UDK 579.841.2:633.111:632.954:631.811.98

NITROGEN-FIXING BACTERIA OF WINTER WHEAT RHIZOSPHERE DEPENDING ON THE INFLUENCE OF BIOLOGICALLY ACTIVE PREPARATIONS ON THE BACKGROUND OF DIFFERENT PRECEDING CROPS

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In the article the analysis of Azotobacter bacteria which activity in the soil depends on the influence of herbicide and plant growth regulators applied during the seed treatment before sowing and after sprouting of winter wheat is given.

Crop productivity formation depends significantly on the supply of plants with the mineral nutrition elements, primarily – with nitrogen. Microorganisms are one of the sources of environmentally friendly biological nitrogen in the soil which are able to fix molecular nitrogen of atmosphere [1, 2].

At present the ability to fix atmosphere nitrogen has been found in more than 60 genuses of soil microorganisms, including the Azotobacter bacteria.

Azotobacter is a unique microorganism adapted to a free existence. Almost all its representatives are high-producing nitrogen fixers, metabolites of which contain substances of phytohormonal action, organic acids, vitamins [4, 5].

The activity of Azotobacter bacteria in the soil depends on different factors including chemical compounds which are widely used in agriculture.

Thus, the researchers argue that Azotobacter is very sensitive to herbicides. In the investigations of B. Tulubaiev, N. Azymbegov [6], Z.M. Hrytsaienko and V.P. Karpenko [7] it is determined that most of herbicides suppress the development of Azotobacter in agricultural crops in the initial period after the application of preparations. As for the influence of plant growth regulators on the formation of associative symbiosis it is established that plant hormones in the concentrations that stimulate plant growth, increase the development of Azotobacter bacteria significantly, and the presowing treatment of cereals with phytohormones promotes the increase of nitrogen-fixing microbial activity [8].

On that basis, the objective of our investigation was to determine the effect of different norms of herbicide Lantselot 450 WG, applied separately and in combination with growth regulator Biolan on the development of nitrogen-fixing Azotobacter bacteria in winter wheat rhizosphere, the seeds of which were and weren't treated with growth regulator Radostim before sowing against maize for silage and perennial grasses predecessors.

Research methods. The research was conducted in 2011-2012 on the experimental field of training, research and production department of Uman National University of Horticulture. Soil of the research field is podzolized chernozem, low humus content heavy-loamy on loess with humus content in the plow layer (0-30cm) –3.3%. In the experiment, winter wheat "Smuglianka" was sown after maize for silage and perennial grasses predecessors.

Field experiments were laid out in accordance with the scheme given in the tables.

In the phase of full tillering of winter wheat herbicide Lantselot 450 WG (AI aminopiralid 300 g/kg and florasulam 150 g / kg) was applied in spring after seedling stage at the rates of 13,23 and 33 g / ha; in the third variant Biolan was applied separately (AI – Emistim C – 1.0 g / l, trace elements) by spraying seeds; in the variants 7-9 PGR Biolan was applied in spring in the phase of tillering in combinations with appropriate rates of Lantselot 450 WG; in the variants 10-17 seeds were treated with Radostym (AI – Emistym C – 0,3 g / l, potassium salt of alpha-acid naftylotstovoyi 1.0 ml / l and microelements) before sowing at the rate of 250 ml / t (ground); in the variants 12-14 in spring in the phase of tillering Lantselot 450 WG at the rates of 13, 23, and 33 g / ha was applied on the background; in the variant 11 in spring in the phase of tillering only Biolan was applied on the background; and in the variants 15-17 in spring in the phase of tillering Lantselot 450 WG was applied at the rates of 12, 23, and 33 g / ha in combination with Biolan at the rates of 20 ml / ha on the background.

Spraying was carried out using knapsack sprayer “Era-4”, consumption rate of the working fluid is 300 l / ha. The number of nitrogen-fixing Azotobacter bacteria was determined at the 10th and 25th days after applying preparations after Zviagintsev and etc. [9].

Research results. As the result of the investigation it has been determined that the associative Azotobacter bacteria are sensitive to the effects of herbicide and plant growth regulators, independent from the preceding crop winter wheat has been grown after. So, analyzing the growth of Azotobacter bacteria in winter wheat rhizosphere after maize for silage predecessor, seeds of which haven’t been treated before sowing it is determined 2% excess in control 1 in the variant with applying growth regulator Biolan 20 ml / ha and 2, 9% with hand weeding (Table 1).

