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The content of macroelements in barley grain after application of growth regulators and mineral fertilizers.

V.A. Isaichev[1], N.N. Andreev[2]*, and K.A. Vinogradova[3].

[1]Doctor of Agricultural Sciences, First Vice-Rector - Vice-Rector for Research, FSBEI HE Ulyanovsk State Agrarian University, Russia
[2]Candidate of Agricultural Sciences, Associate Professor of the Department of Biology and Chemistry, the department of Storage Technology and Crop Produce Processing, FSBEI HE Ulyanovsk State Agrarian University, Russia
[3]3rd year student of the Faculty of Agrotechnology, Land Resources and Food Production, FSBEI HE Ulyanovsk State Agrarian University, Russia

ABSTRACT

The influence of various growth regulators on the content of macroelements (nitrogen, phosphorus, potassium, sulfur) in barley grain has been investigated. Studies have shown that when using growth regulators and mineral fertilizers, positive changes take place in the accumulation of main nutrients in barley grain.
Key words: barley, growth regulators, mineral fertilizers, macroelements, mineral nutrition.

Corresponding author

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INTRODUCTION

In crop production, the maximum yield of appropriate quality is possible only with a favorable combination of all factors of plant life. One can observe quite often a lack of moisture supply and nutrients, and recently, anomalously high temperatures. At the same time, the greatest negative effect on productivity is caused by a deficit of macro- and microelements that occurs during the critical phases of plant growth and development.

In the life of plants, mineral nutrition is one of the fundamental physiological processes. The main indicator of the quality of crop production is the accumulation of nutrients in the grain, which is largely determined by the content of mineral elements in the soil, especially nitrogen, phosphorus and potassium. The effect of elements of mineral nutrition in different phases of growth and development is determined by the fact that they have a positive effect on the physiological, biochemical processes in the plant organism. In the process of plant ontogeny, the nature and intensity of metabolic processes undergo significant changes with certain plant requirements for environmental conditions characteristic of individual growth phases and stages of development [2]. Mineral nutrition elements in terms of their accessibility to vegetating plants can be divided into three parts: insoluble (inaccessible elements), soluble (potentially accessible elements) and elements of the soil solution (actually available elements). It is inadmissible to identify the number of mineral nutrition elements detected by the chemical analysis of the soil, with the amount actually available to the plant. Under the really available element fund, one should understand its maximum quantity, which can be absorbed by a certain crop for the entire period of its growing season.

An increase of coefficients in the use of nutrients can be achieved as a result of the accumulation of a physiologically grounded amount of the latter in plant organs, where they are used in biochemical reactions of cells, which ensures increased growth and increased plant productivity. One of the ways to intensify the absorption of main nutrients is the use of microfertilizers and growth regulators [5,6]. At present, the main objective of crop farming is to increase grain production which under contemporary conditions can be solved by adapting the field crops to various weather conditions, biologization of land resources and using resource saving technologies with the mineral nutrition optimization of the plant. Seed treatment or treatment of vegetating plants with stimulating preparations is referred to resource-saving technologies of cultivation of grain crops, which give a positive effect in strengthening the root nutrition for plants [3,4]. Thus, to assess the use of growth regulators and mineral fertilizers in the technology of cultivation of feed barley, we conducted studies to determine the accumulation of macroelements in the grain of experimental crops.

OBJECTS AND METHODS OF RESEARCH.

