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Using Physiologically Active Substances Into The Technology For Winter Wheat Cultivation In The Zone Of Unstable Moistening Of The Stavropol Region.

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ABSTRACT

In the Russian market in recent years, new drugs have emerged that are a complex of organo-mineral compounds, including both macro and microelements, and amino acids, polysaccharides and other organic compounds. Unfortunately, the mechanism of their action on the plant organism in the literature is insufficiently illuminated. Therefore, studies are needed to establish the features of the formation of the yield and quality of winter wheat grain when using such preparations that will allow the development of scientifically based recommendations for their use. The aim of the research was to study the effect of complex physiologically active substances (CFAFA) on the features of the production process of winter wheat. It is established that the use in the technology of growing CFAF and their combinations in the zone of unstable moistening of the Stavropol Territory helps to increase the yield of winter wheat by an average of 4.2-11.8 c / ha. Complex physiologically active substances contributed to the improvement of the quality of winter wheat grain: both the amount of protein (up to 0.8%) and the amount of raw gluten in grain (by 1.0-3.6 absolute%) are increased, while the grain does not change the quality group. Technological methods using the CFAF increase the chlorophyll photosynthetic potential of winter wheat crops (up to 15% compared to the control). The greatest photosynthetic efficiency is found in winter wheat sowing, where all tested complex physiologically active substances are used, the net productivity of photosynthesis is 25.7% higher than in the control variant. The highest values of PPE were observed when using Raikat Start in combination with other complex physiologically active substances. The use of complex physiologically active substances contributes to the preservation of high nitrate reductase activity in plants during the period of grain loading, this indicator is 3.6-79.0% higher than in the control variant. The greatest nitrate reductase activity was noted in variants with the use of Atlanta Plus (by 51.6-79.0% in comparison with the control). The best conditions for nitrogen nutrition of plants of winter wheat at the end of vegetation were noted in variants with the use of grain nutrient in the X stage of organogenesis (the excess of nitrogen content in plants compared to the control was 64.8-102.2%).

Keywords: winter wheat, physiologically active substances, productivity, grain quality.

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INTRODUCTION

The main grain crop in the Stavropol Territory is winter wheat. The improvement of technologies for its cultivation, aimed at obtaining stably high yields, should be based on scientific developments that allow creating low-cost, environmentally safe and highly effective methods of cultivation that contribute to optimizing the production process of plants [1, 2, 3].

In recent decades, significant climate changes have occurred, which are manifested, on the one hand, in the form of an improvement in the average annual moisture and heat availability of the territory of the Stavropol Territory, and on the other, an increase in the number of extreme events such as severe frosts, droughts, dry winds, etc. [4, 5]. Therefore, in modern technologies, there must be elements that increase the adaptability and stress resistance of plants. This can be achieved in several ways, the most important of which are genetic, that is, variety selection and technology is the optimization of plant growth and development through the selection of the precursor, soil cultivation, application of fertilizers, and protective measures [6, 7]. Also to the second is a relatively low-cost, but highly effective method - the use of physiologically active substances [8, 9].

On the Russian market in recent years, new drugs have emerged that are a complex of organo-mineral compounds, including both macro and microelements, and amino acids, polysaccharides, and directly biologically active substances [10, 11]. Some of these drugs are already used in agricultural production, but, unfortunately, without scientific advice. Therefore, studies are needed to establish the features of crop formation and the quality of winter wheat grain when using complex physiologically active substances that will allow the development of scientifically based recommendations for their use.

The aim of the studies was to study the effect of complex physiologically active substances on the features of the production process of winter wheat.

MATERIAL AND METHODS

General conditions and methods of conducting research. The investigations were carried out on the experimental field of the North Caucasian Federal Scientific Agrarian Center located in the zone of unstable moistening of the Stavropol Territory. Work was carried out from 2015 to 2017. The predecessor is black steam. The repetition of the experiment is threefold, the area of each plot is not less than 25 m^2.

The following complex preparations based on physiologically active substances were studied in the experiments: Raikat Start, Aminokat 10%, Atlante Plus, Nutrivant Grain. The scheme of the experiment included: application of all the preparations separately (Raikat Start - seed treatment (o / s) in a dose of 0.5 l / t seeds, 10% Aminokat - non-root fertilizing of crops in the fourth stage of organogenesis in a dose of 0.3 l / ha, Atlanta Plus - foliar fertilizing of crops in the VIII stage of organogenesis in a dose of 0.5 l / ha, Nutrivant Grain - no-root fertilizing of crops at the beginning of the XI stage of organogenesis in a dose of 2 kg/ha, as well as all combinations of preparations in the appropriate phases of growth and development of plants winter wheat.

