

ANNOTATION

The topic of the dissertation for the degree of Doctor of Philosophy (PhD) is "Intra-field variability of nutrient content in light chestnut soils under a precision farming system in southeast Kazakhstan".

Relevance of the topic.

There are conclusions that if the human population continues to grow at this rate, then by 2050 the human population will increase dramatically and reach 10 billion. And this, in turn, is the fact that the supply of food to mankind will become one of the main problems. At present, even in the country itself, the average annual production rates of domestic products do not correspond to the growth rates of consumption and incomes in general. As a result, the gap in the market is filled by imports, and its share in domestic consumption remains very significant. Therefore, in solving this problem, the role of agricultural science as the main goal of food production is important. In the age of advanced technology, it is necessary to widely use modern technologies in agriculture on a digital system. One of them is precision farming.

Precision farming is the management of crop yields, taking into account the internal variability of the plant habitat, the main goal of which is to optimize agricultural production, maximize profits while saving economic and natural resources. This will open real opportunities for the production of quality products and environmental protection. Such an approach, as world experience shows, gives a much greater economic effect and, most importantly, allows you to increase soil fertility and increase the level of environmental friendliness of agricultural products. Precision farming can reduce the cost of fertilizer, seeds and agricultural machinery by an average of 20%.

The study of the influence of internal heterogeneity on productivity and its differentiated impact is relevant with the advent of new information technologies. Methods for studying the heterogeneity of the soil cover are constantly being improved, especially with the development of sensor technologies that reduce the cost of analysis, the productivity and speed of processing the initial data, as well as increase the accuracy and results reliability.

In this regard, in the conditions of irrigated agriculture in the south-east of Kazakhstan, the development, adjustment and adaptation of a relatively new method of precision farming, as well as taking into account the biological characteristics of agricultural plants, the development of operational management of their production process, making the right agrotechnical decision is an urgent and priority direction.

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The south-east of Kazakhstan (Almaty, Zhetysu, Zhambyl regions) is one of the largest agro-industrial regions of the republic. Agriculture here is mainly carried out on rich, semi-fertilized and rainless soils, as well as on irrigated areas, more than half of which is concentrated in this vast area. Winter wheat is one of the leading field crops. The natural and climatic potential of the region corresponds to the biological potential of these crops, which puts them in the category of promising ones.

In the future, the development of domestic crop production is associated with the modernization of the industry, the development and implementation of technologies that require modern science based on the landscape approach that has proven itself in the developed countries of the world. Thanks to the development of these technologies, Western European countries at the beginning of the new century increased the yield of grain crops by 60 t/ha and continue to increase it, and the average world grain yield has reached 30 t/ha. The technologies offer a unified system for managing the production process of crop production by optimizing the scheme of crop rotation in crop rotations, using fertilizers and plant protection products in the system.

The beginning of research into precision farming technologies based on a differentiated impact on the "soil-plant-environment" system began in the 90s of the last century. Currently, work is underway to create technologies and technical means for differentiated surface and underground application of mineral, organic and liquid fertilizers, ameliorants in accordance with the requirements of the standards of the USA, Germany, Israel, Japan, and China.

According to experts, the profit from the introduction of new technologies in agriculture is 50-600 US dollars per hectare. The division of soils into agro-ecological groups in precision farming is carried out for the first time in the country. Based on a detailed account of landscape conditions, agricultural technologies created in the real farming system can not only determine the performance of all technological operations, but also be able to give a specific agroecological assessment of a particular region.

The goal of precision farming in crop production is to maximize yields, generate financial returns, and at the same time minimize capital investment and environmental impact. It has been established that the technology of precision farming makes it possible to create a better structure of the field, save seed consumption by 10-15%, carry out agrotechnical activities not only during the day,

but also at night, save the consumption of mineral fertilizers and chemical means of protection by 15-20%.

The scientific concept of precision farming is based on the idea of the heterogeneity of one agricultural area. To determine this heterogeneity, the latest technologies are used, such as global positioning systems (7-GPS, GNSS, GLONASS), satellite and drone imagery, as well as special programs developed for agricultural management. The information obtained is used for crop planning, calculation of fertilizer and plant protection rates, accurate yield forecasting and financial planning.

