

PRODUCTIVITY AND QUALITY OF SPRING SOFT WHEAT GRAIN DEPENDING ON ROOT FEEDING WITH LIQUID NITROGEN FERTILIZERS ON BLACK SOILS OF SOUTH ORENBURG REGION

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Abstract. The relevance of the topic of scientific research is associated with the use of new liquid fertilizers and a growth regulator in spring wheat crops to increase the yield and quality of grain in the central zone of the Orenburg region. Ensuring food security today is becoming one of the most urgent tasks set by the government of the Russian Federation for domestic agriculture. To solve this problem, it is necessary, first of all, to increase the yield of agricultural crops, rationally using all the factors affecting it. One of these factors is the timely and sufficient application of mineral fertilizers, the cost of which largely determines the size of the cost of production. The emergence of precision farming is associated, first of all, with the improvement of all types of agricultural machinery and technologies, as well as with the rapid development of computer technology, methods of computer modeling and information technology. The integrating basis of the technology is geographic information systems that allow registering and processing information characterizing the state of soil and crops. This information makes it possible to effectively use one of the most significant resources in crop production - mineral fertilizers.

Keywords: precision farming, productivity, spring wheat, nitrogen fertilizers, crop productivity.

1. Location and climatic conditions of the area

The territory of the educational and experimental field of the OGAU is located in the southeastern part of the Orenburg Cis-Urals and is part of the Orenburg administrative region. It is a wavy-ridged plain lying at an altitude of 200 to 400 m above sea level, dissected by erosional valleys and ravines. Almost in the middle of the Southern Urals there is the General Syrt Upland, the watershed ridges and ridges of which alternate with vast leveled spaces of terraces of large rivers. The Orenburg region is characterized by a continental climate. One of the indicators of the continentality of the climate is a large annual temperature amplitude (the difference between the average temperatures of the warmest and coldest months). For Orenburg, this amplitude, according to long-term average data, is 36°C. The absolute amplitude (the difference between the absolute maximum and the absolute minimum) reaches 87 ° C.

The average long-term temperature of the warmest month (July) is 20.9°C, and the coldest (January) is 14.9°C. The warm period (the average daily temperature is above 0°C) accounts for 206 days, the



cold - 159 days. The beginning of the spring growing season (the transition of the average daily temperature through 5°C) is observed on April 17-19, the end of the autumn growing season - October 10-13. The beginning of active vegetation (the transition of the average daily temperature through 10°C) occurs in the spring from April 30 to May 2, in the fall - from September 22 to 25. The sum of positive temperatures above 5°C is 2600-2800°C, the sum of temperatures above 10°C is 2400-2600°C.

The average annual precipitation is 367 mm with sharp fluctuations in one direction or another, the value of the GTC is 0.6-0.8. At the same time, 60% of precipitation from their annual amount falls in the warm period.

The main source of water supply for plants throughout the summer period is moisture accumulated by spring in the root layer of the soil. Therefore, in the zone of insufficient moisture, the spring moisture reserves largely determine the conditions for the formation of the crop.

2. Experiment scheme, observation and research technique

The work was carried out at the Department of Agrotechnology, Botany and Plant Breeding in 2019 at the training and experimental field of the Orenburg State Agrarian University. A univariate experiment was set up with spring wheat varieties Saratovskaya 42. Experiment scheme:

1. the crops were fed in the heading phase with liquid nitrogen fertilizer Carb-N-Humik at a rate of 2.0 l / ha;
2. the crops were fed in the heading phase with liquid nitrogen fertilizer Carb-N-Humik at the rate of 2.0 l / ha + biological product Albit 40g / ha;
3. the crops were fed in the heading phase with liquid nitrogen fertilizer Carb-N-Humik at the rate of 0.5 l / ha + biological product Albit 40g / ha + liquid fertilizer Amino Zn at the rate of 0.5 l / ha;
4. for the control was adopted the option of crops, which were treated with water.

The experiment was carried out in three replicates, the accounting plot area is 40 sq. m.

