

ANNOTATION

The dissertation work of Maksat Nurbayevich Poshanov on the topic “Influence of soil salinity extents and the use of biological preparations on the productivity of corn (Using the example of Shoulder irrigation area)”, presented for the degree of Doctor of Philosophy (PhD) in the field of specialization 6D080100-“Agronomy”.

Relevance of the research topic.

Agricultural production at the present stage of development requires systematic and widespread improvement of the fertility of irrigated lands in Kazakhstan. The statement articulated by President K. Tokayev of the Republic of Kazakhstan underscores that constructive public dialogue serves as the cornerstone for the stability and prosperity of Kazakhstan. It is highlighted that by the year 2030, the extent of irrigated land is projected to reach up to 3 million hectares, facilitating a substantial surge in agricultural production by 4.5 times.

Presently, there is a pressing and perilous issue surrounding the degradation of soil cover and agricultural land, particularly given that 95% of the global population is dependent on soil fertility for sustenance. The Food and Agriculture Organization (FAO) of the United Nations has reported that, under typical circumstances, 80% of revenue is derived from soil fertility. Furthermore, the decrease in the yield of crucial agricultural crops as a result of moisture scarcity and soil salinity ranges from 20% to 50%.

In the irrigated regions of southern Kazakhstan, corn stands out as a prominent crop cultivated for both grain and silage purposes. According to the Statistics Agency of the Republic of Kazakhstan in 2020, the total area allocated for corn cultivation reached 274 thousand hectares, with 164.3 thousand hectares dedicated to grain corn and 109.7 thousand hectares designated for silage production.

Corn is one of the most important feed and food crops. It is grown for grain and silage. Corn ranks third in the world in importance after wheat and rice. The global grain harvest of corn exceeds 710 million tons. All major types of maize are used for food purposes. Maize grain significantly exceeds barley and oats in feed value.

Corn is also important as a crop for intercropping because it is a good pre-seeding crop. After corn, the field that has been properly maintained will be free from weeds. When following the cultivation technology, individual farms achieve high grain yields - up to 130 quintals per hectare, as well as green mass with milky-waxy ripe sorghum - up to 500-600 quintals per hectare. However, overall, the yield across the Republic and the region remains low, with low mass of silage and low nutritional value of the grain, which is influenced by the unfavorable ameliorative state of the soil. In 2020, the yield of maize grain in Kazakhstan amounted to 58.8 quintals/hectare, silage - 138.9 quintals/hectare, which means that the potential of maize has not been fully utilized.

In this regard, the search for ways to improve the ameliorative soil conditions and increase the yield of high-nutrient green corn mass based on the use of an adapted corn hybrid is also a very relevant problem.

The goal of the dissertation research.

The aim of the work is to increase the yield of grain and silage corn by using bio-products and improve the ameliorative condition of the soil with the use of irrigated field runoff.

Research objectives:

- creating the electronic foundation of the information system for the research object (GIS) in the experimental plot of the Shoulder irrigation array, conducting a salt survey;
- study the impact of the research object on the agrochemical and ameliorative properties of soils;
- to study the influence of biopreparations on the improvement of the reclamation status of saline soils;
- the study of the influence of biopreparations on photosynthetic indicators, growth processes, and development of maize plants;
- study of the influence of bio-preparations on the yield and grain quality of corn in soils with different degrees of salinity;
- establishing the correlation between corn yield and soil salinity level;
- economic and energy assessment of the effectiveness of biopreparations in various degrees of soil salinity.

Research methods.

Field and laboratory research were conducted during the execution of the dissertation work.

In research, the instruction "field experiment design and statistical analysis of its data" was used as commonly accepted methods and fundamental guiding principles.

In our research conducted on experimental plots with varying degrees of salinity, we measured the biometric indicators of corn: at the initial stage of plant development (6-8 leaf stage), we measured plant height and weight; at the milk-wax ripeness stage - plant height from soil surface to the top of the ear, plant weight characteristic to the experimental plot, weight of raw cobs; at the fully mature stage - grain length and diameter; number of rows per ear, weight of 1000 grains, percentage of grain yield in cobs.

Field investigations were conducted in accordance with the all-union instruction on studying soils and creating large-scale soil maps for land use, as well as the "Instruction for conducting large-scale soil investigations in the Kazakh SSR."