In the variants where pre-sowing treatment of winter wheat seeds grown after the same predecessor was done, with growth regulator Radostym the growth of nitrogen-fixing bacteria was more active. So, after treatment of winter wheat seeds with growth regulator Radostym 250 ml / t (Table 1) it is registered the excess of control 1 by 3,3%, in the variant with applying growth regulator Biolan after seedling stage – by 4,2%, and also by 4,6% in the variant with hand weedings. When sowing non-treated with Radostym winter wheat seeds after the perennial grasses predecessor it was noticed the activation of growth and development of Azotobacter microorganisms compared with control by 3,2% in the variant with applying growth regulator Biolan (20 ml / ha) and by 4,0% in the variant with hand weeding (Table 2).

At the same time in the variants of the experiment when winter wheat seeds were treated with growth regulators Radostym (250ml \ t) before sowing after perennial grasses predecessor it was noticed more active growth of associative nitrogen-fixing Azotobacter bacteria compared with control 1. The number of overgrown lumps with microorganisms was higher than control 1 by 4.6% in the variant with application of Biolan after seedling stage – by 4.4% and by 5.0% – in the variant with hand weeding (Table 2).

1. Development of nitrogen-fixing Azotobacter bacteria under the effect of different norms of herbicide Lantselot 450 WG and different application methods of PGR Biolan and Radostym on winter wheat grown after maize for silage predecessor (2011-2012)

Variant of experiment	On the 10th day after application of preparations			
	Number of overgrown lumps of soil, pcs			
	2011	2012	average for the years	% to control
Without application of preparations (control I)	46,5	44,1	45,3	100
Without application of preparations + hand weeding during the growing season (control II)	47,4	45,8	46,6	102,9
Biolan 20 ml / ha	47,7	45,5	46,3	102,2
Lantselot 450 WG 13 g / ha	34,6	33,0	33,8	74,6
Lantselot 450 WG23 g / ha	33,1	31,5	32,3	71,3
Lantselot 450 WG33 g / ha	31,0	29,4	30,2	66,7
Lantselot 450 WG 13 g / ha + Biolan 20 ml / ha	35,2	33,6	34,4	75,9
Lantselot 450 WG. 23 g / ha + Biolan 20 ml / ha	34,3	32,7	33,5	74,0
Lantselot 450 WG. 33 g / ha + Biolan 20 ml / ha	31,4	29,8	30,6	66,5
Radostym 250 ml / t – seed treatment (ground)	47,6	46,0	46,8	103,3
Ground + Biolan 20 мл/га.	48,0	46,4	47,2	104,2
Ground + Lantselot 450 WG 13 g / ha	35,5	33,9	34,7	76,6
Ground + Lantselot 450 WG23 g / ha	34,3	32,7	33,5	74,0
Ground + Lantselot 450 WG33 g / ha	31,6	29,7	30,8	68,0
Ground + Lantselot 450 WG 13 g / ha + Biolan 20 ml / ha	36,4	34,8	35,6	78,6
Ground + Lantselot 450 WG 23 g / ha + Biolan 20 ml / ha	34,7	33,1	33,9	74,8
Ground + Lantselot 450 WG 33 g / ha + Biolan 20 ml / ha	31,9	30,3	31,1	68,7

2. Development of nitrogen-fixing Azotobacter bacteria under the effect of different norms of herbicide Lantselot 450 WG and different application methods of PGR Biolan and Radostym on winter wheat grown after the perennial grasses predecessor (2011-2012)

Variant of experiment	On the 10th day after application of preparations			
	Number of overgrown lumps of soil, pcs			
	2011	2012	average for the years	% to control
Without application of preparations (control I)	48,3	46,7	47,5	100
Without application of preparations + hand weeding during the growing season (control II)	49,9	48,9	49,4	104,0
Biolan 20 ml / ha	49,8	48,2	49,0	103,2
Lantselot 450 WG 13 g / ha	37,0	35,4	36,2	76,2
Lantselot 450 WG23 g / ha	35,1	35,7	34,3	72,2
Lantselot 450 WG33 g / ha	33,3	31,7	32,5	68,4
Lantselot 450 WG 13 g / ha + Biolan 20 ml / ha	39,2	37,6	38,4	80,8
Lantselot 450 WG. 23 g / ha + Biolan 20 ml / ha	36,5	34,9	35,7	75,1
Lantselot 450 WG. 33 g / ha + Biolan 20 ml / ha	34,2	32,6	33,4	70,4
Radostym 250 ml / t – seed treatment (ground)	49,9	49,5	49,7	104,6
Ground + Biolan 20 ml / ha	49,9	49,3	49,6	104,4
Ground + Lantselot 450 WG 13 g / ha	39,1	37,5	38,3	80,6
Ground + Lantselot 450 WG23 g / ha	37,4	35,8	36,6	76,8
Ground + Lantselot 450 WG33 g / ha	34,2	32,3	33,4	70,3
Ground + Lantselot 450 WG 13 g / ha + Biolan 20 ml / ha	38,2	39,8	39,0	82,1
Ground + Lantselot 450 WG23 g / ha + Biolan 20 ml / ha	38,0	36,4	37,2	78,3
Ground + Lantselot 450 WG 33 g / ha + Biolan 20 ml / ha	35,4	33,8	34,6	72,8

