

This means that it is possible to provide the necessary moisture for the root layer of soil when watering trees without any external forces, that is, without their participation. To do this, you can use hoses with a diameter of 32-50 mm intended for a drip irrigation system or similar micro-sprinklers made for droppers, filled from the inside with special water-absorbing fabric (special wicks made of cotton or knitted ropes) tubes with a diameter of 10 mm. It should also be noted that the larger the diameter of the water supply pipe, the better the provision of the dropper tubes with water. The method of irrigation based on osmotic pressure can water orchards, this method can save up to 30-35% of water than with the method of drip irrigation. However, for all other agrotechnical measures, costs will be required. When irrigated by this method, plants develop more slowly than when irrigated by other methods (good soil and climatic conditions), the yield also decreases slightly, but the use of this method in order to effectively use land and water resources, as well as create a safe supply environment in regions with a difficult condition water supply is considered appropriate.

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