Table 1: Scheme of experience

Processing Phase			
seeds	**spring tillering**	**earing**	**milk ripeness**
Control (no treatment)			
Raikat Start			
	Aminokat 10%		
		Atlanta Plus	
			Grain nutrivant
Raikat Start	Aminokat 10%		
Raikat Start		Atlanta Plus	
Raikat Start			Grain nutrivant
	Aminokat 10%	Atlanta Plus	
	Aminokat 10%		Grain nutrivant

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		Atlanta Plus	Grain nutrivant
Raikat Start	Aminokat 10%	Atlanta Plus	
Raikat Start	Aminokat 10%	Atlanta Plus	Grain nutrivant

The investigations were carried out on the sap of winter wheat of the variety Bagira. The variety is medium-ripening, resistant to lodging and grain shedding, high-yielding.

The indices of photosynthetic productivity were calculated by conventional methods. The chemical composition of the bodies of winter wheat was determined in mixed samples by the method of V.T. Kurkaev et al. [12]. The chlorophyll content was determined by the method of Ya. Milayeva and N.P. Primak using the Wintermans and De Motzs equations [13]. The activity of nitrate reductase was studied by the Mulder method in Tokarev's modification [14]. The harvest was recorded by direct combining.

RESULTS AND DISCUSSIONS

Studies have shown that the use of complex physiologically active substances in the cultivation technology contributes to an increase in the yield of winter wheat grain by an average of 4.2-6.9 c / ha (Table 2).

Table 2: Influence physiologically active substances on the productivity of winter wheat

Option	Number of stems, pcs.	Biomass yield, centner / ha	Height of plants, cm	Grain weight, g	Rate, c/hectare	K_{farm}
Control (no treatment)	528	150	87,5	1,19	62,7	0,42
Raikat Start (c)	555	159	87,7	1,20	66,9	0,42
Aminokat (IV)	592	169	88,3	1,16	68,5	0,41
Atlanta Plus (VIII)	557	158	92,6	1,24	68,6	0,44
Grain nutrient (X)	552	160	89,9	1,27	69,6	0,44
Raikat Start (c) + Aminokat (IV)	550	175	89,9	1,25	68,0	0,39
Raikat Start (c) + Atlanta Plus (VIII)	582	173	91,2	1,23	71,4	0,41
Raikat Start (c) + Grain nutrient (X)	560	177	93,0	1,30	72,3	0,41
Aminokat (IV) + Atlanta Plus (VIII)	580	179	93,0	1,27	72,5	0,41
Aminokat (IV) + Grain nutrient (X)	586	184	93,3	1,23	71,7	0,39
Atlanta (VIII) + Nutrivant (X)	554	169	95,3	1,27	70,2	0,42
Raikat (c) + Aminokat (IV) + Atlanta (VIII)	577	181	92,6	1,25	70,8	0,39
Raikat (c) + Aminokat (IV) + Atlanta (VIII) + Nutrivant (X)	598	196	94,8	1,26	74,5	0,38
HCP_{05}					**3,3**	

The use of combinations of drugs in our experiments increased the yield by 5.3-11.8 c / ha, depending on the variant. The greatest increase was obtained with the full use of all complex physiologically active substances in the corresponding phases of growth and development of winter wheat plants.

Great value for the harvest of a grain of winter wheat has a productive stem. In our studies, the use of complex physiologically active substances in cultivation technology contributed to the preservation of productive stems at the end of vegetation in plants of winter wheat. So the use of the studied preparations increased the number of stems in harvesting on average over the years of research by 27-70 pieces per m2. Variants Aminokat 10% (IV), Raikat Start (o / c) + Atlanta Plus (VIII), Aminokat 10% (IV) + Grain nutrient (X) and

Raikat Start (o / c) + Aminokat 10% (IV) + Atlanta Plus (VIII) + Grain nutrient (X), this increase was more than 10%.

The study of the remaining main elements of the crop structure (the mass of 1000 grains, the grain size of the spike and the yield of grain from 1 ears) did not reveal any reliable provable regularities.

It should be noted that the general regularity for the coefficient of economic efficiency in our experiments was its increase with increasing grain yields.

