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THE INFLUENCE OF NUTRITION ELEMENTS AND HERBICIDES ON CHLOROPHYLL CONTENT IN MODERN VARIETIES OF WINTER WHEAT

Established strong relationship between chlorophyll content, chlorophyll photosynthetic potential of leaves and yield confirms the importance of regulating of the photosynthetic apparatus size on the levels of mineral nutrition and means for crop protection to obtain high yields of winter wheat.

Key words: mineral nutrition, herbicides, chlorophyll, productivity

Introduction. It was known that the yield and grain quality of winter wheat determined by many factors: climate, soil, and variety, predecessors, the level of mineral nutrition and others. The questions of the relationship of yield, grain quality and level of mineral nutrition deeply studied in the 60-80 years of the last century [1, 2]. However, modern high-intensity winter wheat varieties differ significantly from previous architectonics plants, some biochemical parameters and potential of productivity [3-9].

In particular, it was found that in years with favourable weather conditions chlorophyll photosynthetic potential of modern drafts varieties of winter wheat was higher than tall ones [6]. There was data that drafts wheat varieties on high doses of nitrogen nutrition more use nitrogen to form grain than tall ones. Although, there was no difference in the efficiency of utilization of nitrogen in the grain (which assessed as ratio of the nitrogen content in grain to it content in total biomass) between contrasting in grain productivity varieties of winter wheat. Nevertheless, high-yield varieties were more efficient by absorption of nitrogen from the soil [3-5].

The structural organization of the photosynthetic apparatus of plants may be one of the factors that determine the althoughs of modern varieties of wheat. According [1, 3, 7-9], the indicators of photosynthetic activity of plants is most closely correlated with their productivity. Simultaneously, the question of the reaction of the photosynthetic apparatus of new varieties of crops to high doses of mineral nutrients that are needed to realize their genetic potential, insufficiently investigated. It is known that the rate of photosynthesis depends on the presence of heat, moisture, nutrients and light. For all these factors, the cultivated plants competing by weeds. Thus, reducing the weeds levels in crops, herbicides contribute to better ensure winter wheat with abiotic factors. Thus, the chlorophyll content in wheat leaves may depend on the effectiveness of the protection of crops from weeds. Reliable protection of winter wheat against weeds creates the better conditions for growth and development of this culture, promotes the improvement passage of intensity of physiological processes by which the yield formed.

The purpose of the work was to determine the effect of nutrition and composition of herbicide against dicotyledonous with graminicides on chlorophyll content in plants of modern varieties of winter wheat.

Materials and methods. Studies conducted in experimental agriculture department of Institute of Plant Physiology and Genetics, NAS of Ukraine in 2011-2013. The variety of winter wheat Smuglianka is high-intensity type and Pereiaslavka is intensity one. From studies presented data in 2012.

Measurement of chlorophyll content in leaves of winter wheat was carried out using field SPAD-502 (Konica Minolta, Japan) [10, 11]. Determination of leaf area index of crops carried out during the period from flowering to milky- wax ripeness of grain. The green leaves area (S) of winter wheat was calculated as $S = 0,76 \times l \times h$, where: l - length and h - maximum width of the

leaf. Leaf area index (LAI) characterized the area of green leaves (m²) above the unit soil surface (m²). The chlorophyll index (Chl I) was calculated as the multiplication of leaf area and total chlorophyll content in them. Chlorophyll photosynthetic potential corresponds to the sum of the daily values Chl I for a certain period of development [1].

The main area of the field was treated of herbicide against dicotyledonous Derby 175 SC (Syngenta, Switzerland) – 0.07 l/ha – and graminicide Axial 045 EC – 1,0 l/ha – in the phase of tubing. The area of field 0,2-0,3 hectares was left for research. Phosphorus and potassium were in the form of monopotassium phosphate and potassium sulphate, foliar nitrogen – as KNO₃, NH₄NO₃, (NH₄)₂SO₄ and Ca(NO₃)₂ in a dose of 5 kg/ha in the form of UAN-32 at doses of 5-20 l/ha and during the formation of generative organs – urea (production of Cherkassy NGO "Nitrogen"). Spraying was done in the evening, with the temperature of 20-24⁰C and in the absence of wind.

Determining the parameters of yield structure was done by selecting plants for a week before harvesting by analysis sheaves. Harvesting was performed by direct harvesting with combine harvester Sampo-500. Accounting of yield by weighing the yield of each plot with simultaneous determination of moisture. Determination of protein and dry gluten (%) in grain was carried out in the laboratory of grain quality of IPPG of NAS of Ukraine by infrared analyzer Inframatik 8600 (Pertin Instruments AB, Sweden). Statistical analysis of the results was performed according to standard methods [12, 13].

Results and discussion. Using of herbicide against dicotyledonous Derby and graminicide Axial provides effective weed control, compared with a control variant, whereupon increasing leaf surface was established. Application of herbicides has led to a significant growth LAI compared with control: by 30-50 % in the stages of flowering and milky wax ripeness and by 20-25 % – in the milky-wax ripeness stage.

There was a positive effect of composition of herbicide Derby and Axial with nitrogen on the chlorophyll content in leaves of varieties winter wheat plants Smuglianka and Pereiaslavka. In the control variant – without application of herbicides – chlorophyll content was lower than in ones using herbicides, which is probably due to the higher efficiency of weed control (Table 1).

