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CHANGES OF BIOLOGICAL – PHYSIOLOGIL INDICES IN PLANTS OF WINTER WHEAT DEPENDING ON THE INFLUENCE OF LONTRIM HERBICIDE AND PLANT GROWTH REGULATOR EMISTYM C

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The results of three-year research of effects of different rates of herbicide Lontrim compatible with Emistym C on the enzyme activity of redox nature, the content of chlorophyll in leaves of winter wheat variety Bilosnizhka and the yield in the conditions of Right-Bank Forest-Steppe are given.

Key words: photosynthesis, yield, Lontrim, Emistym C, enzyme, catalase, polyphenol oxidase, peroxidase, content of chlorophyll, winter wheat.

More than a third of the area for winter wheat in our country is located in the forest-steppe zone, conditions of which favor the development of weeds. Therefore, arable lands of this zone are characterized by high potential infestation of seeds and by vegetative propagation and as a result of it there is a constant source of crop weediness [1]. Successful cultivation of crops is impossible without reliable protection of crops from weeds. When growing crops by intensive technology their timely destruction is essential in the formation of high yields [2, 3]. Therefore, a theoretical platform for biological agriculture is the scientific study of the principles of comfortable plant nutrition as a prerequisite to obtain high-quality products and prevent adverse environmental effects of excessive chemicals [4, 5]. So, one of the main directions of developing agricultural sector in Ukraine is to intensify production, application of new advanced technologies that allow to increase productivity and resilience of crops to adverse environmental factors. The part of this direction is the development of methods for exogenous regulation and stabilization of adaptive reactions of plants through the use of herbicides and physiologically active substances of natural origin [6, 7].

The purpose and objectives. In the field and laboratory experiments during 2011-2013 the effect of herbicide Lontrim compatible with growth bio-stimulant Emistym C was studied to determine the most effective, biologically-based, ecologically safe measures of controlling weeds in the crops of winter wheat variety Bilosnizhka. The expansion of research on combined effect of growth bio-stimulants and herbicides on important bio – physiological indices of plants would be of great importance. Such mixtures have positive impact on the competitiveness of winter wheat plants, providing suppression of weeds [8]. Studying these issues will significantly increase the yield of crops with reduced herbicide use and reduced pesticide load on plants and the environment. Therefore, we set the goal to explore the degree of influence of herbicide introduced with growth bio-stimulant on the enzyme activity of redox nature, the content of chlorophyll in leaves of winter wheat variety Bilosnizhka and the yield in order to optimize the norms of its

use, which in turn plays a crucial role in the formation of crop productivity.

Research Methodology. In the experiments, which were laid on the experimental field of Uman NUH the effect of herbicide Lontrim at norms of 1.0, 1.5, 2.0 l/ha together with Emistym C at norm of 20 ml/ha was studied. Establishment of experiments was performed by randomized reps. The experiment was repeated three times. The area of experimental plots is 100 m^2, accounting plots – 80 m^2. Herbicide spraying of plants was carried out in full tillering stage of winter wheat before stem elongation. Expense of working solution was 300 l / ha. The activity of redox enzymes in plants of winter wheat by H.M. Pochynok [9], the chlorophyll content in leaves by D.P. Viktorov [10], harvest accounting were done by continuous grain harvesting on the version of the experiment, followed by its weighting.

Research results. Enzymes catalyze all the vital processes in plants and how deeply reactions of enzyme catalysis are affected, the state of the plant, its development and productivity will depend on it. Herbicide molecules can alter the activity of cellular enzymes acting on them directly or indirectly. Passing of oxidation and reduction reactions depends on the activity of redox enzymes by which detoxification of herbicides occurs. In particular, using catalase plant organism loses a very toxic compound – hydrogen peroxide, much of which accumulates in cases when the plant is in adverse conditions. Peroxidase oxidizes a variety of compounds of phenols and certain aromatic amines using hydrogen peroxide [11].

