TRAICON
Publishing House

ISBN 978-83-65180-19-3
2017, Vol. II, No. 1, pp. 248-263
SCIENTIFIC ACHIEVEMENTS IN AGRICULTURAL ENGINEERING, AGRONOMY AND VETERINARY MEDICINE

FORMATION OF CROPS, PRODUCTIVITY AND QUALITY OF MALTING BARLEY GRAIN DEPENDING ON TECHNOLOGICAL FACTORS

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KEYWORDS

winter brewing barley, seeding rates, norms of application of mineral fertilizers, grain productivity, grain quality.

ABSTRACT

The scientific work highlights the results of the research of productivity and quality of winter brewing barley depending on the norms of fertilization and seeding rates. it has been set, that applied fertilizers combined with seeding rate influenced the formation of high-yield crops of winter brewing barley. it has been shown, respectively, the role of technological factors included in the experiment, in the management of the planting process – an important component of the growth and development of plants. Application of mineral fertilizers contributed to the increase in productivity of winter barley crops. Grain yield levels, depending on the background of nutrition, were: N0P0K0 – 4.44 t/ha, N30P30K30 – 5.78; N60P60K60 – 6.94; N90P90K90 – 7.85; N120P120K120 – 8.56 t/ha.

1. INTRODUCTION

Recently, winter barley is becoming increasingly popular. Interest in it is due to somewhat higher yield than in spring barley. According to long-term data, it can provide 7.0-8.0 t/ha and more of grain, which is approximately 1.0-1.5 t/ha higher than that of spring barley. the advantage of winter malting barley over spring barley lies in the fact that it ripens earlier. This makes it possible to use the grain this year more quickly for the production of new crop of malt. Under such conditions, from an economic point of view, the problem of a stable loading of malting with raw materials is solved. in addition, it is possible to free premises for storing the grain of a new spring barley harvest without any additional rebuilding. That is why the production of malt from winter barley, due to its development biology, and especially after the introduction of new varieties, is of great importance.

The evaluation of the elements of the technology of winter barley cultivation for brewery needs in Ukraine is an issue of relevance. This applies to seeding, fertilizer application. the nutrition conditions play a significant role in winter crop stability, and ultimately affect the yield and quality of the grain. Therefore, the study

of the dependenceof grain yield and grain quality on these factors is particularly relevant and requires appropriate scientific substantiation.

2. MATERIALS AND METHODS

The research was conducted on the research field of Obolon Agro Ltd. in Chemerovetsky District, Khmelnytsky Region.

The experiments were conducted in compliance with the requirements of scientific agronomy stated by B.A. Dospekhov, V.F. Moiseychenko and V.O. Yeshchenko.

The task of the experiment was to study the individual elements of growing technology of winter malting barley. Scheme of experiment: factor a – norms of application of mineral fertilizers: variants – $N_0P_0K_0$ (control – without fertilizer), $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$; factor B – seeding rate: variants – 300, 350, 400, 450 pcs./m^2. Placement of areas: repetitions are quadrilateral, variants are randomized. the object of research is a variety of two-row winter barley Vintmalt.

The sowing date is the end of the third decade of September. Pre-planting of soil was carried out at depth of seeding up to 4 cm. at the laying of the experiment phosphoric-potassium fertilizers were introduced as ammophos (N-12%, P_2O_5-52%) and potassium chloride (K_2O-60%), as well as 50% application of nitrogen fertilizers in the form of ammonium nitrate (N-34,5%) in pre-planting soil tillage. the second part of nitrogen fertilizers (50%) was introduced in the spring at the earliest opportunity to perform work in the field. the accounting for winter barley grain of experimental areas was carried out in a phase of full ripeness by direct combine harvesting, by combine Sampo-500.

Records, observations and analyzes were conducted during the studies.

For the mathematical analysis of the obtained results, the method of the Duncan multi-path test was used, which established significant differences between the data based on the allocation of homogeneous groups indicated by symbols – ***, as well as correlation and regression analyzes.

3. RESULTS

An indispensable condition for success in growing field crops is to obtain homogeneous viable stacks, which should in future ensure a high grain yield of the proper quality. an important indicator in the formation of crops is the field sprouting of seeds. as a result of the conducted studies, it was determined that the field sprouting of the seed was

high, its value was in the range from 94.4% to 95.5%. on the field sprouting of the seeds did not affect the introduction of mineral fertilizers. in the control variant, it was 94.6%, on the variants of application of mineral fertilizers – 95.0%. the influence of seeding rate of barley seeds on field sprouting is also not established. Thus, at a norm of 300 s./m^2, it was 94.8%, 350–94.9%, 400–95.1%, at a rate of 450 – 95.0%. in the comparison between the data of all seeding rates according to the Duncan criterion, the significance of the differences is not proved.

