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INFLUENCE OF GROWTH STIMULATORS ON SUPPLY OF CHERNOZEM WITH NITRATE NITROGEN

Research article

Abstract

On the segregated chernozem of the Central Chernozem zone, in a stationary experiment, the effectiveness of various doses of complete mineral fertilizers was studied in the cultivation of spring barley. The studies were carried out in an eight-field field crop rotation. The soil of the experimental site is segregated chernozem. It was found that the use of mineral fertilizers for the main processing improved the indicators of the effective fertility of ordinary chernozem. Their combined use with foliar feeding of spring barley plants with growth stimulants reduced the content of nitrate nitrogen at low and medium doses of NPK. An increase in the concentration of nitrogen in the vegetative mass of plants with the use of fertilizers was noted. There is a clear varietal dependence in the content of mineral elements.

Keywords: mineral fertilizers, growth stimulants, spring barley, chernozem, effective fertility.

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ВЛИЯНИЕ СТИМУЛЯТОРОВ РОСТА НА ОБЕСПЕЧЕННОСТЬ ЧЕРНОЗЕМА НИТРАТНЫМ АЗОТОМ

Научная статья

Аннотация

На черноземе сегрегационном Центрально-Черноземной зоны в стационарном опыте изучали эффективность различных доз полного минерального удобрения при возделывании ярового ячменя. Исследования проводили в восьмипольном полевом севообороте. Почва опытного участка – чернозем сегрегационный. Установлено, что применение под основную обработку минеральных удобрений улучшало показатели эффективного плодородия чернозема обыкновенного. Комплексное их использование с внекорневой подкормкой растений ярового ячменя стимуляторами роста снижало содержание нитратного азота при малых и средних дозах NPK. Отмечено увеличение концентрации азота в вегетативной массе растений при использовании удобрений. Проявляется четкая сортовая зависимость в содержании минеральных элементов.

Ключевые слова: минеральные удобрения, стимуляторы роста, ячмень яровой, чернозем, эффективное плодородий.

1. Introduction

Barley belongs to the most important fodder crop of the Central Black Earth Region and surpasses other agricultural plants cultivated in the zone in area. Due to its biological characteristics - a short growing period, a weak absorption capacity of the root system, it is quite picky about growing conditions.

Mineral fertilizers are one of the main regulated sources of nutrients for agricultural plants. Despite the significant amount of scientific data on changes in the nutrient regime of soils under their influence, there are still quite a lot of unclear issues related to the changed conditions of functioning of modern agrocenoses [4, P.336].

The effectiveness of mineral fertilizers is significantly influenced by the content of nitrogen, phosphorus, potassium in the soil, agrotechnical methods, weediness of crops, the prevailing agro-climatic conditions, soil fertility, etc. [7, P.101-157], [8, P.20-26], [9, P.62-69], [10, P.2-6], [11, P.47-55].

Many researchers note that there is no alternative to strengthening the chemicalization of the agricultural sector [12, P. 44], [13, P.20-30], [14, P.3-15]. Despite the efforts made, the negative balance of nutrient content in the country's soils is progressing intensively. For the period from 1991 to 2015. deficit of nitrogen amounted to 25 million tons, phosphorus 12 and potassium 76 million tons. On average, 40 kg / ha [2, P.3-10]. Thus, the formation of yield occurs at the expense of soil reserves.

At the same time, in recent decades, various biologically active substances and growth stimulants of agricultural crops have been widely developed and introduced into production. The positive role of biological products in increasing the productivity of grain crops is noted [5, P.327-329], [6, P.81-84] In this regard, a comprehensive assessment of the mutual complex effect of mineral fertilizers and growth activators on the state of the soil environment and the formation of plant productivity is necessary.

