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Formation of highly productive crops of summer barley depending on dozes of nitric fertilizers and regulators of growth in conditions of Forest-steppe Right-bank

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The purpose. To determine influence of complex application of dozes of nitric fertilizers and substances regulating growth, on features of growth and development of summer barley and formation of basic elements of productivity in conditions of Forest-steppe Right-bank. **Methods.** General scientific (dialectics, experiment, analysis and synthesis, hypotheses); special: field — for studying interaction of subject of researches with weather conditions and receptions of technology of cultivation, visual, measuring and weight, quantitative, physiological, method of trial sheaf — for determination of individual efficiency of plants of summer barley, laboratory — for determining qualitative characteristics of soil of a plot, dispersive, correlation and regression — for determination of reliability of distinctions between factors, pair and plural dependences. **Results.** Results of researches on formation of individual and grain efficiency of summer barley depending on the level of mineral feed ($N_{45-90}P_{45}K_{45}$) and regulators of growth Binom and Terpal are brought. It is noted that high parameters of individual productivity (quantity of productive stalks, bushing factor, quantity of grains in an ear and weight of grain from an ear) and productivity of grain of varieties of summer barley Vinnytsia 28 and Nabat were generated at entering nitric fertilizers in doze of N_{90} on phosphorus-potash background $P_{45}K_{45}$ and treatment of crops with regulator of growth Terpal. High dependence of productivity of grain of barley on technological receptions of its cultivation and individual efficiency of plants is fixed. Between productivity of grain and elements of individual productivity there is a strong positive dependence. The factor of plural correlation is equal R^2=0,991. **Conclusions.** Direct dependence and positive influence of various dozes of mineral fertilizers and regulators of growth on efficiency of summer barley is determined. So, maximum level of productivity of grain (6,39 t/hectare),quantity of productive stalks (618 pieces/m^2) and grains in an ear (24,9 pieces) and its weight (1,01 g) were received in a variant of experiment where they sowed a variety of summer barley Nabar, used regulator of growth Terpal and entered nitric fertilizers in doze of N_{90} on phosphorus-potash background $P_{45}K_{45}$.

Key words: *summer barley, variety, doze of nitric fertilizers, regulator of growth of plants, individual productivity, productivity.*

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In Ukraine, grain production is the leading industry in agriculture. In recent years, variation in the production of barley grain production has been noted. Firstly, due to changings in the priority of crops in the market, in particular, the volumes of corn, wheat and soybeans production have increased. Secondly, less attention was paid to the technologies of growing new intensive varieties and changes in the effective use of hydrothermal resources [1, 2].

However, it should be noted that for 2016-2017 MY production of barley in Ukraine amounted to 9.9 million tons - this is the fourth indicator in the world. More barley is produced in Australia (13.4 million tons), Russia (17.5 million tons) and EU countries (59.8 million tons). For the past 14 years, the area of sown barley has declined by a half: from 5, 8 million hectares in 2003 to 2.5 million hectares in 2017 year. However, the yield of barley grain has grown from 2.0 t/ha to 3.43 t/ha over the past 7 years. While in the EU countries, the grain yield of barley was about 7.0 t/ha [3].

Consequently, the actual problem in Ukraine is to increase the volumes of barley production at the expense of maximizing the implementation of the genetic potential of modern sorts, as well as the

effective use of the intensification factors. An important reserve for improving crop yield and improving the quality of agricultural products is the use of natural or synthetic plants growth regulators and macro elements, which make it possible to regulate the most important processes in a plant organism, to fully realize the potential of the sort, inherent in the genome by nature and breeding [4].

The purpose of the research – is to find out the effect of the complex application of doses nitrogen fertilizers and growth-regulating substances on the peculiarities of the growth and development of barley and formation of the basic elements productivity under the conditions of the forest steppe of the Right bank.

Research methodology. The research was conducted during 2009-2011 at the Institute of feed research and agriculture of Podiliya NAAS. Soils are grey, medium-sandy forest. In the experiment, the effect and interaction of three factors were studied: A - sort; B - regulators of plant growth; C - fertilizer doses. The gradation of factors was 2x3x5. Factors were placed systematically in two tiers. The experiment was repeated four times. The registration area is 25 m^2.