The soil of the experimental site is southern chernozem, medium-thick, calcareous, heavy loamy with a humus content of 4.4%, mobile phosphorus - 4.5%, nitrate nitrogen - 1.35, exchangeable potassium - 35 mg per 100 g of soil. The reaction of the soil solution is slightly alkaline (pH = 7.8) [2-14].

Research methodology

1. Weight seeding rates were calculated taking into account the sowing qualities of seeds taken from the certificate of seed condition. The index of the numerical seeding rate was adopted as 4.0 million germinating seeds per hectare. Calculation of the seeding rate is carried out according to the formula:

$$HB = \frac{A \times M1000 \times 100}{III}, \text{ where}$$

HB – weight seeding rate of seeds, kg / ha;

A – numerical norm index, million germinating seeds per hectare;

M1000 – weight of 1000 grains, gram;

III – sowing suitability, %.

$$III = \frac{\Psi \times B}{100}, \text{ where:}$$

Ψ – seed purity, %;

B – seed germination, %.

Seeding rate at 4.5 million / ha - 150 kg / ha.

2. Field germination was calculated by dividing the number of emerging plants by 1 sq. m on the number of sown germinating seeds and expressed as a percentage.

3. Before harvesting by counting and dividing the number of preserved plants by 1 sq. m, the number of emerging seedlings was determined by the safety of plants.

4. The biological yield and the structure of the yield was determined by selection, counting and analysis of plants from 1 sq. M. m taken before cleaning.

5. Determination of gluten, its quantity and quality.

6. Determination of natural weight.
7. Economic efficiency was calculated on the basis of technological maps.
8. Mathematical processing of the results was carried out by the method of analysis of variance according to B.A. Dospekhov on a PC.

The predecessor of the studied variety of spring soft wheat was winter wheat. In autumn, plowing was carried out to a depth of 25-27 cm.

In the spring, with the onset of physical ripeness of the soil, the moisture was closed in two tracks with harrows BZSS - 1.0 across the main cultivation. Then, on May 15, 2019, pre-sowing cultivation was carried out with a KPS-4 cultivator to a depth of 5 - 6 cm.

On the same day, i.e. On May 21, wheat was sown with a seeding rate of 4.0 million viable seeds per hectare to a depth of 5 - 6 cm, using a SZ-3.6 seeder.

In the heading phase of spring wheat, foliar fertilization was carried out with liquid nitrogen fertilizer according to the experimental scheme.

Harvesting was carried out with a Terrion 2010 combine in the phase of full grain ripeness at the end of August.

Saratovskaya 42. Created by breeders of the Research Institute of Agriculture of the South-East (Saratov) by the method of complex stepwise hybridization with the participation of varieties Saratovskaya 29, Sarrubra, Albidum 43. Recommended for cultivation since 1973. A variety of albidum. The bush is upright. The leaf is short, narrow, with rather dense pubescence and a weak waxy coating, of a bluish-green color. The spike is cylindrical, slightly tapering towards the top, of medium density and medium length, in the upper part it has small osteiform formations. Spikelet scales are lanceolate-ovate, rather delicate, with pronounced nerve. The keel is clearly expressed, in the form of a thin cord it reaches the base of the scales. The tooth is short, straight, or slightly curved towards the shoulder. The shoulder is narrow, oblique at the base of the spike, straight in the middle part, and rather strongly raised in the upper part. The grain is shortened in shape, with a wide shallow groove, weight of 1000 pieces 30–37 g. Plant height is about 100 cm. Mid-early: growing season 82–91 days, before earing about 45 days. Resistant to drought, plant lodging and grain shedding. Sufficiently resistant to damage from brown and stem rust, dusty smut, to damage from the Swedish fly. Milling and baking qualities are high. The protein content in the grain is about 14%, the strength of the flour is on average 360 units of the alveograph. The nature of the grain is 810 g / l. Refers to varieties of strong wheat. [12-28]

3. Field germination, safety and overall survival of plants

Distinguish between laboratory germination, which is determined in control and seed laboratories, and field - seed germination is determined in the field. Field germination of grain crops varies from 60 to 80% of the number of germinating sown seeds, i.e. it is 20-40% lower than the laboratory one.