Thus, the use of complex physiologically active substances and their combinations in the cultivation technology contributes to an increase in the yield of winter wheat by an average of 4.2-11.8 c / ha. The increase in yield is mainly due to the preservation of productive stems.

In our experiments, the use of complex physiologically active substances contributed to the improvement of grain quality indicators (Table 3).

Table 3: Influence physiologically active substances on the quality of winter wheat grains

Option	Protein,%	Crude gluten,%	Indications Idk	Quality group
Control (no treatment)	12,9	20,7	59,5	I
Raikat Start (c)	13,7	24,3	68,0	I
Aminokat (IV)	13,0	21,7	63,5	I
Atlanta Plus (VIII)	13,0	22,3	69,5	I
Grain nutrient (X)	13,2	22,3	62,5	I
Raikat Start (c) + Aminokat (IV)	12,8	22,6	67,0	I
Raikat Start (c) + Atlanta Plus (VIII)	13,7	24,0	71,0	I
Raikat Start (c) + Grain nutrient (X)	13,1	22,6	67,0	I
Aminokat (IV) + Atlanta Plus (VIII)	13,1	23,0	69,0	I
Aminokat (IV) + Grain nutrient (X)	13,4	22,3	72,0	I
Atlanta (VIII) + Nutrivant (X)	12,8	21,4	61,0	I
Raikat (c) + Aminokat (IV) + Atlanta (VIII)	13,6	23,2	67,0	I
Raikat (c) + Aminokat (IV) + Atlanta (VIII) + Nutrivant (X)	13,2	22,9	65,0	I

The use of the studied preparations, as a rule, increased the amount of protein in the grain, this excess was up to 0.8% absolute - on the Raikat Start variant (o / c). In the same version, the biggest increase in the amount of raw gluten in grain relative to control was noted - by 3.6%. On all variants of the experiment with the use of complex physiological substances, there was an increase in the content of gluten. In addition, its quality did not deteriorate - all grain belongs to the I quality group, although the indicator of the IDK on the variants with the studied drugs was slightly increased.

Thus, the use of complex physiologically active substances in cultivation technology contributes to the improvement of the quality of the grain of winter wheat - the amount of protein in the grain increases to 0.8% and the number of raw gluten increases by 1.0-3.6%, while the grain does not change the quality group.

Photosynthesis is one of the most important processes determining the productivity of grain of winter wheat and its quality. Of great importance for the photosynthetic productivity of plants are both the size of the assimilation apparatus and the time of its active functioning. Our research has shown that the use of all complex physiologically active substances and their various combinations studied by us helps to increase the amount of chlorophyll in plants of winter wheat at the end of vegetation (XI stage of organogenesis) by 55-178%, in comparison with the control variant (Figure 1). As a consequence (Table 4), the chlorophyll photosynthetic potential (HFSP) of winter wheat crops is increased (up to 15% compared to the control). The best results for this indicator are shown by the options: Raikat Start (o / c) - 14.9%, Aminokat 10% (IV) - 12.5%, Raikat Start (o / c) + Atlanta Plus (VIII) - at 14.5%, Raikat Start (o / c) + Grain nutrient (X) - by 14.7% and Aminokat by 10% (IV) + Grain nutrient (X) - by 12.5% compared to the control.

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Table 4: Influence physiologically active substances on the photosynthetic productivity of winter wheat plants

Option	HFSP, g/m²day	ChPF,y/y per day
Control (no treatment)	149,1±4,5	10,1±0,3
Raikat Start (c)	171,3±5,1	9,3±0,3
Aminokat (IV)	167,8±5,0	10,1±0,3
Atlanta Plus (VIII)	155,3±4,7	10,2±0,3
Grain nutrient (X)	150,2±4,5	10,7±0,3
Raikat Start (c) + Aminokat (IV)	152,4±4,6	11,5±0,3
Raikat Start (c) + Atlanta Plus (VIII)	170,7±5,1	10,1±0,3
Raikat Start (c) + Grain nutrient (X)	171,0±5,1	10,4±0,3
Aminokat (IV) + Atlanta Plus (VIII)	161,2±4,8	11,1±0,3
Aminokat (IV) + Grain nutrient (X)	167,8±5,0	11,0±0,3
Atlanta (VIII) + Nutrivant (X)	155,5±4,7	10,9±0,3
Raikat (c) + Aminokat (IV) + Atlanta (VIII)	154,0±4,6	11,8±0,4
Raikat (c) + Aminokat (IV) + Atlanta (VIII) + Nutrivant (X)	154,6±4,6	12,7±0,4

Of great importance for the overall productivity of plants is not only the size of the assimilation apparatus and the time of its functioning but also the activity of the photosynthetic apparatus. An indicator characterizing the productivity of sowing for the creation of organic substances over a certain period of time is the net productivity of photosynthesis (PFD). Our studies showed that the greatest photosynthetic efficiency is in winter wheat crops, where all tested complex physiologically active substances were used. The net productivity of photosynthesis in this variant is higher than the control one by 25.7%.