In addition to the traditional method of laying incisions and drilling wells, salt surveys, is used for conducting a salt logging.

The methodologies detailed in the manual for general soil analysis were used for the analysis of the soil's chemical composition.

The analysis of soil samples included determining the content of humus, readily hydrolysable nitrogen, available forms of phosphorus, and potassium.

The assessment of saline soils was based on three main criteria: the chemistry (type) of salinity, the degree of salinity, and the depth of the saline horizon. The chemistry of saline soils was determined by the composition of anions and cations. Anions were primarily taken into consideration, including the magnitudes of their ratios in soil water extractions.

Justification of novelty and practical significance of the obtained results.

Scientific novelty. Research has proven the possibility of using remote sensing (RS) and geographic information systems (GIS) technologies to study the ameliorative conditions of soils, as they differ from surface investigation methods in terms of speed, sufficient accuracy, large area coverage, and relative affordability, which is a scientific novelty of this work. This enables the acquisition of information for prompt decision-making in management.

The scientifically based technology of applying a new biological humic preparation of domestic production called "BioEcoHum" has been established for cultivating corn for grain and green mass in the conditions of irrigated saline soils of varying degrees in the Shaulder irrigation system.

The scientific and practical value of the work.

Cartographic data on soil degradation conditions identified during dissertation research can be utilized by district administration specialists and agriculture management personnel for agriculture planning and design, the committee on environmental regulation and control, as well as land resource management.

The use of remote sensing data and GIS technologies in conducting reclamation surveys of agricultural lands will improve the system of remote monitoring of soil salinization.

The recommendations and conclusions obtained from the research can be used by farmers and peasant households engaged in livestock farming as methodological guidelines.

The recommendations presented in this paper create conditions for the optimal use of agricultural lands. Furthermore, the results of the dissertation research contribute to the deepening of theoretical and practical knowledge for students in educational institutions.

Depending on the degree of soil salinity, the grain yield of corn has increased from 11.5 to 33.0% when using the technology. Moreover, depending on the degree of soil salinity, the net income from the application of this technology ranges between 29.5 and 129.9 thousand tenge per hectare.

The main conclusions presented in defense:

- modernization of the remote monitoring system for soil salinity and fertility indicators using remote sensing data and GIS technologies;
- positive dependence of the biopreparation on the growth of corn and the degree of soil salinity;
- the relationship between soil salinity levels and corn yield;
- the economic and energy efficiency of using bio-preparations in maize cultivation on saline soils at different levels.

The personal contribution of the author to the work. The PhD student contributed to the work by selecting the research object, defining the goals and tasks of the study, collecting data, processing and analyzing them, creating cartograms using satellite images in GIS technology, processing data in Statistica program, conducting analysis, and carrying out field and laboratory research.

The contribution of a PhD student in the preparation of each publication. All the results and conclusions presented in the dissertation were obtained and formulated with the direct participation of the individual applicant in accordance with the results of the conducted research. The doctoral candidate prepared and organized publications in domestic and international scientific journals for the discussion and publication of the results obtained through the mastery of the research methodology.

The manuscript of the dissertation research was discussed at an extended meeting of the Department of Agronomy, Breeding, and Biotechnology of the Agrobiological Faculty at the Kazakh National Agrarian Research University. The main results and conclusions of the work have been published as 10 articles in domestic and international scientific journals. Among them, 5 articles were published in "OnLine Journal of Agronomy," "Journal of Ecological Engineering," and "OnLine Journal of Biological Sciences," registered in the Scopus database. 5 articles have been included in the list of the Committee for Science Control of the Ministry of Education and Science of the Republic of Kazakhstan.

Correspondence to the directions of scientific development or government programs: Scientific research work on the topic of the dissertation work from 2018-2020, with state registration carried out within the framework of program 0118PK01386 "Issues of irrigated saline soils in the Turkistan region and their solution through the application of innovative technologies to enhance soil fertility and productivity."

Structure and Volume of the Dissertation.

The dissertation consists of an introduction, 4 chapters, a conclusion, a list of references, and appendices. The main body of the work spans 96 pages and includes 24 figures, 23 tables, 167 cited literary works, and 3 appendices.