As to applying of herbicide Lantselot after seedling stage on the background of different predecessors it was determined that associative Azotobacter microorganisms were sensitive to its effect too. The most toxic to them was the herbicide application rate of 33 g / ha. In particular, on the 10th day after application of preparations after the predecessor maize for silage on the background of non-treated before sowing seeds the number of overgrown lumps of soil decreased at a rate of Lancelot of 13 g / ha by 5.4% relatively to control 1, after application 23 g / ha – 28.7%, and in variant after application 33 g / ha – by 33.3%.

Under the combined use of herbicide Lancelot with Biolan (20 ml / ha) on the background of non-treated before sowing seeds with growth regulators Radostym on the background of maize for silage predecessor the number of nitrogen-fixing microorganisms decreased compared with control 1 at a herbicide rate of 13 g / ha by 24.1%, at a rate of 23h / ha – by 26%, and at a rate of 33h/ha – by 33.5% (Table 1).

According to the data, it can be stated that the use of herbicide mixed with plant growth regulator reduces the toxic loading on the studied group of bacteria to some extent.

Analyzing the impact of different rates and ways of application of preparations after different predecessors, we also observed the reduction of overgrown lumps.

At the same time a certain regularity of growth of associative nitrogen fixers was observed – with increasing a rate of herbicide (Tables 1 and 2) the number of overgrown with soil bacteria lumps in relation to the control I decreased. However, it is necessary to point out that in the variants with the application of herbicide Lantselot at the investigated rates on the background of pre-treatment of seeds with the growth regulator Radostym, both separately and together with the growth regulator Biolan applied after seedling stage on the background of different predecessors, the number of overgrown soil lumps was albeit less than in control I, but compared to the variant without treatment of seeds before sowing exceeded them.

With the application of the highest rate of herbicide Lantselot (33 g / ha) after maize for silage predecessor on the background of non-treated before sowing seeds with the growth regulator Radostym (Table 1) the number of overgrown soil lumps was 66,7%, and with the application of pre-sowing treatment of seeds with the growth regulator Radostym with the analogical rate of herbicide – 68%. On the background of non-treated before sowing seeds after the predecessor perennial grasses (Table 2) at the most toxic for Azotobacter rate of Lantselot (33 g / ha) the number of overgrown soil lumps was 68,4%, on the background of treated before sowing seeds with the growth regulator Radostym (at the same rate of herbicide) – 70,3%.

The growth of Azotobacter was fully restored on the 25th day after application of preparations in all variants of the experiment. Only in the variant, in which the highest rate of the herbicide Lancelot on the background of non-treated before sowing seeds of winter wheat with the growth regulator Radostym and maize for silage predecessor was applied the number of Azotobacter was lower than in the control I by 4.2% (Table 1).

Conclusions

1. The pre-sowing treatment of winter wheat seeds with growth regulator Radostym and post-sowing applying of growth regulator Biolan effect the growth and development of Azotobacter bacteria positively.

2. Herbicide Lantselot 450 WG at the rates of 13, 23 and 33 g / ha applied after seedling stage of winter wheat inhibits the growth of Azotobacter.

3. In winter wheat rhizosphere the most active growth of Azotobacter microorganisms is observable under the pre-sowing treatment of seeds with growth regulator Radostym (250 ml / t) and post-sowing treatment of crops with growth regulator Biolan (20 ml / ha) after the perennial grasses predecessor.

4. The growth of Azotobacter in winter wheat rhizosphere recovers completely on the 25^{th} day after the use of preparations, except for the variant when herbicide Lantselot 450 WG at the rates of 33 g / ha on the background of non-treated seeds after maize for silage predecessor was used.