When winter barley is grown, hibernation is important for plants. This indicator depended on both the norms of applied mineral fertilizers and the seed seeding rates. it was established that the significantly lower index of wintering of winter barley was 90.4% compared to the variants using mineral fertilizers. in variants $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$ overwintering was the same and amounted to 95.0%; 95.2%, respectively. When applying the norms of mineral fertilizers $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$ the hibernation of plants was also the same and amounted to 96.1% and 96.3%, but significantly better than the $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$ variants. as regards the assessment of the effect of seeding rates, it was found that it was better and statistically the same with 300 and 350 s./m^2– 95.1% and 95.4% respectively. Significantly lower this indicator was at the norm of 400 and 450 s./m^2 and amounted to 94.1% and 93.7%, respectively.

The results obtained by us show the dependence of the total survival of plants on the investigated factors. it has been established that in general, in the experiment, the overall survival of plants, as compared to most of the literature sources, was high 81.1%. the indicator of total survival of barley plants of winter depended on the applied mineral fertilizers, but the norms of their introduction to significant changes did not cause. as a result, the indicators for the application of mineral fertilizers were the same and amounted to an average of 82.2%. in the case of no mineral fertilizers, the overall survival of plants was significantly lower by 6%. the assessment of the effect of seeding rate, as a factor, indicates that under the norms of 300 and 350 s./m^2, the total survival of plants was the same for 82.1% and 81.9%. However, significantly lower, but slightly this indicator was at the rates of 400 and 450 s./m^2– 80.2% and 80.1%.

The most important task in cultivating technology is to ensure the formation of highly productive sowing, which functions according to the regularity of the transformation of sunlight energy into the energy of covalent bonds of organic substances. the number of plants per unit area of sowing is an important indicator in the characterization of crops structure (agrophytocenosis). as a result of the conducted research, it was found that

on average, the number of barley plants was 304 pcs./m^2, the number of productive stalks was 564 pcs./m^2, and the coefficient of productive planting was 1.9 (table 1).

The estimation of the influence of factors on the number of plants shows that this indicator depended on the applied mineral fertilizers, but the rates of their introduction did not differ in their interaction with each other.This is evidenced by the data given according to the same seeding rates. in particular, when sowing 300 s./m^2 the number of plants per 1 m^2 was smaller only on the control, and on all other backgrounds of mineral nutrition was the same. a similar pattern is established and for the norm of seeding 350, 400, 450 s./m^2. Shown results are confirmed by statistical analysis (table 2). as a result, the indicators were the same regardless of the background of mineral nutrition and amounted to an average of 307-309 pcs./m^2. on control the number of plants was smaller – 286 pcs./m^2. Dependence of the number of plants per unit area of sowing on mineral fertilizers consisted in the best survival.

The second important indicator of the structure of agrophytocenosis is the number of productive stems in barley plants per unit area of sowing. Regarding the influence of the use of mineral fertilizers, the analysis of the effect of the factor revealed that each increase in the level of mineral nutrition contributed significantly to this parameter of crops. as a result, a number of numerical values are set in accordance with the standards of mineral fertilizers – 357 < 456 < 572 < 672 < 761 pcs./m^2. Such a pattern is revealed through the intensification of the planting process under the influence of applied fertilizers. Each norm forms a separate statistical homogeneous group, indicating a significant difference in comparison between the data of all adjacent variants. According to the variant without fertilizers, the coefficient of planting was the lowest – 1.26. in the case of the $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$ ratios, the indices were respectively 1.50; 1.88; 2.20; 2.49.

