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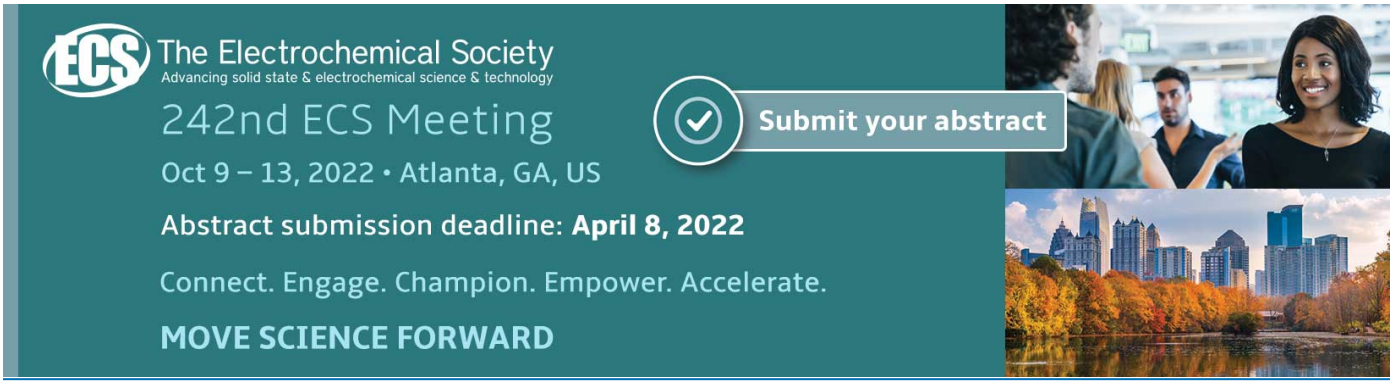

UV treatment of agricultural plants in territories subject to salination of soil

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Abstract. An assessment of the influence of electrotechnology of ultraviolet irradiation of seeds and pre-sowing soil treatment and the creation, on their technological basis, of management and control of salt and nutritional regimes of irrigated soils has been carried out. Relative yield of field crops versus the concentration of toxic salts in the soil solution at full moisture capacity are shown. By results of experimental researches acting of UV irradiation on the amount of ammonifying bacteria in the soil under cotton for increasing the accumulation of the most mobile nitrate forms of nitrogen are defined.

1. Introduction

Salt and feed regimes are important irrigation regimes that determine soil fertility, soil structure, growth conditions and plant development. Intensification of agricultural production on ameliorated lands leads to a decrease in natural soil fertility due to the removal of nutrient and biologically active elements with the harvest of agricultural crops [1-2]. Another problem is associated with an increase in water mineralization in natural water sources, the need to use collector-drainage waters, which can lead to salinization of soils [3]. At the same time, the use of fertilizing and ameliorating substances for the regulation of salt and nutritional regimes in the traditional way by introducing them into the soil in the form of solid fertilizers with a reserve for the entire growing season leads to their washout by surface waters and precipitation [4]. In this case, both the loss of substances and the deterioration of the ecological state of the environment occur. The regulation of salt and food regimes is an important task of land reclamation and involves the use of technologies based on modern advances in science and technology for these purposes [5]. In irrigated agriculture, it is advisable to apply fertilizing and ameliorating substances together with irrigation water, using the energy of the flow and the dissolving properties of water [6]. At the same time, they can be fed fractionally, in the required quantities and at the required growing season, which ensures optimal feed and salt regimes of soils, prevents surface washout and premature decomposition of substances.

It is advisable to carry out researches on the influence of ultraviolet irradiation of seeds electrotechnology and pre-sowing soil treatment and the creation on their basis of a scientific and technological basis for the management and control of salt and food regimes of irrigated soils [7]. Many studies have focused on the creation of mathematical models for determining the multicomponent salt, nutrient, and trace element compositions of pore solutions, solid, and sorbed phases of soil, while taking into account chemical ingredient absorption by plants' root systems. Wisheimer and Smith [8] proposed a quantitative indication

of the risk of soil salinization during irrigation with saline water, based on the sorption-selective properties of soils and the chemical composition of irrigation water. A complicated SAR indicator developed by American researchers is employed in land reclamation operations [9].