Therefore, it was important to determine the changes in enzymatic processes in plants of winter wheat depending on different rates of the herbicide and its effect with growth bio-stimulant. We studied the effects of various norms of herbicide Lontrim, introduced separately and together with growth bio-stimulant Emistym C on the enzyme activity of redox nature. As a result of the research it was found that different norms of Lontrim, introduced individually and in mixtures with growth bio-stimulant Emistim C, differently affected the activity of catalase, peroxidase and polyphenol oxidase.

We investigated that if the application of herbicide Lontrim was at norm 1.0, 1.5 and 2.0 l/ha on winter wheat crops, catalase activity of coming into ripe ear stage was 33.0, 34.5 and 32.0 microns Mole of decomposed H_2O_2, while in the control, where no herbicide was introduced – 29.0 microns Mole of decomposed H_2O_2 (Table 1). When applying the same norms of Lontrim compatible with Emistym C at norm 20 ml/ha, catalase activity was the highest in comparison with all variants of the experiment and constituted 37.5, 38.5 and 36.00 microns Mole decomposed H_2O_2, that was more than control in 24.1 – 32.7%.

Peroxidase activity also increased compared with control in all variants of the experiment, but the highest it was in the application of Lontrim at norm 1.5 l/ha and was 61.05 microns Mole of oxidized guaiacol. In introducing Lontrim compatible with Emistym C the highest rates of peroxidase were observed in the variant with the introduction of 1.5 l/ha of Lontrim with 20 ml/ha of Emistym C, which is probably the result of the active herbicide detoxification by enzymes in plants of winter wheat in the process of metabolism. Increasing of catalase activity

contributed to increased activity of peroxidase.

1.Effect of the herbicide introduced, both individually and together with the growth stimulant on the activity of enzyme of redox nature in the plants of winter wheat (coming into ripe ear phase)

Variant of the experiment	Enzyme activity					
	Catalase, microns Mole decomposed H_2O_2	% before control	Polyphenol oxidase, microns Mole of oxidized ascorbic acid	% before control	Peroxidase, microns Mole of oxidized guaiacol	% before control
Control (no herbicide and growth stimulants)	29,0	100,0	17,8	100,0	58,12	100,0
Emistym C 20 ml/ha	31,0	106,9	18,4	103,5	59,24	101,9
Lontrim 1,0 l/ha	33,0	113,8	19,4	108,8	60,23	103,6
Lontrim 1,5 l/ha	34,5	118,9	20,0	112,3	61,05	105,0
Lontrim 2,0 l/ha	32,0	110,3	19,1	107,0	60,12	103,4
Lontrim 1,0 l/ha + Emistym C 20 ml/ha	37,5	129,3	21,6	121,1	61,57	105,9
Lontrim 1,5 l/ha + Emistym C 20 ml/ha	38,5	132,7	22,2	124,6	62,64	107,7
Lontrim 2,0 l/ha + Emistym C 20 ml/ha	36,0	124,1	20,9	117,6	61,34	105,5

Activity of polyphenol oxidase for all variants of the experiment was high, which perhaps was conditioned by the protective effect of plant response to herbicides.

Thus, the determination of enzyme activity of redox nature shows that activity of these enzymes was different. The most active enzymes were at introducing Lontrim at norm 1.5 l/ha with Emistym C and their indicators were higher than control in 32.7, 24.6 and 7.7%, respectively, thereby increasing plant life.

Chlorophyll in the leaves is one of the main causes of the biological productivity of plant organism. In studies Z.M. Grytsayenko [12] it was found that chlorophyll content varied depending on norms of chemicals. So the purpose of our research was to determine how the chlorophyll content in leaves of winter wheat

changes depending on introducing different rates of the herbicide with growth stimulant in coming into ripe ear phase.