Tab. 1. Indicators parameters of winter barley crops depending on the influence of norms of mineral fertilizers application and seeding rate

Norms of mineral fertilizers, kg/ha	Seeding rate, s./m^2	Number of plants, s./m^2	Number of productive stems, s./m^2	Coefficient of productive tillering
$N_0P_0K_0$	300	233	322	1.38
	350	271	341	1.26
	400	302	367	1.21
	450	338	398	1.18
$N_{30}P_{30}K_{30}$	300	248	426	1.72
	350	291	447	1.54
	400	325	466	1.43
	450	365	487	1.33
$N_{60}P_{60}K_{60}$	300	249	531	2.13
	350	289	554	1.92
	400	326	585	1.80
	450	367	620	1.69
$N_{90}P_{90}K_{90}$	300	250	621	2.48
	350	291	648	2.23
	400	327	688	2.10
	450	365	729	2.00
$N_{120}P_{120}K_{120}$	300	251	708	2.82
	350	292	738	2.52
	400	325	776	2.39
	450	367	823	2.24

Tab. 2. Structure parameters of barley agrophytocenoses depending on the influence of mineral fertilizers application (Duncan test)

№	Norms of mineral fertilizers, kg/ha	Np[1]	Homogeneous groups		Nps[1]	Cpt[1]	Homogeneous groups				
			1	2			1	2	3	4	5
1	$N_0P_0K_0$	286	***		357	1.26	***				
2	$N_{30}P_{30}K_{30}$	307		***	456	1.50		***			
3	$N_{60}P_{60}K_{60}$	308		***	572	1.88			***		
4	$N_{90}P_{90}K_{90}$	308		***	672	2.20				***	
5	$N_{120}P_{120}K_{120}$	309		***	761	2.49					***

[1] Np – number of plants, pcs./m²; Nps – number of productive stems, pcs./m²; Cpt – coefficient of productive tillering

Effect factor analysis of seeding rate. a direct dependence of the number of plants per unit area of sowing on seeding rate was established. the regularity of the changes in the results is shown in table 3. the smallest values in the number of 246 pcs./m^2 were at the norm of seeding of 300 s./m^2, with the number of plants increased by 41 pcs. and amounted to 287 pcs./m^2, 400 s./m^2 – 321 pieces/m^2, which is more than 34 pcs./m^2 and at a rate of 450 s./m^2 – 360 pcs./m^2. as regards the effect of seeding rate on the number of productive stems, each of them forms a separate homogeneous group. the smallest values are set for the seeding rate of 300 s./m^2 – 522 pcs./m^2 and the largest ones – for seeding standards of 450 s./m^2 – 611 pcs./m^2. the assessment of seed sowing rates by the effectiveness of the action, as a factor, also proves that they significantly affect the indicator of productive tillering. He has always been the largest at the rate of seeding 300 s./m^2 – 2.11 and gradually decreased with an increase in seeding rates of 350, 400, 450 s./m^2 – from 1.89 to 1.69. Each of them according to the coefficient of planting forms its homogeneous group. This suggests, however, that they differ significantly in the effect on planting.

The dependence of the number of productive stems and the coefficient of productive tillering on the norms of mineral fertilizer application and seeding rates are characterized by the same values of correlation bonds ($R_{y.xz}$=0.99).

Tab. 3. Structure parameters of barley agrophytocenoses depending on the effect of seeding rate (Duncan test)

№	Seeding rate, s./m^2	Number of plants, s./m^2	Number of productive stems s./m^2	Coefficient of productive tillering	Homogeneous groups			
					1	2	3	4
1	300	246	522	2.11	***			
2	350	287	546	1.89		***		
3	400	321	576	1.79			***	
4	450	360	611	1.69				***

Productivity of barley ear in terms of the number of grains and grain weight depended on the application of mineral fertilizers and seeding rates. on average, by experiment, the number of grains in the ear was in the range from 21.6 to 26.3 pcs., and the grains weight – from 50.2 to 55.4 mg (table 4). Such parameters of changes prove the effective ability to control the productivity of the ear.

It was established that the average value of the indicator of grains number in the ear of barley was greatest when mineral fertilizers were not introduced – 25.3 pcs. and the smallest at the norm $N_{120}P_{120}K_{120}$ – 22.8 pcs. Accordingly, mineral fertilizers led to a significant logical decline in the indicator, as evidenced by the data given in table 5. the weight of ear grain of barley under the influence of norms of the mineral fertilizers application was also a dependent value. According to the control, $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$ indicators was 54.2 > 53.4 > 52.6 > 51.7 > 51.1 mg, which corresponds to the regularity of reducing the biological potential of the genotype. as a result of an increase of mineral fertilizers application it was revealed a difference in the data, which is more than 2 mg.