2. Research methods

The studies were carried out in a stationary experiment laid down in 2011. on the fields of V.V. Dokuchaeva (Stone Steppe). Research period 2018-2019 The culture is spring barley. The experience is three-factor. The first order factor is crop rotation fertilization levels. The scheme includes 4 levels - no fertilizer, (NPK) 67, (NPK) 133 and (NPK) 200. Directly under barley - no fertilizers, N30P30K30, N60P60K60, N90P90K90. Second order factor - agrochemicals used for vegetative plants: 1 - without treatment with agrochemicals; 2 - lignohumate at a dose of 0.2 kg / ha in the tillering phase - the beginning of booting and heading - flowering; 3 - Brentax Triple at a dose of 0.4 l / ha in the tillering phase - the beginning of booting and S. PROGEN growth at a dose of 0.4 kg / ha in the heading-flowering phase; 4 - Aquadon - Micro at a dose of 3.0 l / ha in the tillering phase - the beginning of booting and heading - flowering; 5 - Gumi - 20 M Rich at a dose of 1.0 l / ha in the tillering phase - the beginning of booting and heading - flowering.

Factor of the third order - barley varieties: Priazovsky 9, Ikorets, Talovsky 9, 13/14 (promising line), Medicum-157, Oskolets.

The area of the last order plots (3.6m x 11m) is 39.6 m2. Mineral fertilizers were applied in autumn for the main tillage (plowing by 20-22 cm).

The background soil of the experimental site is represented by segregation (ordinary) chernozem, medium-thick, medium-humus, heavy loamy granulometric composition. The humus content in the 0-30 cm layer is 6.39%; pH of the salt extract - 6.0; hydrolytic acidity - 1.67 meq / 100 g, the amount of absorbed bases - 46.12 meq / 100 g of soil, gross nitrogen content - 0.297%, phosphorus - 0.170%, potassium - 1.82%. The content of mobile forms of phosphorus and potassium ranges from 70 to 120 and from 65 to 115 mg / kg of soil, respectively.

3. Results and discussion

The climatic conditions during the years of the research were characterized by significant unevenness and deviation from the average long-term indicators. Average annual air temperature in 2018 and 2019 was higher than the norm by 1.68 and 2.750C, respectively (the norm is 5.790C). In terms of the amount of precipitation that fell per year, one can also state their increase in relation to the average long-term values. During 2018, the annual amount of precipitation was 508 mm, in 2019 - 450 mm (average annual precipitation - 438 mm). It should be noted that the increase in precipitation is characteristic only for the cold season.

During the growing season of barley plants, hydrothermal conditions had their own characteristics. The air temperature in April exceeded the long-term average by 1.84 - 3.240C (average value 6.660C). In May, the differences were more significant - 3.8 - 2.70C (14.40C). In June - by 0.9 -3.00C (18.20C).

In July 2018, the air temperature exceeded the average annual value by 2.30C (20.10C). In 2019, the temperature background was lowered. The average monthly temperature was 19.40C. During the period of research, the air temperature in August exceeded the average annual value by 0.1 - 2.70C (19.00C).

The amount of atmospheric precipitation during the summer growing season was lower than the average annual values, except for July. With an average of 61.7 mm, the monthly amount of precipitation over the years was 135.1 - 108.2 mm. The most critical moisture conditions are typical for the first growing season - May and June. With average annual values of 44.8 mm in May, during the years of research, the amount of precipitation was 19.2 and 40.3 mm, in June, 57.0 mm and 3.1-34.2 mm, respectively.

Judging by the moisture coefficient (K), the barley plants experienced a lack of moisture, especially during the first growing season. In confirmation of the more severe growing conditions, the calculated Ku were mainly lower than the average long-term values. In April, with an average value of Ku at the level of 0.55 for the years of research, it was 0.91 (2018) and 0.26 (2019). For May, the moisture conditions were also not very favorable. Ku is noted in the range of 0.14-0.31, which is lower than the average long-term value (0.41). Hydrothermal conditions developed similarly in June. Ku was 0.02-0.22 with an average value of 0.46. During the research years, July was characterized by a high degree of moisture at the level of 0.9-0.82, which significantly exceeds the long-term indicators (0.47).

Nitrates are important in the physiological processes in plants, while being a source and constant supplier of nitric oxide [1, P.81-96]. In our studies, the content of nitrate nitrogen in the soil, to a greater extent, was determined by the dose of nitrogen fertilizers applied at all stages of plant development. Treatment of plants with growth stimulants had less effect. The complex use of mineral fertilizers in combination with growth stimulants had an ambiguous effect on the nitrate regime.