Field experiments were conducted in 2015-2017 on the experimental field of Ulyanovsk State Agrarian University. The experimental crop is the barley variety Nutans 553. The area of the plot is 20 m^2, the replication of the experiment is four times, the location of the plots is randomized. The soil of the experimental field is leached black soil, of medium thickness, average clay loam with the following characteristics: the humus content is 4.3%, the content of mobile phosphorus and potassium compounds (according to Chirikov), is respectively 193 and 152 mg / kg soil, mobile sulfur content is 4.7 mg / kg of the soil, pH of the salt extract is 5.3. The objects of research were: growth regulators - Nagro and Megamix, as well as complex mineral fertilizers of diammophoska N15P15K15, diammophoska N15P15K15S10. At the beginning of the tillering phase, the fertilization treatment of the crops with the growth regulators studied was carried out at concentrations recommended by the manufacturer. The application of experimental plant growth regulators was carried out simultaneously with the introduction of herbicides in view of 200 liters of working solution per hectare. Analyses, counts and observations in the experiment were carried out in accordance with generally accepted methods and state standards. Farming practice in all the variants of the experiment is traditional - generally accepted for this natural and climatic zone of the Ulyanovsk region. The preparation “Nagro” has a set of properties (“all in one”) in the effect on crops treated with these preparations: it has the properties of a fertilizer; stimulates the plant growth; strengthens the immunity of plants (maximum and long-term); it has fungicidal and bactericidal action; it has an insecticidal effect; it restores soil fertility; has an exceptionally high biological efficiency when applied even in very low concentrations of the working solution; it relieves pesticide stress; increase the resistance of agricultural crops to sharp changes in temperature, frost, drought, waterlogging, lack of the sum of active temperatures; it increases the germination and energy of germination of seeds,

survival of sprouts; it increases the yield of agricultural crops from 35 to 150%; improves the quality of agricultural products.

Megamix is a liquid mineral fertilizer for top dressing with a rich content of trace elements (g / l): B - 1,7; Cu - 7.0; Zn-14; Mn - 3.5; Fe - 3.0; Mo is 4.6; Co - 1.0; Cr - 0.3 and macronutrients (r \ n): N - 6; S-29; Mg-15. The wide and rich composition of the fertilizer is aimed at a complex stimulation of all processes in the plant. Synergism and antagonism of individual nutrients are also taken into account. The purpose of "Megamix" is: to eliminate the shortage of trace elements; to prevent and treat endemic diseases; to stimulate root nutrition, to activate enzymes and replenish missing elements of nutrition; to increase the yield due to the stimulation of enzymatic processes and extend vegetation; to improve the quality of the yield.

RESULTS AND ITS DISCUSSION

Nitrogen is the most important of the nutrition elements for plants, as it is a required component of all protein molecules, amino acids, nucleic acids, chlorophyll, alkaloids, glucosides, many vitamins, biologically active compounds, enzymes, which ultimately constitute the biochemical basis of protoplasm. It is in this element that plants have the most acute deficiency. The lack of nitrogen in nutrition leads to the weakening or cessation of vital processes of the whole plant organism. At earlier stages of development of crops, it is necessary to create an assimilating surface, so plants need the most intensive nitrogen nutrition. The studies show that, on average, over the years of research, the maximum nitrogen content in barley leaves is observed in the phase of tillering. A high uptake of nitrogen in this phase of growth and development is explained by the fact that plants in this period need a large amount of protein to construct tissues.

With the coming of the subsequent phases of growth and development, a decline in the accumulation of nitrogenous compounds in the leaves of the experimental crops takes place, reaching a minimum level in the milky ripeness phase of barley. This is due to their intensive outflow into the reproductive organs, which is very important in the formation of high-grade, high-protein grain of this crop. The nitrogen content in the reproductive organs increased under the influence of growth regulators and mineral fertilizers. The maximum increase in the nitrogen content of barley grain was found in the variant Nagro after application of complex mineral, sulfur-containing fertilizers and it was 0.22%, compared to the control group (Table 1). The outflow of nitrogenous compounds from vegetative organs does not coincide with its introduction into generative ones. It should be noted that during the ripening of barley, up to 20-25% of absorbed nitrogen, potassium up to 35%, sodium about 38% is lost. These losses are due to the transfer of nutrients at the end of maturation into the root system, which ultimately remain in the fallen leaves, etc. An intensive outflow of nitrogenous compounds from the leaf and stem mass into the generative organs of the experimental crop under the influence of growth regulators creates prerequisites for the highest protein content in the grain.

The role of phosphorus in the processes that occur in the plant organism is great. This is connected with the fact that phosphorus is a part of vitamins, protoplasm, a component of the cell nucleus. To form a high quality yield of grain crops, intensive phosphorous nutrition is required in the plant organism [1]. The phosphorus nutrition of barley plants has effect on the level of photosynthetic potential and net productivity of photosynthesis. Phosphorus is involved in the synthesis of protein and complex carbohydrates, necessary in the process of respiration. At present, it is known that the absorption of this element by the plant occurs mainly in the form of hydro-dehydrogenphosphates of anions, which leads to the direct relationship on their presence in the soil.