Factor – seeding rate also significantly influenced the implementation of these elements of the productivity of the ear (table 6). According to the statistical analysis at sowing of 300 s./m^2, the largest number of grains in the ear is 25.2 pcs. and the largest is grain weight of 53.8 mg. a further increase in seeding rates by 50 pcs./m^2 resulted in a significant reduction in the parameters of these indicators, which is established on the basis of comparison of group average data, each of the seeding rates forms its homogeneous group.

Tab. 4. Productivity of winter barley ear depending on the influence of the norms of mineral fertilizers application and seeding rate

Norm of fertilizers, kg/ha	Seeding rate, s./m^2	Number of ear grains, pcs.	Weight of ear grain , mg
$N_0P_0K_0$	300	26.30	55.44
	350	25.75	54.81
	400	25.08	53.79
	450	24.25	52.72
$N_{30}P_{30}K_{30}$	300	25.86	54.63
	350	25.28	53.96
	400	24.53	53.04
	450	23.62	51.90
$N_{60}P_{60}K_{60}$	300	25.28	53.83
	350	24.72	53.21
	400	23.77	52.26
	450	22.78	51.07
$N_{90}P_{90}K_{90}$	300	24.62	52.93
	350	24.03	52.24
	400	23.05	51.23
	450	22.10	50.53
$N_{120}P_{120}K_{120}$	300	23.94	52.12
	350	23.28	51.23
	400	22.55	50.72
	450	21.61	50.22

The analysis of the results proves that the elements of the productivity of ear barley, in particular the number of grains, are dependent magnitude on the effect of mineral fertilizers application and seeding rate as factors of influence. the confirmation of such a pattern shows the multiple correlation coefficient $R_{y.xz}$=0.99 and the regression equation is established. Such correlation of the predicted effect, which is proved on the basis of theoretical calculations for the established regression equation (figure 1).

Tab. 5. Productivity of barley ear depending on the effect of mineral fertilizers application (Duncan test)

Norm of fertilizers, kg/ha	Number of ear grains, pcs.	Weight of ear grain , mg	Homogeneous groups				
			1	2	3	4	5
$N_0P_0K_0$	25.34	54.19	***				
$N_{30}P_{30}K_{30}$	24.82	53.38		***			
$N_{60}P_{60}K_{60}$	24.14	52.59			***		
$N_{90}P_{90}K_{90}$	23.45	51.73				***	
$N_{120}P_{120}K_{120}$	22.84	51.07					***

Tab. 6. Productivity of barley ear depending on the effect of seeding rate(Duncan test)

Seeding rate, s./m^2	Number of ear grains, pcs.	Weight of ear grain , mg	Homogeneous groups			
			1	2	3	4
300	25.20	53.79	***			
350	24.61	53.09		***		
400	23.80	52.21			***	
450	22.87	51.29				***

Similarly, a strong correlation between the dependence of the weight of barley grains on the levels of mineral nutrition provided by the norms of application and seeding rate is $R_{y.xz}$=0,99. the effect of these factors is predictable, which shows the results of calculations using the regression equation (figure 2).

The yield of barley grain is the result of the complex interaction of the biological factor with the factors of vegetation, as well as the factors of technology. in the studies, the grain yield of winter barley on average was 6.72 tons per hectare. Table 7 actually shows the effect of the variable component of two technology factors. the experimental data emphasize that the influence of the two factors involved in the experiment was unequal in character. in particular, the rules for seeding rate in the variant without the use of mineral fertilizers significantly affected the level of yield. in all other cases where mineral fertilizers were used, the seeding rate did not contribute to the increase in the yield of grain, nor did it lead to its decline, as evidenced by the results of statistical analysis.