Against an unfertilized background and at low (medium) doses of their use, a slight decrease in the supply of plants with nitrogen is noted (Table 1). As the fertilization rate increased to N90P90K90, foliar feeding with biological products contributed to an increase in the nitrogen content in the soil. Moreover, this pattern is typical for all phases of development of spring barley plants.

The maximum amount of nitrate nitrogen is observed at the beginning of the growing season in the control variant without the use of agrochemicals when applying mineral fertilizers at a dose of N60P60K60. A higher dose of N90P90K90 inhibited nitrification processes, and the amount of available nitrogen in relation to other fertilization backgrounds (N60P60K60) decreased. In subsequent phases of development, the advantage of fertilized options is noted. At the end of the growing season, differences in the supply of nitrate nitrogen reach insignificant values. Smoothing of values is associated with the removal and consumption of nitrogen for the formation of grain yield. And also with possible other expenditure items - denitrification, removal by weeds, nitrogen consumption by soil microorganisms.

The minimum amount of nitrate nitrogen is typical for the variant without fertilizers. On average, at the beginning of the spring barley growing season, the nitrogen concentration was 16.0 mg / kg. The use of mineral fertilizers had a positive effect on the supply of nitrogen to the spring barley plant. Against the background of N30P30K30 fertilization, on average, the amount of available nitrogen food was 20.5 mg / kg, increasing to 24.2 mg / kg against the background of N60P60K60 and 28.2 mg / kg when N90P90K90 was applied.

Table 1 – Content of nitrate nitrogen in the soil, mg / kg

Fertilization background	Experience options	Plant development phases		
		bobbing	earing	ripeness
without fertilizers	no grochemicals	17,2	15,5	15,1
	lingogumat	15,3	17,8	14,0
	gumi 20	15,4	17,0	13,3
	the average	**16,0**	**16,8**	**14,1**
$N_{30}P_{30}K_{30}$	no grochemicals.	21,2	20,1	15,3
	lingogumat	20,0	15,2	11,8
	gumi 20	20,2	23,9	12,9
	the average	**20,5**	**19,7**	**13,3**
$N_{60}P_{60}K_{60}$	no grochemicals	31,1	24,5	17,4
	лингогумат	18,5	20,7	13,6
	gumi 20	22,9	27,2	17,1
	the average	**24,2**	**24,1**	**16,0**
$N_{90}P_{90}K_{90}$	no grochemicals	26,5	25,2	17,8
	lingogumat	29,4	38,7	19,8
	gumi 20	28,8	23,3	18,1
	the average	**28,2**	**29,1**	**18,6**

NDS05 main effects:

fertilizers	3,56	2,6	0,95
agrochemicals	2,2	1,9	0,80

Of particular interest are these changes in the supply of nitrogen with the combined use of growth stimulants and mineral fertilizers. In the natural unfertilized variant, the use of lingogumat and gumi 20 caused a slight change in the content of nitrate nitrogen. At the beginning of the growing season and during the harvesting period, a decrease in its concentration was noted. In the heading phase, when using agrochemicals, there was a tendency to an increase in the amount of nitrogen in the soil. The complex application of mineral fertilizers at low and medium doses of NPK led to a decrease in nitrogen concentration. At the maximum dose, on the contrary, it stimulated the accumulation of nitrates in the soil.

The reasons for the change in the content of nitrate nitrogen in the soil may be associated with an increase in the absorption of N-NO3 by plants when treated with humic substances [3, P.155-161] The increase in the absorption of nitrates during the treatment of HS is explained by the facilitation of the H + / NO symptoms of ions. HS increased the absorption of NH by plants, while the activity of enzymes malate dehydrogenase, glutamate dehydrogenase, and phosphoenolpyruvate carboxylase increased.

4.Conclusion

The conducted studies of the effective fertility of segregated chernozem made it possible to reveal the effect of fertilizers on the supply of nitrate nitrogen. The highest values are characteristic of the maximum application rate. The content of nitrate nitrogen in the first half of the growing season with the use of mineral fertilizers increased by 28.1 - 76.2% (from 16.0 to 20.5-28.2 mg / kg). Their complex use with growth stimulants led to a decrease in the concentration of nitrogen in the soil due to consumption for the formation of higher yields.

Conflict of Interest

None declared.

Конфликт интересов

Не указан.

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