Unlike SO_4^{2-} and NO_3 anions, phosphate ions are not restored in plants up to digestible forms, but are present in an oxidized form. Intensive phosphoric nutrition of spring wheat plants creates conditions for the formation of high quality grain.

The studies have demonstrated that the applied growth regulators and mineral fertilizers increase the phosphorus content in the grain of feed barley. The analysis of the dynamic pattern of phosphorus compounds in plant organs and in the phases of growth and development shows a similar character with the dynamic pattern of nitrogen in plants. During the growth and development of the experimental crops in the ear formation phase it was found that the amount of phosphorus was greater in the leaves than in the stems in all the variants, and during the phase of milky ripeness the outflow of this element from the vegetative organs into the reproductive organs was observed. In our experiments, the content of phosphorus in the grain fluctu-

ated on average from 0.29 to 0.37%. The highest values were observed in the versions of Megamix and Nagro in contrast to the previous application of NPKS, which is higher than the control by 0.08% (Table 1).

Unlike nitrogen and phosphorus, potassium, composing various organic compounds, is contained in plants almost entirely in ionic form and partly in the form of soluble salts in the cell sap in the adsorbed state on the structural elements of the cell and enters the plants as a cation. Potassium increases the cytoplasm hydrophilicity, has influence on the formation and movement of carbohydrates, protein synthesis, regulates the activity of other nutrients.

In our experiments, the content of potassium in the leaves and stems of the experimental crop was maximal during the tillering and shooting phases. Essential changes in the dynamic pattern of potassium in plants of spring wheat under the influence of growth regulators did not occur. Potassium in plants is subjected to high recirculation, apparently, insignificant changes in the dynamics of potassium from the use of growth regulators are associated with this (Table 1).

Table 1 – Influence of growth regulators and mineral fertilizers on the content of macroelements in barley grain, % on absolute dry matter, (2015-2017)

Variants	N	P_2O_5	K_2O	Ca	Mg	Na
Control group	1,84	0,29	0,30	0,04	0,07	0,043
Nagro	1,82	0,30	0,30	0,07	0,08	0,046
Megamix	1,84	0,31	0,31	0,06	0,07	0,049
Control + NPK	1,86	0,34	0,32	0,05	0,07	0,049
Nagro + NPK	1,92	0,33	0,33	0,07	0,08	0,047
Megamix + NPK	1,94	0,33	0,32	0,05	0,07	0,052
Control + NPKS	2,02	0,36	0,33	0,07	0,08	0,057
Nagro + NPKS	2,06	0,37	0,34	0,08	0,09	0,054
Megamix + NPKS	1,92	0,37	0,36	0,06	0,07	0,062

The highest content of potassium in the grain of barley was found in variants with the use of Megamix and Nagro in contrast to the previous application of NPKS, which is higher than in the control group by 0.06 and 0.04%, respectively. In other cases, this value also exceeded the control group, but insignificantly. By the content of calcium in the grain on average for 2015-2017 the maximum content of the macroelement was seen in the plant treatment variant with the Nagro preparation after application of NPKS and was 0.08%, while in the control group it was 0.04% (Table 1).

By the content of magnesium in the grain on average over the years of research, there are no big differences between the variants. The highest content of the macroelement was also found in the Nagro variant after application of NPKS and was -0.09%, in respect of the control group - 0.07% (Table 1). Treatment of barley plants with the growth regulator Megamix (after application of NPKS) promoted a greater increase in the sodium content to 0.062%, which exceeded the values in the control group by 0.019%. For other variants, this value did not differ significantly (Table 1)

CONCLUSIONS

So, our studies confirm the expediency of using growth regulators and mineral fertilizers in the cultivation technology of feed barley. They contribute to improving nitrogen and phosphorus metabolism, improving energy metabolism in the plant organism, thereby creating prerequisites for obtaining high-quality grain and increasing the yield.

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