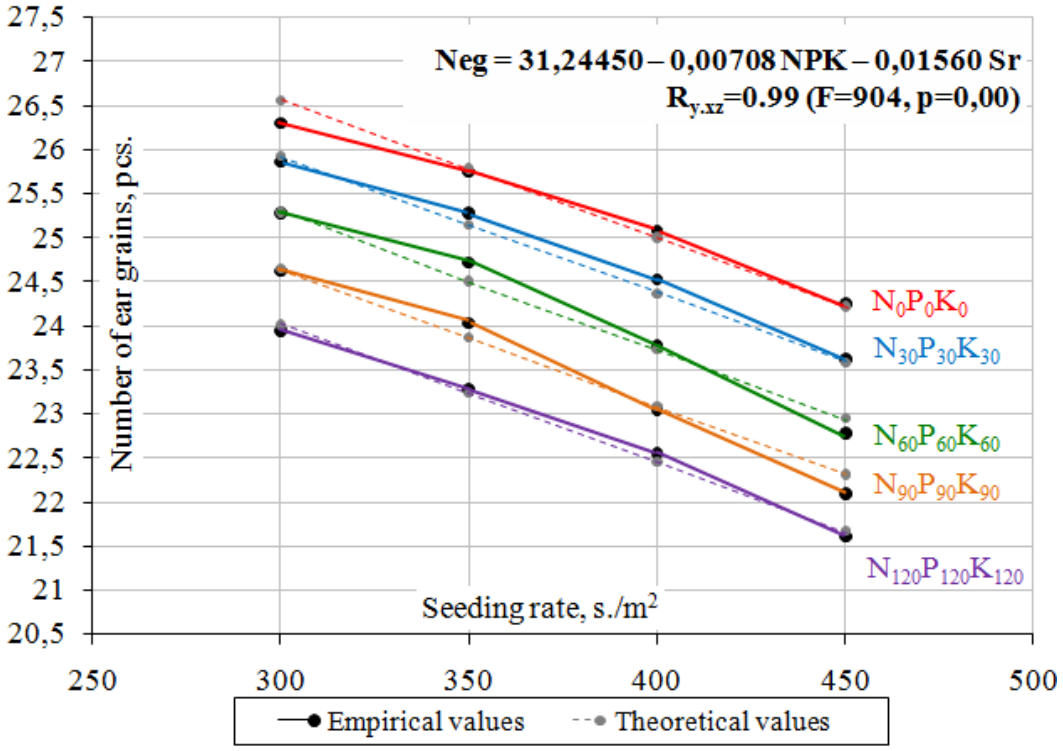

Fig. 1. Dependence of the grain quantity of barley ear on the norms of mineral fertilizers application and seeding rate

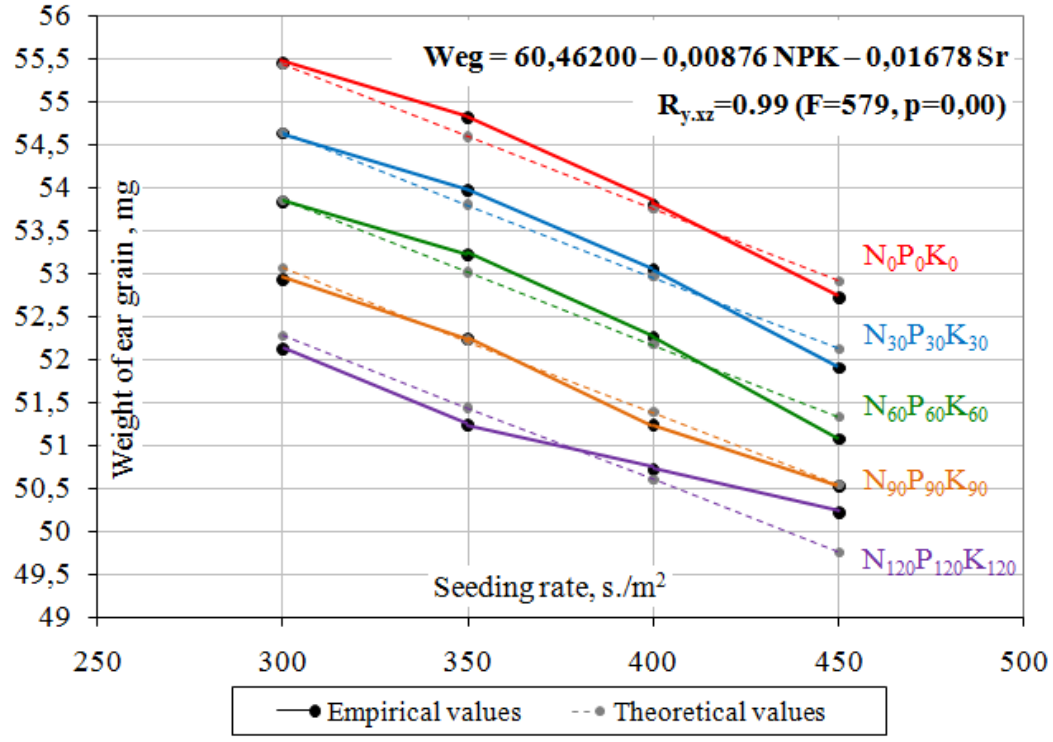

Fig. 2. Dependence of the grain weight of barley ear on the norms of mineral fertilizer application and seeding rate