REFERENCES

1. Патика В.П. Біологічний азот/ В. П. Патика, С. Я. Коць, В. В. Волкогон. – К.: Світ, 2003. – 424с.
2. Посыпанов Г.С., Биологический азот и его эколого-экономическое значение в растениеводстве /Г. С. Посыпанов, А. В. Дозоров, Г.А. Дозорова // Зерновые к-ры. – 2000. – №2. – С. 24-26.
3. Покровский Н.П. Особенности азотфиксации черноземных почв полевых севооборотов / Н.П. Покровский // Плодородие почв при интенсивном земледелии; Харківський с.-г. ін.. – т. – Х., – С. 84-96.
4. Зайцева Г.Н. Биохимия азотобактера / Г.Н.Зайцева – М.: Наука,1965. – 303с.
5. Рубенчик Л.И. Физиология азотобактера / Л.И. Рубенчик // Успехимикробиологии. – М.:Наука, 1965. – С.126-144.
6. Тулабаева Б. Действие произвольныхтреазина и мочевины на почвенную микрофлору / Б. Тулубаева, Н. Азимбегов // Химия в сельськом хозяйстве. – 1967. – № 3. – С. 43-44.
7. Грицаєнко З.М., Сумісне застосування гербіцидів і регуляторів росту в посівах озимої пшениці та кукурудзи / З. М. Грицаєнко, В. П. Карпенко // Пропозиція. – 2002. – № 4. – С. 73.
8. Волкогон В.В. Влияниефитогормонов и ихсинтетическиханалогов на активностьассоциативнойазотфиксации / В.В. Волкогон, П.Г. Дульнев, Е.П. Ковтун и др. // Микробиология. – 1996. – № 6. – С.850 – 854.
9. Методы почвенной микробиологии и биохимии / [Асеева И.В., Бабъева И.П., Бызов Б.А. и др.]; под ред. Д.Г.Звягинцева. – М.: Изд-во Московского университета, 1991. – 304с.

Одержано 19.03.13

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Азотфиксирующи бактерии ризосферы озимой пшеницы в зависимости от действия биологическиактивных препаратов на фоне различных предшественников

В статье представлен анализ бактерий рода Azotobacter, деятельность которых в почве зависит от ряда факторов, в том числе и химических соединений, которые широко применяются в сельскохозяйственном производстве. Определено, что Azotobacter чувствителен к действию гербицидов, причем большинство из них подавляют развитие азотобактера в посевах сельскохозяйственных культур в начальный период после внесения препаратов. Применение же регуляторов роста стимулирует развитие растений и значительно повышает развитие бактерий Azotobacter.

Мы выяснили, что на рост и развитие бактерий Azotobacter положительно влияет предпосевная обработка семян озимой пшеницы регулятором роста Радостим и послевсходовое внесение регулятора роста Биолан.Гербицид Ланцелот 450 WG в нормах 13, 23 и 33 г / га, внесенный после всходов озимой пшеницы, ингибирует рост азотобактера. В ризосфере озимой пшеницы наиболее активный рост микроорганизмов рода Azotobacter наблюдается при предпосевной обработке семян регулятором роста Радостим (250 мл / т) и при послевсходовой обработке растений регулятором роста Биолан (20 мл / га) на фоне предшественника многолетние травы. Рост азотобактера в ризосфере озимой пшеницы полностью восстанавливается на 25-й день после внесения препаратов, кроме варианта, где применяли гербицид Ланцелот 450 WG. в норме 33 г / га на фоне не обработанных перед посевом семян по предшественнику кукуруза на силос.

***Ключевые слова**: бактерии рода Azotobacter, гербицид, регулятор роста, ризосфера, предшественник.*

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Nitrogen-fixing bacteria of winter wheat rhizosphere depending on the influence of biologically active substances against different predecessers

In the article the analysis of Azotobacter bacteria which activity in the soil depends on different factors including chemical compounds which are widely used in agriculture is given. It is determined that Azotobacter is sensitive to herbicides, besides the most of them suppress the development of azotobacter of agricultural crops in the initial period after the application of preperations. But the use of growth regulators stimulates the growth of crops and promotes the development of Azotobacter bacteria significantly.

We've studied out that the presowing treatment of winter wheat seeds with Radostim growth regulator and postemergence apply of Biolan growth regulator effect the growth and development of Azotobacter bacteria positively. Lantselot herbicide 450 WG in the norms of 13, 23 and 33 g / ha used after seedling stage of winter wheat inhibit the growth of azotobacter. In winter wheat rhizosphere the most active growth of

Azotobacter microorganisms is observable under the presowing treatment of seeds with Radostim growth regulator (250 ml / t) and postemergence treatment of crops with Biolan growth regulator (20 ml / ha) against the predecessor of perennial grasses. The growth of azotobacter in winter wheat rhizosphere recovers completely on the 25th day after the use of preparations, except for the variant when Lantselot herbicide 450 WG in the norms of 13, 23 and 33 g / ha against non-treated seeds after maize for silage predecessor was used.

***Key words**: Azotobacter bacteria, herbicide, growth regulator, rhizosphere, predecessor.*