In our studies, the field germination rate of spring wheat was high and amounted to 91.1%. Top dressing with the studied fertilizers in the heading phase did not contribute to an increase in the number of preserved plants for harvesting. On the variants Carb-N-Humik and Carb-N-Humik + Albit, Carb-N-Humik + Albit + Amino Zn, the number of plants to be harvested decreased by 10, 6 and 13 pcs / m² respectively with respect to the control case.

Table 1. Field germination, safety and overall survival of spring wheat

Top dressing in the heading phase	Number of seeded. germinating seeds pcs. / 1 sq. m	The number of vyso-shedsh. plants per 1 sq. m	Number saved plant for cleaning pcs / per 1 sq. m	Field germination, %	Save plants, %	Overall survival, %
control	450	410	238	91,1	58,0	52,9
Carb-N-Humik	450	410	228	91,1	55,6	50,7
Carb-N-Humik + Albite	450	410	232	91,1	56,6	51,6
Carb-N-Humik + Albite + Amino Zn	450	410	225	91,1	54,9	50,0

In this regard, the safety and overall survival of plants was the greatest in the control, and the greatest in the studied variants.

4. General and productive tillering

Distinguish between general and productive bushiness. The total bushiness is understood as the average number of stems per plant, regardless of the degree of development of the shoots. Productive bushiness is the average number of normally developed grain-producing stems per plant [3-5].

Our experiments showed that the productive tillering of spring wheat was typical and averaged 1.05 units. In the context of the studied variants of the experiment, the highest productive tillering was noted for the variants Carb-N-Humik and Carb-N-Humik + Albit + Amino Zn, where it was 1.06 and 1.07 units, which is 0.02 and 0.03 units more in comparison with the control variant (Table 2). The smallest productive bushiness is 1.04 units. marked on the variant Carb-N-Humik + Albit and control. It should be noted that the number of productive stems per unit area in the control variant was the highest 248 pcs / m².

Table 2. Total and productive tillering of spring wheat

Top dressing in the heading phase	The number of surviving plants for harvesting, pcs / m ²	The total number of stems of stems pcs / m ²	Number productive stems, pcs / m ²	General bushiness	Productive bushiness
control	238	339	248	1,42	1,04
Carb-N-Humik	228	337	241	1,48	1,06
Carb-N-Humik + Albite	232	333	242	1,44	1,04
Carb-N-Humik + Albite + Amino Zn	225	333	240	1,48	1,07

5. Crop structure and yield of spring wheat

In 2019, spring wheat produced an average biological yield typical of the arid Orenburg region. On average, for the studied variants of the experiment, it was 11.0 c / ha.

Foliar dressing during the earing phase contributed to an increase in the yield of spring wheat. Thus, the biological yield on the variants Carb-N-Humik and Carb-N-Humik + Albit + Amino Zn increased

by 0.6 and 0.5 c / ha relative to the control variant and amounted to 11.0 and 10.9 c / ha, respectively. (Table 3).

The highest biological yield of 11.5 c / ha was obtained on the variant where fertilizing was carried out with the fertilizer Carb-N-Humik + Albit + Amino Zn. The highest yield was obtained due to the largest number of grains in an ear of 17 pcs. The lowest biological yield is 10.4 c / ha against the control background, which is primarily associated with the smallest number of grains in an ear of 15 pcs. and a mass of 1000 grains of 27.9 g. The economic yield also varied depending on the options studied. We found that top dressing contributed to an increase in the number of grains per ear, grain weight per ear, and 1000 grain weight relative to the control. For example, on the Carb-N-Humik variant, the number of grains per spike increased to 16, the weight of grain from one spike - up to 0.46 g., The weight of 1000 grains - up to 28.5 g.