Tab. 7. Grain yield of winter barley depending on the influence of norms of mineral fertilizers application and seeding rate, t/ha

Norm of fertilizers, kg/ha, factor A	Seeding rate, s./m^2, factor B			
	300	350	400	450
$N_0P_0K_0$	4.18	4.35	4.56	4.68
$N_{30}P_{30}K_{30}$	5.74	5.81	5.80	5.78
$N_{60}P_{60}K_{60}$	6.91	7.00	6.96	6.90
$N_{90}P_{90}K_{90}$	7.89	7.83	7.81	7.87
$N_{120}P_{120}K_{120}$	8.62	8.58	8.51	8.55

The analysis of influence, according to the literature sources, on the grain yield of mineral fertilizers showed that their application in the technology of growing crops was always an issue. in the conducted studies of the effect of the factor on the basis of Duncan's criterion, it was found that each rate of mineral fertilizer is effective. For each NPK variant, a separate homogeneous group is identified. Data analysis shows that the control version was characterized by the lowest figures. at the rate of seeding of 300 s./m^2, the rate was 4.18 t/ha, with the seeding rate of 350 s./m^2 – 4.35 t/ha, 400 s./m^2 – 4.56 t/ha and 450 s./m^2 – 4.68 t/ha. Each subsequent application of the norms of mineral fertilizers led to a significant increase in productivity. Thus, on the variant $N_{30}P_{30}K_{30}$ grain yield increased compared to the control by 1.34 t/ha. Further increase of the rates of mineral fertilizers by 30 kg/ha each of the nutrition elements also contributed to the increase in grain yield compared to the previous variant. However, it should be noted that each subsequent increase in the norm for $N_{30}P_{30}K_{30}$ compared with the previous one contributed to the increase in grain yield, but to a lesser extent (figure 3). Accordingly, a set of numerical values characterizes the pattern, the connection form of which is described by the regression equation Gy = 4.366952 + 0,017246 NPK – 0,000016 NPK^2. the mathematical model characterizes the functional form of the dependence of the investigated object on the factors of influence. the strength of the relationship between the yield of winter barley and the influence of the mineral fertilizers is characterized by the correlation value $\eta_{y.xz}$=0.98.