In the experiment, the medium-grained, intensive type of barley sorts Vinnytsia 28 and Nabat were sown. In the period of vegetation, the barley (end of the bush process-the beginning of the exit into the tube) on the variants of the experiment according to schemes the growth-regulating substances were used: Terpal (mepquat-chloride (305 g/l) + Ethophon (155 g/l)) in norm 2,0 l/ha (norm of working solution 200 l/ha) and Binom (chlormequat chloride, 305 g/l + Ethophon, 155 g/l) in the norm 2,0 l/ha (norm of working solution 200 l/ha).

The research was guided by "Methodology of Field Experiences" [5].

Research results. It is known that one of the most important elements of the crop structure is the indicator of the productive stems number per unit area. Its size depends on the density of plant standing and the number of productive stems per plant in the phase of complete grain ripeness [6, 7].

The density of productive steams-standing, firstly, depends on the coefficient of planting and the number of plants per 1 m^2. The optimal number of productive stems per unit area before harvest is one of the requirements of intensive crop cultivation technology. Thus, the highest number of productive stems (618 pcs/m^2) and bush coefficient (2.7) was observed during using of the growth regulator Terpal and the addition of $N_{90}P_{45}K_{45}$ mineral fertilizers to the Nabat sort. Somewhat lower values were observed in the Vinnitsa 28 sort and amounted to 596 pcs/m2 and 2.4, which is more than 66 pc/m^2 and 0.8 compared with the control (table 1). Similar results of the study were obtained by other scientists [8, 9].

One of the most important structural elements, which significantly influences on the yield of barley grain, is the productivity of the ear.

Analysis of the structure of barley yield showed that the highest number of grains in the ear (24.9 pcs.), was formed in the Nabat sort with the application of the growth regulator of Terpal and complete mineral fertilizer at a dose $N_{90}P_{45}K_{45}$, which is more to 1.4 pp than to the Vinnitsa 28 with the same fertilizer.

1. Indicators of individual productivity of barley Nabat depending on the doses of nitrogen fertilizers and plant growth regulators (on average for 2009-2011), * M ± m

Plant growth-regulators	Doses of mineral fertilizers	Number of productive stems, pcs/m^2	The coefficient of bush productivity	Number of grains in the ear, pc.	Weight of grains in the ear, g	Weight of 1000 grains, g
Without growth-regulating substances	Without fertilizers	550	1,7	19,2±0,3	0,74±0,04	38,5±0,4
	P_{45} K_{45}	572	1,9	19,1±0,3	0,75±0,04	39,3±0,5
	N_{45} P_{45} K_{45}	583	2,1	20,9±0,5	0,84±0,04	40,2±0,4
	N_{60} P_{45} K_{45}	589	2,2	21,8±0,4	0,89±0,05	40,8±0,5
	N_{90} P_{45} K_{45}	595	2,4	22,2±0,3	0,92±0,04	41,4±0,3

Binom	Without fertilizers	563	1,9	20,3±0,5	0,79±0,04	38,9±0,6
	P_{45} K_{45}	580	2,0	20,2±0,5	0,81±0,03	40,1±0,7
	N_{45} P_{45} K_{45}	591	2,3	21,9±0,4	0,91±0,06	41,6±0,7
	N_{60} P_{45} K_{45}	601	2,5	23,8±0,5	0,96±0,07	40,3±0,5
	N_{90} P_{45} K_{45}	611	2,6	23,9±0,5	0,98±0,06	41,0±0,7
Terpal	Without fertilizers	568	1,9	20,4±0,5	0,81±0,03	39,7±0,5
	P_{45} K_{45}	583	2,1	20,3±0,4	0,81±0,02	39,9±0,6
	N_{45} P_{45} K_{45}	597	2,4	22,1±0,3	0,92±0,06	41,6±0,7
	N_{60} P_{45} K_{45}	605	2,6	24,2±0,4	0,99±0,06	40,9±0,6
	N_{90} P_{45} K_{45}	618	2,7	24,9±0,4	1,01±0,06	40,6±0,5

It was established that on the variant of the experiment where the barley Nabat was sown, the morphoregulator Terpal was used and nitrogen fertilizers were added in dose $N_{45,}$ N_{60} and N_{90}, the number of grains in the ear was 22.1, 24.2 and 24.9 pc, which is more on 2.9, 5.0 and 5.7 pc for control and 0.2-1 pc, where the Binom morphoregulator was used.