2. Research Methods

The set of ions of the main chemical elements present in water:,Na^+ Ca_2^+, Mg_2^+,,SO_4^- HCO_3^-; determine the salinity of water, the growing conditions of plants, depending on their salt tolerance [10]; some of them, such as, are a building material for plants; control physicochemical processes in the "soil-solution" system and the behavior of the solution components by creating a specific environment - the ionic strength of the solution, which affects the activity of each component of the solution. Criteria and gradations of salt tolerance are given in many works, for example [11]. Macrocation composition of water $Ca_2^+, Mg_2^+, Na^+, Ca_2^+, Mg_2^+$ determines the effect on the structure of the soil, controls the processes of dispersion and coagulation of soil colloids.

For soil solutions of arid and semiard regions, where the system Ca, Mg, Na || Cl, SO_4-H_2O water activity can be calculated using the expression [12]

$$\ln a_w = -0{,}018 \cdot I \cdot \sum_{j-1}^{N} \frac{\nu_j}{p_j} \eta_j \cdot \left\{ 1 + \ln 10 \left[\frac{\nu_j + \nu_{j-}}{\nu} \cdot I \left(b_j^0 + \sum_{k=2}^{N} \alpha_{jk}^0 \cdot y_k \right) - \left| z_j + z_{j-} \right| A\sqrt{I}\sigma\left(r_j^0 \cdot B\sqrt{I} \right) \right] \right\}$$

3. Results and Discussions

Based on the dependences of electrical conductivity on osmotic pressure and osmotic pressure on the concentration of toxic salts established in [13], a transition was made to the dependence of the yield on the concentration of toxic salts in the soil solution at full moisture capacity R_T'. This dependence for various agricultural ones is shown in Figure 1.

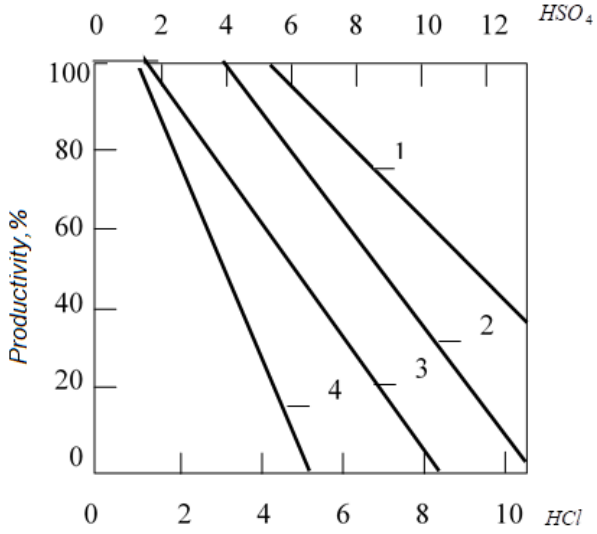

Figure 1. Relative yield of field crops versus the concentration of toxic salts in the soil solution at full moisture capacity: 1 - cotton, 2 - wheat, 3 - alfalfa, 4 - rice

In the physical chemistry of soils, the research of chemical equilibria is accorded the highest priority [14]. The prediction of the directions of chemical reactions happening in soils, which are inextricably connected to the thermodynamics of soil solutions and surface phenomena [15], is one of the difficulties associated with the problem of equilibria.

It is of interest to model the process of temperature change inland, caused by exposure of the soil to ultraviolet radiation. It is known that a temperature deviation of 1^0C from 25^0C leads to a change in the density of a NaCl salt solution by 0.04% [16-17].
Ultraviolet soil treatment is capable of influencing the redox processes in the soil in terms of preserving the mobile forms of microelements in it [18]. This is also shown by the results of experiments on seed treatment carried out in the experimental field base of "BMKB-Agromash" (Figure 2).