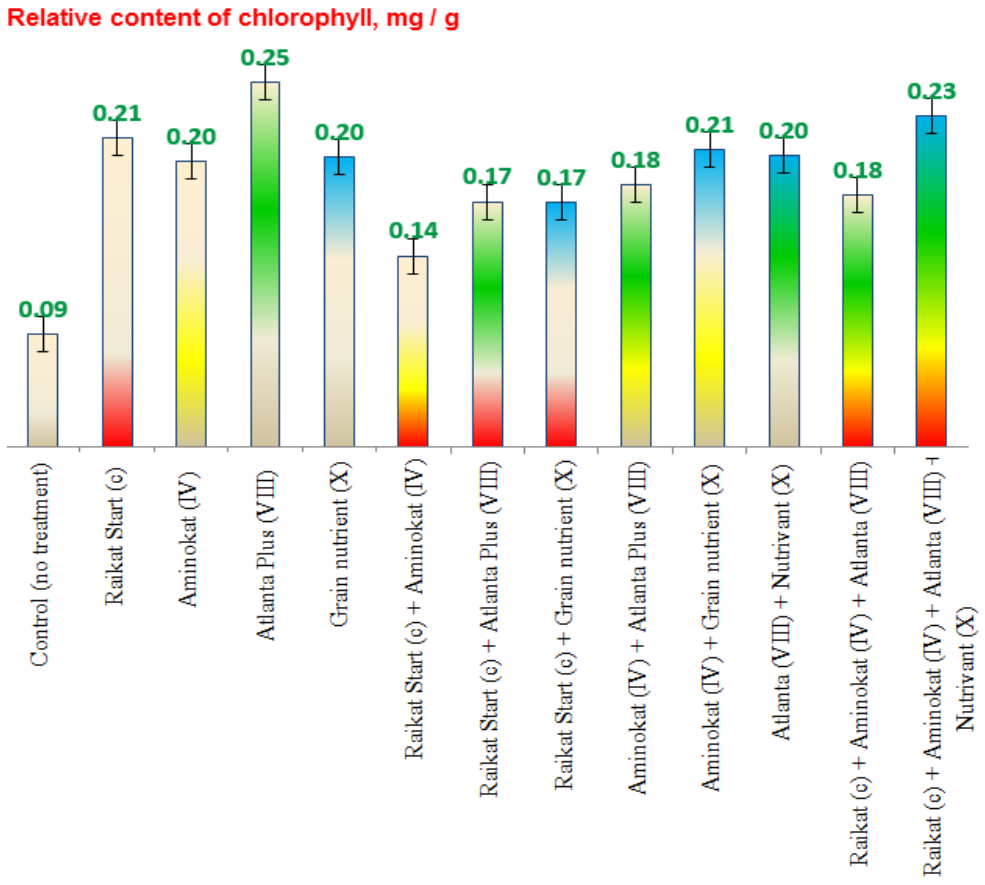

Figure 1: The effect of physiologically active substances on the chlorophyll content in winter wheat plants. Milky wax ripeness (on average over the years of research)

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In addition, photosynthetic efficacy is also high in variants where Raikath Start is used in combination with other complexes physiologically active substances: Raikat Start (o / c) + Aminokat 10% (IV) and Raikat Start (o / c) + Aminokat 10% (IV) + Atlanta Plus (VIII), in which the PSC had more control at 13.9 and 16.8%, respectively. At the same time, in the variant where only Raikat Start was used, the net productivity of photosynthesis was less than in the control variant by 7.9%.

The nitrogen nutrition regime plays an important role in the formation of the grain crop of winter wheat and its quality. Nitrate reductase is the key enzyme of plant nitrogen exchange. In our experiments, the use of complex physiologically active substances and their combinations promoted the preservation of high activity of this enzyme in plants during the period of grain loading: this indicator was 3.6-79.0% higher than in control (Fig. 2). The greatest nitrate reductase activity was noted in variants with the use of Atlanta Plus, either alone or in combination with other complexes physiologically active substances (by 51.6-79.0% compared to the control).