An important indicator of the yield structure is the weight of 1000 grains and the weight of grain from one ear, which depends on the weight of grains. We found that the weight of 1000 grains directly proportional to the effect of nitrogen fertilizers doses. As the doses of nitrogen fertilizers increased, the weight indicators of 1000 grains also increased. The use of growth regulators increased this indicator, but with the use of increased doses of mineral fertilizers and morphoregulators, the weight of 1000 grains slightly decreased, which can be explained by the combined effect of these factors on the increase of the grains number in the ear. Similar dependencies were also found in the studies of other scientists [10, 11].

It was found that for the last three years, the largest weight of 1000 grains (41.6 g) was obtained in areas where a barley Nabat was sown, a complete mineral fertilizer was added at a dose of $N_{45}P_{45}K_{45}$ and the morphoregulator Terpal was used for vegetation, which is more than 3.1 g compared with control.

An important indicator of the effectiveness applying technology elements is the level of grain yield productivity. Thus, according to researches, it was noted that the maximum yield of grain was observed in the Nabat sort of 6.39 t/ha, somewhat lower in the Vinnytsia 28 - 5.78 t/ha, which was obtained for the complete mineral fertilizer in the dose $N_{45}P_{45}K_{45}$ and the use of the morphoregulator Terpal , which is respectively 2.21 and 1.97 t/ha for control (without treatment) (table 2).

It was established that with the increase of the nitrogen fertilizers dose on the phosphoric-potassium background, the grain yield of barley increased: when $N_{45}P_{45}K_{45}$ was applied at 0.9 - 1.6 t/ha, at $N_{60}P_{45}K_{45}$ - 1.26 - 1.3 t/ha, at $N_{90}P_{45}K_{45}$- 1.48 - 1.57 t/ha.

2. Yield of barley grains sorts depending on doses of nitrogen fertilizers and plant growth regulators, t / ha (on average for 2009-2011)

Plant growth-regulators	Doses of mineral fertilizers	Sorts	
		Vinnytsia 28	Nabat
Without growth-regulating substances	Without fertilizers	3,81	4,18
	P_{45} K_{45}	3,95	4,35
	N_{45} P_{45} K_{45}	4,97	5,08
	N_{60} P_{45} K_{45}	5,11	5,44
	N_{90} P_{45} K_{45}	5,38	5,66
Binom	Without fertilizers	4,10	4,38
	P_{45} K_{45}	4,26	4,70
	N_{45} P_{45} K_{45}	5,21	5,46
	N_{60} P_{45} K_{45}	5,40	5,80
	N_{90} P_{45} K_{45}	5,68	6,05

