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The Effect Of Growth Regulators On Photosynthetic Activity Of Spring Wheat Plants.

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ABSTRACT

It has been found the positive effect of growth regulators on the indexes of photosynthetic activity and yielding capacity of spring wheat under conditions of the Middle Volga region of the Russian Federation.

Keywords: spring wheat, growth regulators, assimilation surface of the leaf, photosynthetic potential, dry matter, net productivity of photosynthesis, yield.

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INTRODUCTION

The theory of photosynthetic plant productivity was founded as a result of studying the general laws of the production process. The theory formulates the quantitative characteristics of photosynthesis, substantiates the theoretically possible levels of using photosynthetically active radiation (PAA) to obtain high crop productivity [1].

The stability of the photosynthetic apparatus is due to the organization of all its components, with the result that the light energy absorbed by chlorophyll is used by the plant. When exposed to various factors (for example, the lack of moisture, very often observed in the forest steppe of the Volga region), the sensitivity of plants to light increases, i.e. the photo inhibition effect occurs. Under conditions of water stress (drought), the balance between the mechanisms triggering oxidative phenomena and cellular oxidative protection is disturbed. As a result, the destruction of chlorophyll and the deterioration of other indicators of the photosynthetic apparatus. Moreover, as the water deficit increases, there is a sharp decrease in the intensity of photosynthesis, transpiration, CO₂ concentration in intercellular spaces, chlorophyll content, and stomatal conductance [2]. Taking account of this information, it is necessary: to search, use and study the action of various physiologically active substances to stimulate the processes of forming photosynthetic parameters of plants under conditions of high-risk farming.

Photosynthetic activity is one of the most important factors determining productivity as a complex integrated function of plants [3].

While studying photosynthetic activity of crops, as the main factor of yield, it is necessary to evaluate the conditions for using physiologically active substances that make it possible to grow crops that absorb the most energy of the photosynthetically active part of solar radiation. Its utilization rate for photosynthesis at the same time, and the formation of total and economic yield should be maximal. Obtaining high yields requires not only strict adherence to the technology of cultivating agricultural crops, but also the application of promising and scientifically based approaches using various factors regulating the growth and development of plants.

The yielding capacity of crops is created through photosynthesis, when organic matter is formed in green plants and solar energy is converted into plant biomass energy. The efficiency of this process depends on crops' functioning as a photosynthetic system. To control the formation of the crop is very difficult, and one of the ways to regulate this process is to use physiologically active substances - regulators of plant growth and development [4, 5, 6]. Since the productivity of grain crops is provided, first of all, by the efficient operation of the photosynthetic apparatus, our studies were carried out to determine the degree of the influence of various growth regulators on the photosynthetic structure and functions in spring wheat plants under conditions of the Volga forest-steppe.

OBJECTS AND RESEARCH METHODS

The studies were conducted in laboratory and field settings of P.A. Stolypin Ulyanovsk State Agrarian University. The experimental crop is spring wheat of the variety Zemlyachka, the method of establishing the field experiment is generally accepted for small plot areas, replication is 4 times, the lay-out of variants in the experiment is randomized, the area of plots is 20 m². Before sowing, the seeds were treated with growth regulators — Crezacin, Energia, Albit, Gumi, Zircon, Extrasol, at concentrations recommended by the manufacturer.

The soil of the experimental field is medium leached black soil, medium loam with the following agrochemical characteristics: humus content 4.3% (medium humus soil), PH = 5.8 - 6.8 (slightly acid), mobile phosphorus and potassium content respectively 107 - 142 and 103 - 135 mg / kg of soil (increased). The degree of saturation with bases is 96.4 - 97.9%. The amount of absorbed bases is 25.5 - 27.8 mg - eq. / per 100g of soil. Analyzes, registration and observations in the experiment were carried out in accordance with generally accepted methods and state standards.

RESULTS AND THEIR DISCUSSION

One of the main indicators of photosynthetic activity of plants that determine the yield is the size of the leaf area and the duration of its functioning. As a result of the study, it has been found that the use of growth regulators contributes to an increase in the assimilation surface of the leaves of spring wheat.