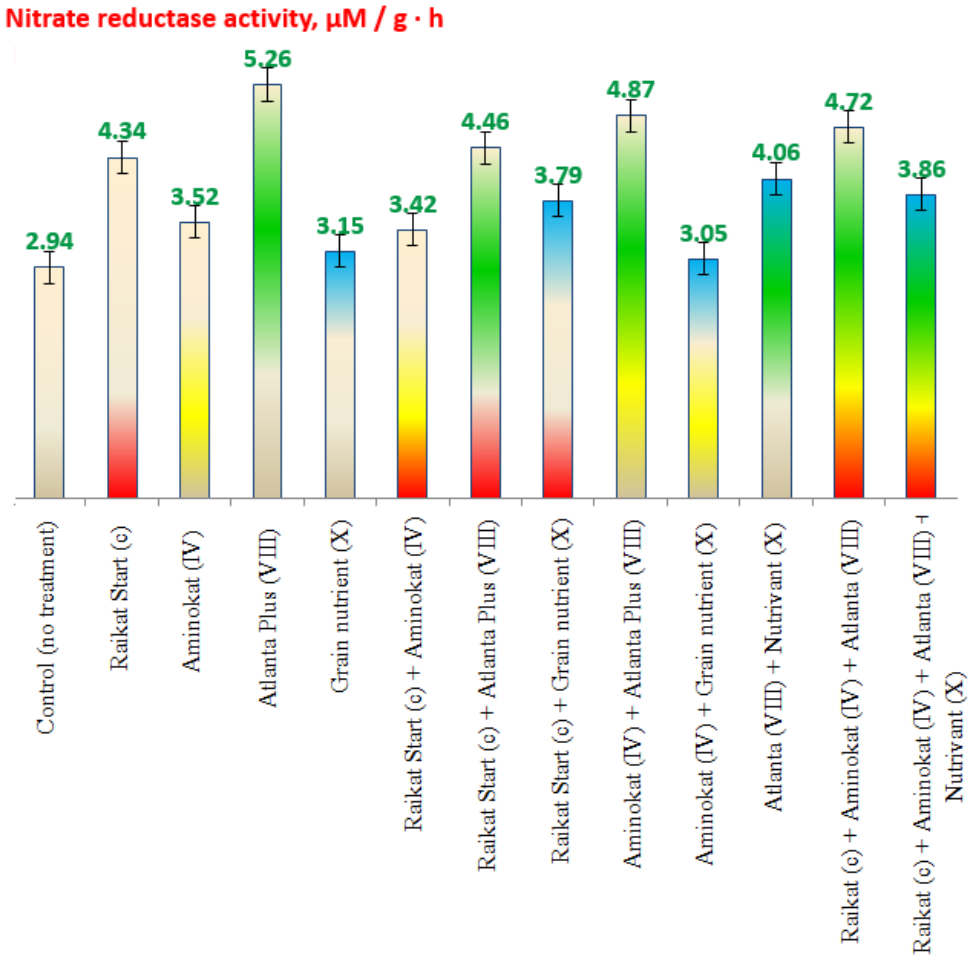

Figure 2: Influence of complex physiologically active substances on nitrate reductase activity of winter wheat (flag list). Grain loading, (2017)

As a result, in the variants with the use of the Atlanta Plus preparation in the period of grain filling, the nitrogen content in the plants of winter wheat is quite high - the excess in comparison with the control variant is 39.6-60.4% (Fig. 3). Nevertheless, the best conditions for nitrogen nutrition of winter wheat at the end of vegetation were noted in the variants with the use of grain nutrient at the X stage of organogenesis, in which the excess of nitrogen content in plants compared with the control is 64.8-102.2%. This is explained by the fact that the composition of the drug includes both nitrogen itself and trace elements, which contribute to the enhancement of nitrogen exchange in plants.