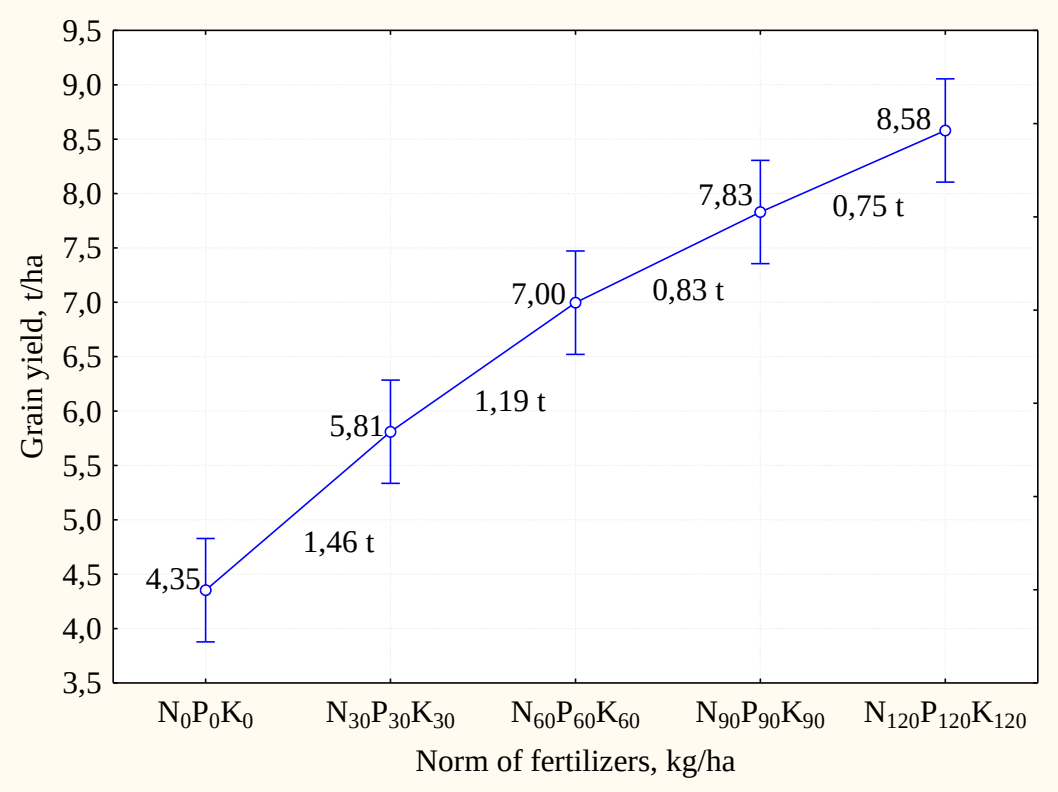

Fig. 3. Grain yield of winter barley depending on the influence of mineral fertilizers at seeding rate of 350 s./m^2

Important technological indicators of the quality of brewing barley are the grain size. a large grain always contains more substances necessary for the manufacture of beer, it is usually low-husk, evenly soaked and germinates well, and well stores the necessary enzymes during maturation. the obtained results in the conducted studies show the dependence of this indicator on the factors included in the experiment. on the basis of the conducted statistical analysis, the average value of the grain size of the experiment is 96.0%. the method of evaluating the effect of the factor on the basis of its effect setting proves that the control variants, $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$, for the effect on the grain size indices significantly differ 96.4 < 97.0 > 96.6 > 95.5 > 94, 3%. the regularity of changes in the grain size of winter barley from the influence of mineral fertilizers is characterized initially when introducing $N_{30}P_{30}K_{30}$ by significant improvement in grain size compared to control and with further gradual increase in NPK application rates by 30 kg/ha of each grain element, the grain size is significantly reduced. Despite such a pattern on the variants $N_{60}P_{60}K_{60}$, the $N_{90}P_{90}K_{90}$ grain was large and consistent with the requirements of the agreed standards of the Brewery Scientific Research Center in Berlin, where grain size ≥95% is considered selective. Significant improvement in the size of the $N_{30}P_{30}K_{30}$ compared to the control can be explained by the fact that when cultivated without fertilizers, crops are

formed with clearly pronounced vertical multi-level sprouts.

The effect analysis of the second influence factor proves that each seeding rate according to the Duncan criterion takes its homogeneous group. Accordingly, all norms with increasing of sowing by 50 pcs./m^2 were influential and led to a decrease in the grain size of winter barley. the maximum was reached at a height of 300 s./m^2 – 96.7% and, accordingly, at the rates of 350, 400, 450 s./m^2, the average parameters of the index were 96.4%; 95.9; 94.9% respectively. Such a pattern can be explained by the fact that an increase in seeding rate leads to the formation of crops due to a larger number of plants per unit area of sowing. There is a growing competition between barley plants, as a result of which, in the yield structure, the ear productivity reduces both by the number of grains and by the weight of grains on which the size depends. the combined analysis of the influence of the two factors of the experiment shows the existence of a strong correlation between the dependence of the grain size of winter barley on the factors of influence included in the experiment $\eta_{y.xz}$=0.99.

The weight of large grains is important in evaluating brewing barley, because it is closely related to quality. the parameters of this indicator are directly dependent on grain size. the conducted statistical analysis of the data gives grounds to assert about the significant influence of both seeding rate and norms of fertilizers, which were introduced on the parameters of the weight of large grains, that is, grains sifted through sorting sieve.

The weight of large grains is a material carrier of all features, properties and characteristics. Figure 4 shows the relationship of grains weight with important quality indicators of barley on the basis of a built-up galaxy. Analysis of the relationship proves that this important indicator depends on the level of grain yield. Correlation coefficient r=-0.81. in fact, this is a confirmation of the fact that the increase in grain yield is due to the impact of mineral fertilizers and leads to a decrease in the weight of large grains on which quality depends.