Our studies revealed that different norms of the herbicide have different effects on chlorophyll content in plants of winter wheat. However, in all variants of the experiment chlorophyll content compared with the control was higher in 10,0-50,0% (Table 2). In particular, the content of chlorophyll in leaves of winter wheat at introducing single Lontrim at norm from 1.0 to 2.0 l/ha respectively was 2,61-3,01 mg/g of wet weight and combined with 20 ml/ha of Emistym C – respectively 3,10-3,30 mg/g of wet weight in comparison to control where the chlorophyll content was 2.20 mg/g of wet weight. Therefore, the introduction of the growth stimulant compatible with the herbicide made it possible to increase the number of green pigments at all norms of Lontrim. Thus, the combined use of Lontrim and Emistym C significantly increased the amount of chlorophyll, especially at norm 1.0 and 1.5 l/ha. In these variants the chlorophyll indicators increased compared with the control, respectively 45.5 and 50.0% and amounted to 3.20 and 3.30 mg/g of wet weight, while in the application of single Emistym C this indicator was 2.42 mg/g of wet weight that means it was higher than control by 10.0%.

2.Effect of the herbicide introduced, both individually and together with the growth stimulant on chlorophyll content in leaves of winter wheat
(coming into ripe ear phase)

Variant of the experiment	Chlorophyll, mg/g of wet weight	% before control
Control (water processing)	2,20	100,0
Emistym C 20 ml/ha	2,42	110,0
Lontrim 1,0 l/ha	2,61	118,6
Lontrim 1,5 l/ha	3,01	136,8
Lontrim 2,0 l/ha	2,88	130,9
Lontrim 1,0 l/ha +Emistym C 20 ml/ha	3,20	145,5
Lontrim 1,5 l/ha +Emistym C 20 ml/ha	3,30	150,0
Lontrim 2,0 l/ha +Emistym C 20 ml/ha	3,10	140,9

At higher norm of Lontrim to 2.0 l/ha introduced together with Emistim C chlorophyll content decreased compared to previous norms, amounting to 3.10 mg/g of wet weight.

Thus, when combined use of Lontrim and Emistym C chlorophyll content was the highest at norm of the herbicide 1,5 l/ha, which contributed to the increase of content of green pigments in coming into ripe ear phase, and is the result of improved conditions for plant nutrition.

One of the main indicators of the effectiveness of herbicides is their impact on

the productivity of crops. In our experiments investigational product showed high efficacy in controlling weeds, resulting in the formation of high-yield crops. However, winter wheat yield depended on the norms of introduced product and its use with growth bio-stimulant. Thus, the highest yield of winter wheat (Table 3)on average of research years was obtained in variants using Lontrim introduced with Emistym C at norm 1.5 l/ha, which was 62.0 h/ha, compared with the control – 52.4 h/ha.

3. Winter wheat yield depending on the application of different norms of the herbicide introduced, both individually and together with growth stimulant, h/ha

Variant of the experiment	2011	2012	2013	Average for 3 years
Control (water processing)	54,1	44,7	58,9	52.4
Emistym C 20 ml/ha	56,0	49,0	60,5	55,2
Lontrim 1,0 l/ha	58,9	49,5	64,7	57,7
Lontrim 1,5 l/ha	60,9	51,5	66,5	59,6
Lontrim 2,0 l/ha	56,8	48,4	63,3	56,2
Lontrim 1,0 l/ha + Emistym C 20 ml/ha	58,8	51,7	68,7	59,7
Lontrim 1,5 l/ha + Emistym C 20 ml/ha	61,9	54,1	69,9	62,0
Lontrim 2,0 l/ha + Emistym C 20 ml/ha	58,3	51,4	67,0	58,9

It should be noted that with increasing of application norm of Lontrim yield of winter wheat decreased. Thus, on average for years of research at introducing Lontrim at norm 1.0 l/ha the yield was 57.7 h/ha, the norm introduction of the product was 1,5 l/ha and the yield was 59.6 h/ha and at norm 2.0 l/ha it was 56, 2 h/ha. Reducing the yield of winter wheat by increasing norms of introduced product to 2.0 l/ha can be related to its depressing effect on the crop, especially in the initial period after its introduction.

In general yield of winter wheat in variants of the experiment with the use of products exceeded indicators of control without the herbicide and growth stimulant, and was higher than the yield in a variant using only Emistym C.