Table 1

Effect of Derby, Axial and their composition with urea on a chlorophyll content in winter wheat flag leaves, SPAD rel. units

Variant, dose	Smuglianka	Pereiaslavka
N ₉₀ P ₆₀ K ₆₀ S ₁₀ (control)	52,4±0,7	52,1±1,4
N ₉₀ P ₆₀ K ₆₀ S ₁₀ + Axial, 1,0 l/ha	57,0±0,7*	53,8±0,9
N ₉₀ P ₆₀ K ₆₀ S ₁₀ + Derby, 0,07 l/ha	56,9±1,1*	53,9±1,7
N ₉₀ P ₆₀ K ₆₀ S ₁₀ + Derby, 0,07 l/ha + Axial, 1,0 l/ha	58,5±0,9*	54,0±1,6
N ₉₀ P ₆₀ K ₆₀ S ₁₀ + Derby, 0,07 л/га + Axial, 1,0 l/ha + urea, 10 kg/ha	60,7±1,2*	54,1±0,7

Used the application of herbicides and urea composition provided an increase in chlorophyll content in plants of both cultivars. However, with almost identical values of chlorophyll content for control variants both varieties, the content of this pigment was higher in flag leaves of variety Smuglianka than ones of variety Pereiaslavka.

Interaction of mineral nutrition and herbicides advisable to consider in terms of intensification technologies of growing agricultural crops, including winter wheat. Currently, this problem is of high actuality in connection with the increased requirements for efficient use of agrochemicals and reduce environmental load of chemicals by introducing into crop production.

We found that the addition of UAN to spraying solutions increased Axial activity without damaging winter wheat crops (Table 2).

Effect of UAN-32 on the activity of herbicides Derby and Axial

Variant	Number of plants, stem/m ² / weight of dry matter, g/m ²	
	<i>Apera spica-venti</i> L.	<i>Cirsium arvense</i> L.
Control	35/160	5/145
Axial, 1,0 l/ha	2/11	6/7
Axial, 1,0 l/ha + UAN-32, 5,0 l/ha	½	6/149
Axial, 1,0 l/ha + UAN-32, 10,0 l/ha	0	5/148
Axial, 1,0 l/ha + UAN-32, 20,0 l/ha	0	6/177
Derby, 0,07 l/ha + Axial, 1,0 l/ha + UAN-32, 5,0 l/ha	0	5/21
Derby, 0,07 l/ha + Axial, 1,0 l/ha + UAN-32, 10,0 l/ha	0	5/18
Derby, 0,07 l/ha	35/160	4/27
LSD _{0,05}	2/3,5	2/12

It should be noted that increasing doses of UAN in the working solution (5-20 l/ha) was not significantly enhances graminicide Axial activity. A trend to increased herbicide Derby phytotoxicity mixed with Axial and UAN there was revealed. N₉₀P₆₀K₆₀S₁₀ variant was use as a control.

It was established that the introduction of nitrogen fertilizers and herbicides has led to a significant increase of crop's chlorophyll potential compared with it size in control: more than 1.5 times for the variety Smuglianka and 2 times for Pereyaslavka [9]. The mass of dry matter in plants in variants with herbicides was 39-52 % higher than in the control variant. The net efficiency of photosynthesis increased too (by 12-28 %). During the period of flowering to milk ripeness in variants with herbicides the productivity of photosynthesis was 33-43 % higher compared with the control variant, indicating an intensification of the process of photosynthesis in crops without competition with weeds.

The use of nitrogen fertilizers and herbicides significantly impacted also on parameters of yield and grain quality, but most of all – on the grain productivity: it increased on average by 74-78 %. The influence of mineral nutrition and protection indicators grain quality was lower: a protein content and gluten in grains increased by 5-10%.

Thus, it was found that the use of herbicides promotes an increasing of chlorophyll content in leaves of wheat, probably by reducing weedy fields. Effective weeds control in crops creates the favourable conditions for growth and development of culture, promotes the intensification of physiological processes, including photosynthesis, and causes the increase of yield of winter wheat.

Conclusions. Study of relationships between parameters of assimilation apparatus of two varieties of soft winter wheat and the level of mineral nutrients and crop protection showed that the combined use of mineral nutrients and herbicides leads to increases of photosynthetic activity of crops. Coaction of nitrogen and herbicides by foliar application led to an increase of leaves chlorophyll content of winter wheat varieties Smuglianka and Pereiaslavka an average of 10-15 %, which resulted in the raise of chlorophyll potential of crops and, consequently, contributed to higher yield of winter wheat.

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Анотація

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Вплив елементів живлення та гербіцидів на вміст хлорофілів у рослинах сучасних сортів озимої пшениці

Встановлено, що тісний взаємозв'язок між вмістом хлорофілу, хлорофільним фотосинтетичним потенціалом листків та урожайністю підтверджує важливість регулювання величини фотосинтетичного апарату рівнем мінерального живлення та захисту посівів для отримання високих врожаїв озимої пшениці.

Ключові слова: елементи живлення, гербіциди, хлорофіл, урожайність

Аннотация

Михальская Л.Н., Прядкина Г.А., Швартау В.В.

Влияние элементов питания при совместном применении с гербицидами на содержание хлорофиллов в растениях озимой пшеницы

Установлено, что тесная взаимосвязь между содержанием хлорофилла, хлорофилльным фотосинтетическим потенциалом листьев и урожайностью подтверждает важность регулирования величины фотосинтетического аппарата уровнем минерального питания и защиты посевов для получения высоких урожаев озимой пшеницы.

Ключевые слова: элементы питания, гербициды, хлорофилл, урожайность