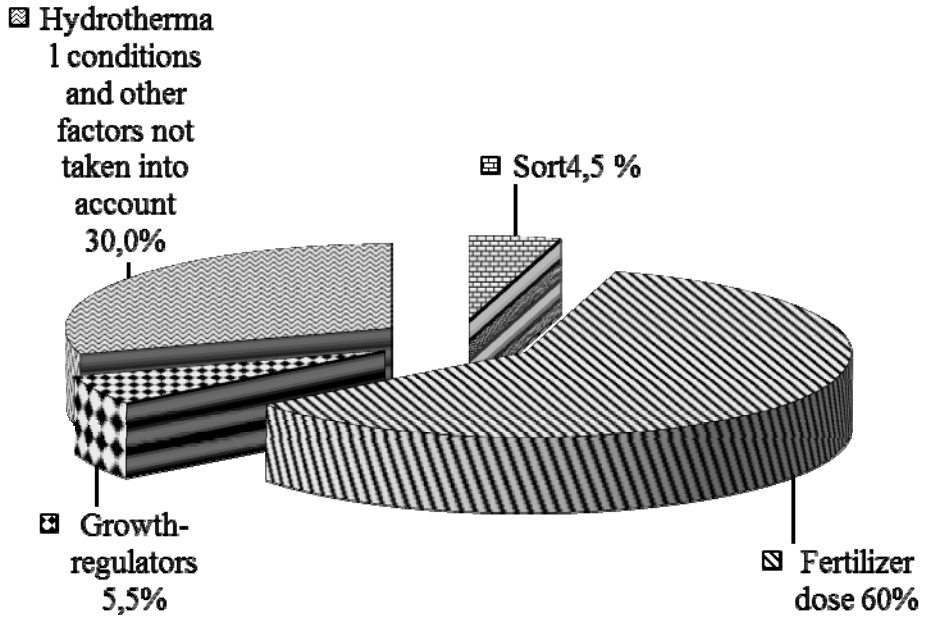
Terpal	Without fertilizers	4,23	4,54
	P_{45} K_{45}	4,38	4,78
	N_{45} P_{45} K_{45}	5,33	5,55
	N_{60} P_{45} K_{45}	5,54	6,01
	N_{90} P_{45} K_{45}	5,78	6,39

Note: factor A – sort; B - plant growth regulator; C - doses of mineral fertilizers; D - year.

$HIP_{0,95}$ t/ha (during 2009-2011) A – 0,105; B – 0,129; C – 0,166; D – 0,129; AB – 0,182; AC – 0,235; AD – 0,182; BC – 0,288; BD – 0,223; CD – 0,288; ABC – 0,407; ABD – 0,315; ACD – 0,407; BCD – 0,499; ABCD – 0,705.

Also, the increase in grain yield was influenced by using of plant growth regulators. Terpal on the background of mineral nutrition had the best effect on the growth of the crop and the Nabat sort was 0.36-2.21 t/ha or 8.61-52.87 %, while in the Vinnitsa 28 - 0.42-1, 97 t ha or 11.02-51.71 %, somewhat lower were given when using Binom 0.20-1.87 t/ha or 4.78-44.74 % and 0.29-1.87 t/ha or 7.61-49.08 % respectively.

On the basis of the dispersion analysis, it was found that on the average in the 2009-2011 research years, the level of the crop production of barley depended on 60 % of mineral fertilizer doses, by 5.5% of the plant growth regulator and by 4.5 % of the sort. The high level of influence (30.0%) on the formation of barley grain yield was due to hydrothermal conditions of the year and other factors not taken into account (Picture 1).



Picture 1. The influence of factors in the formation of barley grain yield (average for 2009-2011).

The correlation-regression analysis shows a strong positive conjunction between the indicators of individual productivity and barley grain yield. Thus, the correlation coefficient between the number of grains in the ear and the yield was r = 0.96, between the weight of the grains and the yield r = 0,98; between the density of productive steam-standing and yield r = 0.92.

The conjunction between grain yield and individual productivity of barley can be given as a multiple regression equation:

$y= –11,0659–0,9047*592(x_1)+15,8898(x_2)+0,2338(x_3)$,

where y - yield of barley grain, t / ha; x_1 - the number of grains in the ear, pcs; x_2 - the weight of grains from the ear, g; x_3 - number of productive stems, pieces/m^2. The determination coefficient was D = 0,991. The Fischer criterion is F = 499,455 (table value F = 2.98).

Conclusions

Consequently, in the conditions of the forest-steppe of the Right-bank on grey forest soils, the development and introduction of advanced varietal barley technologies is one of the main conditions for increasing the production efficiency and increasing the gross collections of this crop.

It was established dependence and positive effect of various doses of mineral fertilizers and application of growth regulators on the productivity of barley. Thus, the maximum yield of grain (6.39 t/ha), the number of productive stems (618 pieces/m^2) and the number of grains in the ear (24.9 pc) and its weight (1.01 g) were obtained on the experimental version, where the barley of Nabat was sown, the Terpal growth regulator was used and nitric fertilizer N_{90} was added on phosphate-potassium background $P_{45}K_{45}$.

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