The study of the influence of internal heterogeneity on productivity and its differentiated impact is relevant with the advent of new information technologies. In this regard, in the conditions of irrigated agriculture in the south-east of Kazakhstan, the development, correction and adaptation of a relatively new method of precision farming, as well as taking into account the biological characteristics of agricultural plants, the development of operational management of their production process, making the right agrotechnical decision is an urgent and priority direction.

Scientific novelty.

- For the first time in South-Eastern conditions of the Republic of Kazakhstan, intra-field variability of irrigated open black-brown soil and productivity of new varieties of winter wheat were studied.

- A system of applying fertilizers to new varieties of winter wheat was developed in the precision farming system in the irrigated area in the south-east of Kazakhstan.

Object of research:

1. Irrigated open black-brown soils of the upland plain of Ile Alatau;
2. Winter wheat varieties: Bezostaya 100, Grom, Matai, Aliya.

The purpose of the study:

Studying the variability of the amount of nutrients in open dark-brown soils in Tanapish and developing an efficient system of applying fertilizers to winter wheat in a precision farming system.

Research objectives:

- characterization of the changes in the area of the research sites in the supply of nutrients to the soil and determination of the technological sites for the introduction of fertilizers;

- preparation of initial data for the program of differential application of mineral fertilizers to winter wheat varieties in the precision farming system;

- conducting agrochemical research on the soil of the test site;

- study of the influence of fertilizers on the yield index of winter wheat;

- study of photosynthetic activity and productivity of winter wheat;

- determining the relationship between the value of the NDVI vegetation index and the productivity of winter wheat;
- determining the economic efficiency of growing winter wheat using various agricultural technologies;

The main principles of the defense of the dissertation:

- intra-field variability of irrigated open black-brown soils in the south-east of the Republic of Kazakhstan;
- differential introduction of the amount of mineral fertilizers during the development of the precision farming system, taking into account the actual variability of the composition of nutrients in the soil and the intensity of agricultural production;
- determining the photosynthetic activity and productivity of winter wheat varieties in the precision farming system by differential introduction of fertilizers;
- economic efficiency of using fertilizers in precision farming system.
- dissertation results publication.

The results of the research can be used to differentiate the doses of mineral fertilizers in the development of precision farming systems tied to the GLONASS satellite system in the foothill zone of Ile Alatau, taking into account the actual variability of nutrient content in light chestnut soil. The data obtained will be used by agricultural producers to increase the yield and quality of crop production. The use of the proposed technologies contributes to an increase in yield by 30-50%, a decrease in fertilizer consumption by 15-20%, and an increase in product quality. The ecological significance of the research lies in a significant reduction in the chemical load on the natural environment due to the effective timely and targeted application of mineral fertilizers.

Connection of the dissertation topic with state programs:

The work was carried out at the LLP "Kazakh Research Institute of Agriculture and Crop Production" within the framework of the project: 0118RK01214 "Development of a system for differentiated fertilization and tillage for precision farming"; 0118RK01215 "Agrotechnological land typing for the introduction of adapted agricultural technologies and automated systems for their management."

The main results of the dissertation were published by the Control Committee in the field of Education and Science of the Ministry of Science and Higher Education of the Republic of Kazakhstan in 8 publications and 2 foreign conference materials, 2 articles in the Agrivita magazine included in the Scopus database with a 45 percentile.

Approbation of work.

The research results were reviewed and approved at the meetings of the Academic Council, methodological council of KazNII ZiR LLP. The main results of the thesis were presented and reported at the 2nd International Conference (November 10-11, 2011, Astana, Kazakhstan), at the European Biotechnology Congress (May 15-18, 2014, Lecce, Italy), at the International Scientific Conference on biology and biotechnology of plants (May 28-30, 2014, Almaty, Kazakhstan).

Volume and structure of the dissertation.

The dissertation consists of 108 pages with an appendix. It consists of introduction, 4 parts, conclusion and recommendations for production. Contains 35 tables, 24 figures and 4 appendices. The bibliography includes 117 titles, including 70 by foreign authors.