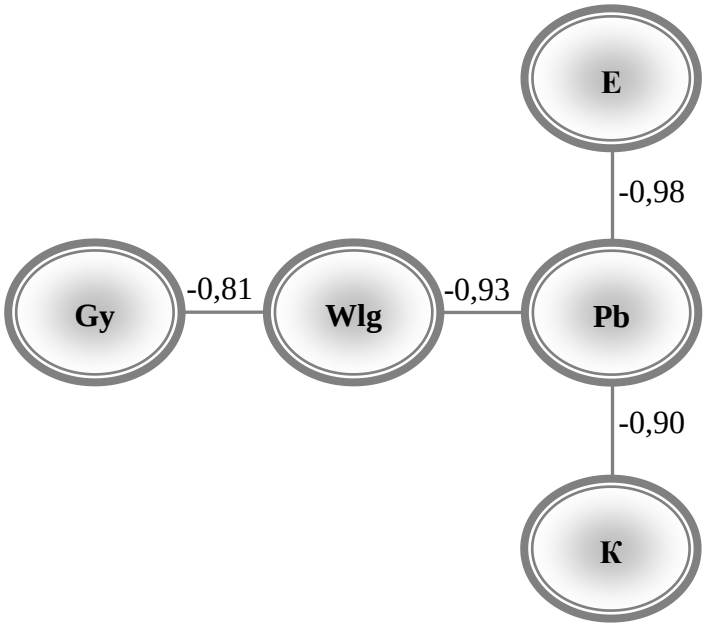

Fig. 4. Correlation galaxy of connection system of large grain weight (Gy – grain yield, Wlg – weight of large grains, E – extractivity, Pb – content of the protein in the grain, K – number of Kolbakh)

The relation between the content of protein in grain and the grain weight according to the correlation coefficient r=-0.93 proves the following: the growth of barley under certain technological conditions with an underage weight of large grains will be conditioned by an increase in the content of protein substances. Increased protein content will cause a correlation relationship r=-0.90 to reduce the Colbakh, that is, reducing the part of the enzyme activity of protein required for brewing. the connection in the galaxy of extraction with the protein content for a high inverse correlation coefficient r=-0.98 is evidenced by the pattern in which the increase in protein content leads to a decrease in extractivity. the established interrelations of the galaxy fit into the general logical system of dependencies.

4. CONCLUSIONS

1. in the formation of highly productive winter barley crops, the important role of technology factors has been established in the process of tillering plants. an equal reduction of seeding rate in the order of 450, 400, 350, 300 pcs./m^2 corresponds to a set of empirical data of the coefficient of planting 1.7; 1.8; 1.9; 2.1. For norms of mineral fertilizers $N_0P_0K_0$, $N_{30}P_{30}K_{30}$, $N_{60}P_{60}K_{60}$, $N_{90}P_{90}K_{90}$, $N_{120}P_{120}K_{120}$ has the appropriate coefficient of tillering 1.3; 1.5; 1.9; 2.2; 2.5.
2. Application of mineral fertilizers contributed to the increase in the grain yieldof barley

winter. Depending on the given nutrition elements, the indicator was $N_0P_0K_0$ – 4.44 t/ha, $N_{30}P_{30}K_{30}$ – 5.78; $N_{60}P_{60}K_{60}$ – 6.94; $N_{90}P_{90}K_{90}$ – 7.85; $N_{120}P_{120}K_{120}$ – 8.56 t/ha. Seeding rates, using fertilizers, did not affect grain yield. the main role in ensuring the increase in grain yield belongs to the structural component – the number of productive sprouts per unit area ofsowing obtained as a result of tillering.

3. the significant influence of mineral fertilizers and seeding rates on the formation of grain yield structure has been established. Each increase in the norms fertilizer application led to a significant decrease in the grains of the ear, which is characterized by data of their number: 25.3; 24.8; 24.1; 23.4; 22.8 pcs. Similarly, an increase in seeding rates led to a decrease in the ear productivity at the number of grains, and the indicators were set at 25.2; 24.6; 23.8; 22.9 pcs. in accordance with seeding rates 300, 350, 400, 450 pcs./m^2.
4. Effective reduction of grain weight of winter barley due to factors – mineral fertilizers and seed sowing rates were found. Changes from the first of them are characterized by values ranging from 54.2 to 51.1 mg. in terms of seeding rates 300 s./m^2 and 450 s./m^2, the difference in comparison of the maximum and minimum value was 2.5 mg. However, it was found that at the same levels of grain yield at the same background of mineral nutrition, the highest grain weight was always at the lowest seeding rate.
5. Correlation dependence of protein content in grain of winter barley on the large grain weight (r=-0.93) was established, which is a direct and effective functional attribute of the influence of technological factors – norms of mineral fertilizers and seeding rates. the inverse correlation dependence on the content of the protein in the grain of Kolbakh number (r=-0.90) and the extractivity (r=-0.98) was established.

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