Analyzing the data in Table 3, it should be noted that the highest increase of the yield was obtained at introducing 1.5 l/ha of Lontrim compatible with growth bio-stimulant Emistym C (20 ml/ha). Depending on the norms of introduced Lontrim in variants of the experiment different crop growth was formed. So introducing into winter wheat crops herbicide Lontrim at norms 1.0, 1.5 and 2.0 l/ha and Emistym C the significant increase of the yield before control respectively was 7.3, 9.6 and 6.5 h/ha. When using a single growth bio-stimulant, the increase was only 2.8 h/ha.

Thus, the present experimental data allows to draw conclusions on the yield of winter wheat. From the obtained data it follows that the high efficiency in crops of winter wheat Lontrim proved at norm 1.5 l/ha compatible with Emistym C, indicating a positive effect of products on the growth processes of winter wheat.

Conclusions:

1. The most active enzymes were at introducing of Lontrim at norm 1.5 l/ha with Emistym C and their indicators were higher than control in 32.7, 24.6 and 7.7%, respectively, thereby increasing plant life.

2. The best conditions for increasing the number of chlorophyll and the highest indicators were noted in the application of Lontrim at norm 1.5 l/ha with Emistym C and they were respectively higher than the control by 50%.

3. Winter wheat yield depended on the norms of introduced product. Application of the herbicide in winter wheat crops in the optimal rate (1.5 l/ha) and growth stimulant positively affected on increasing productivity. According to this norm the highest crop productivity was observed, compared with the control, which increased by 18%.

REFERENCES

1.Tanchyk S.P. Effect of herbicides on weediness and yield of winter wheat. / S.P. Tanchyk, G.M. Zholobetskyi // Quarantine and Plant Protection. – 2007. – №1. – P.9-10.

2.Borona V. Fighting perennial weeds / V. Borona, M. Boyko // Offer. – 1991. – № 3. – P. 25.

3.Grytsayenko Z.M. Herbicides and productivity of crops. / Z.M. Grytsayenko, A.O. Grytsayenko, V.P. Karpenko, I.B. Leontyuk // – Uman, 2005. – 686p.

4.Skuryatin Y.M. Hrodil Maxi and Super Puma is a reliable weapon of a farmer / Y.M. Skuryatin, L.A. Zhyvotkov, P.G. Surzhko // Offer. – 2007. – № 3. – P.82.

5.Bomba M.J. Weediness of crops and ways to reduce / M.J. Bomba, R.V. Stanishevsky, N.V. Ilnytskyi // Farmer. – 2000. – № 5-6. – P.34-35.

6.Serhiyechko O. Technology of cultivation of winter wheat from “Rise-Agro” / O. Serhiyechko, A. Isychko // Offer. – 2004. – № 7. – P.44-45.

7.Taran N.Y. Growth regulators in the formation of adaptive reactions of plants to drought / N.Y. Taran, N.B. Svietlova, O.A. Okanenko, A.O. Meleshko, M.M. Musienko // Bulletin of Agricultural Science. – 2004. – № 8. – P.29-32.

8.Grytsayenko Z. Joint use of herbicides and growth regulators in winter wheat and maize sowings / Z. Grytsayenko, V. Karpenko // Offer. – 2002. – № 4. – P. 73.

9.Pochynok H.M. Methods of biochemical analysis of plants / H.M. Pochynok // – K: Science. Thought, 1967. – P.172-176.

10.Small workshop on plant physiology / D.P. Viktorov // – M.: Graduate School, 1983. – P.51-53.

11.Polishchuk A.K. Biocatalysts of plants. – K: Higher School. – 1973. – 176p.

12.Grytsayenko Z. Joint use of herbicides and growth regulators in winter wheat and maize sowings / Z. Grytsayenko, V. Karpenko // Offer. – 2002. – № 4. – P.73.

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Key words: photosynthesis, yield, Lontrim, Emistym C, enzyme, catalase, polyphenol oxidase, peroxidase, content of chlorophyll, winter wheat.