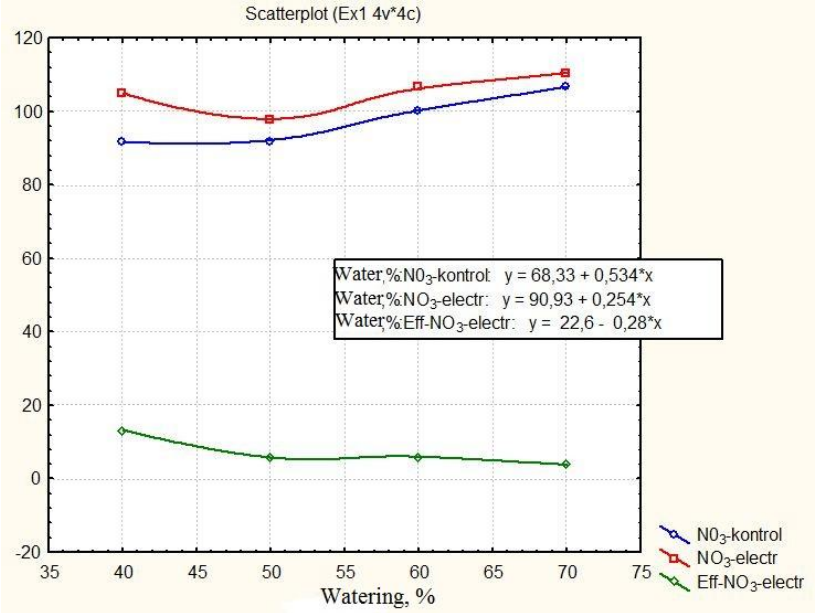

Figure 2. Regression equations for the content of nitrate nitrogen in the soil depending on the water supply of the plant and the use of electric processing technology

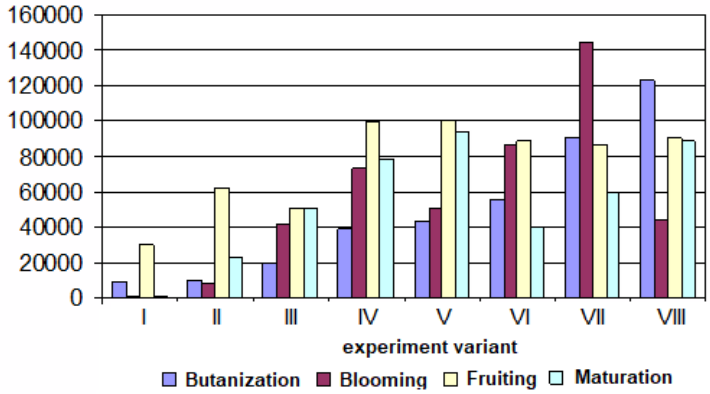

Figure 3. Influence of UV irradiation on the amount of ammonifying bacteria in the soil under cotton (thousand / g of soil): I - control (soil without plants and UV treatment), II - control (soil with a plant and without UV treatment), III - UV treatment of soil without plants, IV - UV treatment of soil and cotton seeds, V - pre-sowing UV treatment of soil and cotton seeds, soil during sowing, VI - UV treatment of soil and plants during their growing season, VII - UV treatment of soil during plant growing, VIII - pre-sowing UV treatment of cotton seeds + UV treatment of soil and plants during the growing season of plants

Further studies were carried out in order to clarify the nature of the supply of nutrients to the aboveground organs of cotton, depending on the conditions of soil fertility (Figure 2). The results of field trials are specified in relation to the phases of plant development, which must be reflected in the model [19]. For this, the third leaves are analyzed for the content of nitrogen compounds, from above along the main stem, as well as leaves on sympodial branches located at young ovaries.
It is known that the nitrogen content in the upper, with sufficiently developed plates, leaves along the main stem can characterize the conditions for the supply of cotton in nutrients. The high content of nitrate nitrogen in cotton leaves is released during the fruiting phase of the plant.
When studying the effect of the growth of ammonifying bacteria [20] under the influence of UV irradiation on the content of mobile forms of nitrogen in the soil under the plant [21, 22], a close correlation of the data series obtained in the experiment was revealed (Figure 3).

4. Conclusions

Treatment with UV radiation provides a decrease in crop losses due to insufficient soil moisture during the sowing period.
When treating seeds with UV radiation with a reduced moisture supply of 40% during vegetative growth, the content of nitrates in the soil increases to 7%, which has a positive effect on the yield of agricultural crops. The accumulation of nitrogen is also facilitated by the activation of the reproduction processes of ammonifying bacteria.

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