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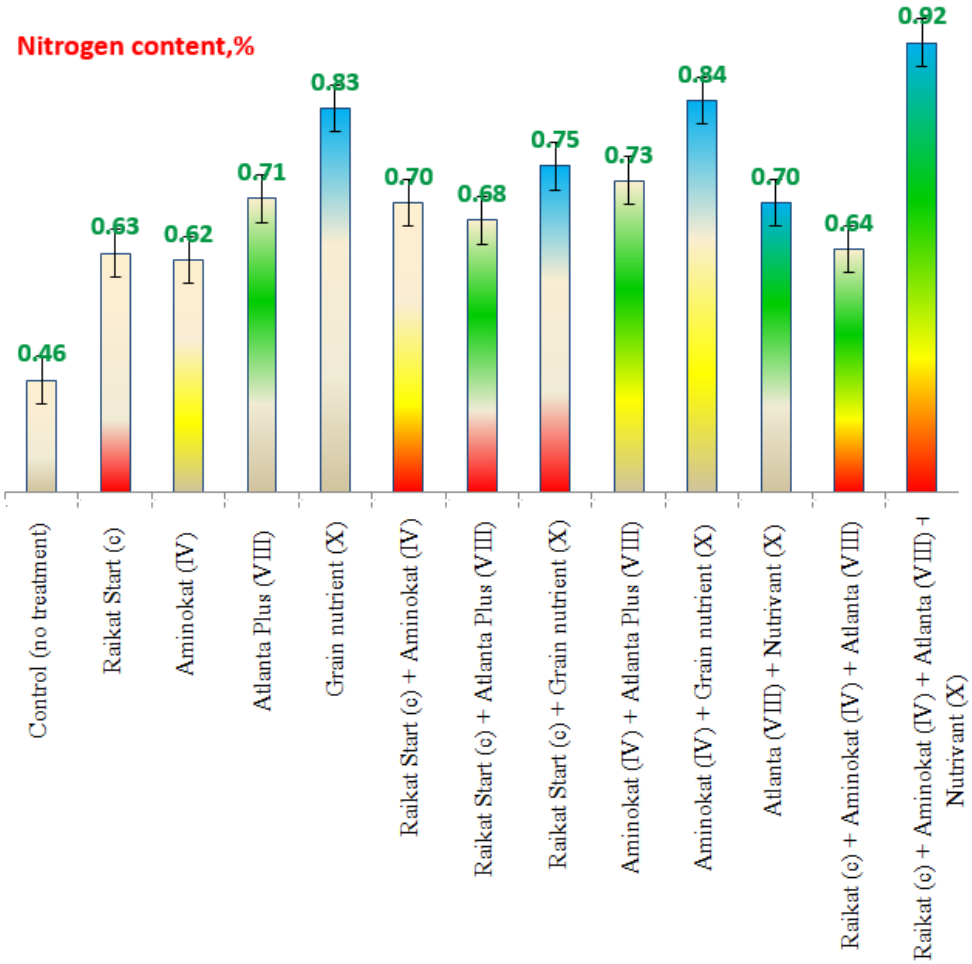

Figure 3: Influence of complex physiologically active substances on nitrogen content in winter wheat plants Milky wax ripeness (on average over the years of research)

Thus, the complex physiologically active substances Atlanta Plus and Nutrivant cereals improve the conditions of nitrogen nutrition of winter wheat. If the use of Atlanta Plus contributes to the preservation of high activity of nitrate reductase during the period of grain loading by 51.6-79.0% compared to the control, then the application of the grain nutrient leads to an increase in nitrogen content in plants by 64.8-102.2%.

CONCLUSION

1. Use in the technology of growing complex physiologically active substances and their combinations in the zone of unstable moistening of the Stavropol Territory helps to increase the yield of winter wheat by an average of 4.2-11.8 c / ha.

2. The use of complex physiologically active substances in cultivation technology contributes to the improvement of the quality of winter wheat grains: both the amount of protein (up to 0.8%) and the amount of raw gluten in grain (by 1.0-3.6 absolute%) increase. In this case, grain does not change the quality group.

3. Technological methods using complex physiologically active substances contribute to an increase in the chlorophyll photosynthetic potential of winter wheat crops (up to 15% in comparison with the control).

4. Winter wheat sowing has the greatest photosynthetic efficiency, where all tested complex physiologically active substances are used, the net productivity of photosynthesis is 25.7% higher than in the control variant. The highest values of PPE were observed when using Raikat Start in combination with other complexes physiologically active substances.

5. The use of complex physiologically active substances contributes to the preservation of high nitrate reductase activity in plants during the period of grain loading, this indicator is 3.6-79.0% higher than in the

control variant. The greatest nitrate reductase activity was noted in variants with the use of Atlanta Plus (by 51.6-79.0% in comparison with the control).

6. The best conditions for nitrogen nutrition of plants of winter wheat at the end of vegetation were noted in variants with the use of grain nutrient at the X stage of organogenesis (the excess of nitrogen content in plants compared to the control was 64.8-102.2%).

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