The main increase in the leaf surface area occurred from the tillering stage, reaching a maximum by the end of the ear formation stage. Beginning from the stage of milky ripeness, this indicator decreases in all the variants of the experiment because of the intensive outflow of assimilates into the reproductive organs. The largest increase in the leaf area was observed in the variants Energia and Crezacin and it was 0.25 - 0.50 thousand m² / ha, depending on the stage of growth and development of spring wheat.

Due to the fact that the maximum leaf area characterizes the temporary condition of crops, and the harvest is the result of photosynthetic activity of crops during the whole vegetation period, it is more correct to associate its size with the integral indicator of work of the assimilation apparatus - photosynthetic potential (PP), which takes into account not only the sizes, but also and the duration of the assimilating surface.

Table 1 - Effect of growth regulators on photosynthetic potential of leaves of spring wheat plants in the variety of Zemlyachka, million m² / ha days (mean values over the years of research)

Variants	Tillering – shooting	Shooting – ear formation	Ear formation – milky ripeness	PP
Control	0,115	0,122	0,163	0,400
Crezacin	0,120	0,126	0,169	0,415
Energia	0,120	0,126	0,170	0,417
Albit	0,120	0,125	0,168	0,414
Gumi	0,119	0,125	0,168	0,412
Zircon	0,119	0,126	0,168	0,413
Extrasol	0,119	0,126	0,167	0,413

It was established that pre-sowing treatment of seeds with growth regulators increases the PP value of leaves of this crop (Table 1).

It should be pointed out that the peak values of PP in the vegetation phases shifted to a later time than the peak values of the leaf area, reaching a maximum towards milky ripeness. This trend is confirmed by other authors [7, 8]. On average, over the years of research, the highest value of PP was observed in the variants of Crezacin and Energia (0.415 - 0.417 million m² / ha), which is quite natural, taking account of the greatest assimilation surface of the leaves in these variants.

The final product in the activity of the photosynthetic apparatus of plants is the formation of organic matter. Up to 90 - 95% of dry plant biomass is formed during photosynthesis. Our experiments have shown that the capacity of accumulation of dry matter increases under the influence of growth regulators which we used.

The greatest increase in the dry mass of the experimental culture was observed in the period of going into the tube - earing. The maximum dry weight was accumulated in the variant Energia and exceeded the values of the control group by 36.08 - 547.41 kg / ha, depending on the stage of growth and development of spring wheat.

To assess the performance of the photosynthetic apparatus in the field, the value of the net productivity of photosynthesis (NPP) is widely used. NPP is a reflection of the balance between the intensity of photosynthesis, photorespiration and respiration during the day and at night.

The value of the NPP was the maximum in the stage of shooting – ear formation in all the variants of the experiment.

The experiments have shown that the NPP increased with the use of growth regulators. The greatest increase index was observed in the variants Crezacin, Energia, Zircon. The stimulation of the processes of forming photosynthetic parameters and improving the character of donor - acceptor relations between the ear and assimilation surface of leaves, accounts for an increase in the productivity of the experimental crop (Table 2).

Table 2 - Effect of growth regulators on the yield of the spring wheat variety Zemlyachka, t / ha

Variant	2010	2011	2012	Mean value	Increase
Control	0,65	3,61	1,28	1,85	-
Crezacin	0,70	4,19	1,65	2,18	0,33
Energia	0,65	4,21	1,70	2,19	0,34
Albit	0,70	3,64	1,51	1,95	0,10
Gumi	0,65	3,73	1,56	1,98	0,13
Zircon	0,75	3,71	1,60	2,02	0,17
Extrasol	0,70	3,80	1,49	2,00	0,15
LSD ₀₅	0,05	0,48	0,2	-	-

On average, over the years of research, the increase in the spring wheat yield amounted to 0.10-0.34 t / ha, depending on the variant. The most effective treatment was with the use of Crezacin and Energia.

CONCLUSIONS

Thus, the revealed positive role of regulators of plant growth and development used in the experiment is manifested in the intensification of the growth functions of spring wheat, the processes of formation of the photosynthetic apparatus, both in the initial and subsequent periods of development. This, ultimately, leads to an increase in the resistance of the photosynthetic apparatus of plants to unfavorable environmental factors (high temperature, low moisture content, weed infestation) and allows one to obtain high yields of agricultural crops even in the areas of high-risk farming, which the Middle Volga region belongs to.

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