Table 3. Yield structure and yield of spring wheat in 2019

Top dressing in the heading phase	Number of stems, pcs / m ²	Plant height, cm	Ear length, cm	The number of spikelets per ear	The number of grains per ear	Grain weight per ear, g	Weight of 1000 grains, g	Biological yield, c / ha	Economic yield, c / ha
control	248	56	5,3	9	15	0,42	27,9	10,4	8,9
Carb-N-Humik	241	56	5,0	9	16	0,46	28,5	11,0	9,7
Carb-N-Humik + Albite	242	55	5,3	9	16	0,45	28,2	10,9	9,4
Carb-N-Humik + Albite + Amino Zn	240	57	5,3	9	17	0,48	28,2	11,5	9,9

LSD₀₅ = 0,5 c/ha

The food market is a complex system of economic relations between producers and consumers of food products, which are mediated by infrastructure enterprises. In accordance with this, the potential of the food market consists of all its available opportunities within a certain region.

The production potential of domestic agricultural producers, as practice shows, is quite large. However, there are a number of constraining factors (price disparity, lack of guaranteed sales markets) that do not allow most agricultural producers to use the available production capabilities to increase the volume of products and improve their quality [14-20].

The production of spring wheat grain on the studied variants of the experiment turned out to be profitable.

Additional costs on the studied variants of the experience did not lead to additional profit. For example, on the Carb-N-Humik + Albit variant, 115,009.47 rubles were additionally spent, but the profit decreased relative to the control variant by 65,009.47 rubles.

Labor costs for all variants of the experiment were practically equal and varied from 106.38 to 108.79 rubles.

Due to the fact that the cost of production was the highest on the Carb-N-Humik + Albit + Amino Zn variant, the prime cost of the main product per hectare was the highest - 7274.69 rubles.

The best economic indicators are noted against the control background, which is associated with lower costs, since did not use fertilizers.

6. Conclusion

The studies we conducted in 2019 in the conditions of the educational and experimental farm of the OGAU allowed us to draw the following preliminary conclusions and recommendations.

1. Agroclimatic conditions in 2019 developed so that by the time of sowing spring wheat, the soil was sufficiently warmed up and saturated with available moisture, which created good conditions for swelling and germination of seeds. As a result, the germination rate was high. The air temperature during almost the entire growing season of wheat was higher than the average annual norms.

During the growing season of wheat, precipitation practically did not fall, until July, when it was already late, which created unfavorable conditions for the formation of the crop.

2. Field germination of wheat seeds was high and amounted to 91.1%. Top dressing with the studied combinations of fertilizers in the heading phase did not contribute to an increase in the number of preserved plants for harvesting. On the contrary, it decreased from 6 to 13 pcs / m².

3. The productive bushiness of spring wheat was typical for our region and varied from 1.04 to 1.07 units. The largest number of productive stems was noted in the control 248 pcs / m². The total number of stems in the variants of the experiment was practically the same and varied from 333 to 339 pcs / m².

4. The yield of spring wheat was low and the average for the experience was 9.5 kg / ha. The highest economic yields of 9.9 and 9.7 c / ha were observed for the variants Carb-N-Humik and Carb-N-Humik + Albit + Amino Zn.

Top dressing contributed to an increase in the number of grains per ear, grain weight per ear, and 1000 grain weight relative to control. For example, on the Carb-N-Humik variant, the number of grains per spike increased to 16, the weight of grain from one spike - up to 0.46 g., The weight of 1000 grains - up to 28.5 g.

5. The largest amount of gluten, 27.2 and 27.4%, was formed in the control and in the Carb-N-Humik variant. On the control variant, gluten of the first quality group was formed, and on the studied variants - the second. In all variants of the experiment, the bulk density of grain did not meet the requirements of high-quality wheat and was below 750 g / l, but it entered the restrictive conditions and was above 710 g / l. The natural weight of grain in our experiments varied from 715 to 718 g / l.

6. The calculation of economic efficiency in 2019 showed that the profit was obtained on all studied variants of the experiment. Higher profits were obtained against the control background. Also, a high profit was obtained on the Carb-N-Humik option, where the profit per 1 hectare was 2703.0, per 1 centner - 278.66 rubles, the level of profitability was 38.6% and the return on costs with products was 1.39 rubles.

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