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OPTIMIZATION OF ELEMENTS OF THE TECHNOLOGY OF *Triticum aestivum* L. CULTIVATION KOLCHUGA VARIETY IN THE CONDITIONS SOUTHERN STEPPE OF UKRAINE

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Abstract

The article presents the results of 7 years of field research (2011-2016) of the main elements of winter wheat (T. aestivum L.) growing technologies Kolchuga variety, namely: sowing dates, seed sowing norms and plant nutrition optimization. The need for this study is due to the warming of the climate, the change in soil fertility and the emergence of new winter wheat varieties and biological products. Results of the researches, showed us the significant influence of sowing terms and the introduction of a moderate dose of mineral fertilizers and the implementation of foliar feeding in the main periods of vegetation of winter wheat plants on the level of yield of the Kolchuga variety was established. With the shift of sowing terms from September 10th to October 10th, the yield of the studied variety increased from 3.73 to 4.92 t/ha^{-1}. The seeding rates and sowing terms significantly influenced the formation of winter wheat grain quality. The highest mass fraction of protein (15.0%) and gluten (30.7%) in winter wheat grain was formed for sowing on October 20th.

The use of Organic D2 and Escort - bio biological products contributed to an increasement in the yield of winter wheat grain at 1.53-1.59 t/ha^{-1} or 52.9-55.0%. The positive effect of optimization of the main elements technology for increasing the quality of winter wheat grain is confirmed. Thus, if without fertilizers on average for the years of research the grain of Kolchuga variety contained of 11.2% protein, the application of only mineral fertilizers before sowing provided an increase in this indicator by 6.7%, and the carrying out of foliar fertilizing on their background provided an increase by 8.2-13.2%. It was determined that some better quality indicators of different grains of the investigated winter wheat variety for joint application of $N_{30}P_{30}$ and foliar dressing of winter wheat crops twice during the vegetation season with Escort-bio preparation. Thus, for this nutrition variant the content of crude gluten in winter wheat grain was 24.2%, and the protein content was 12.9%.

Key words: *Triticum aestivum L., Kolchuga variety, sowing terms, seeding rates, nutrition optimization.*

INTRODUCTION

Today, grain production has a special place in the structure of the agro-industrial complex. It is the grain and products of its processing which are vital products that ensure the food security of the state, play an important role in the socio-economic development of the national economy, form the basis of agricultural exports and determine the degree of its participation in international cooperation. Favorable natural and climatic conditions and fertile lands of Ukraine allow to grow all crops and to receive high-quality food products in sufficient volumes both for domestic needs and for the formation of export potential (Kushniruk and Tolmach, 2016). Over the past five years, Ukraine strengthened its position in the international agricultural market and it is confidently in the world's top ten grain producers. Due to its favorable natural and climatic conditions the South of Ukraine is considered one of the leading regions for the production of soft winter wheat of high quality (Korchova et al., 2018).

Improving the technology of winter wheat growing is an extremely urgent task, because in the current economic conditions, reducing the cost of grain production and increasing its profitability it is possible only in the case of the introduction of new agricultural techniques which do not involve large costs. All around the world the main elements of the technology of winter wheat growing are the selection of varieties, optimal sowing time and seeding rates and plant nutrition system (Macleod et al., 1992; Oleksiak, 2014; Yong et al., 2016; Pasynkov et al., 2017).

In connection with the emergence of new varieties, global climate warming in General and in each climatic zone, soil fertility changes there is a need from time to time to view and clarify the sowing time and seeding rates for each variety in a certain climatic zone of cultivation, in particular in the Steppe zone of Ukraine (Vozhehova et al., 2018). Wheat production in Europe is particularly dependent on synthetic fertilizers as the use of animal manure is very limited, many soils have a naturally low organic matter content in the soil, and there are only a few grenades in the main rotation that can supply symbiotically fixed nitrogen (Biel et al., 2016; Boruga et. al., 2016).

There is a growing global interest in the use of organic farming and in increasing of grain production using low levels of mineral fertilizers (Petrenko et al., 2018). Reducing the dose of mineral fertilizers, especially nitrogen, is possible with the use of foliar fertilizing of plants during the vegetation season with modern growth-regulating preparations.

MATERIALS AND METHODS

The experimental part was carried out during 2011-2013 years at the new Odessa State variety-research station of the branch of the Mykolaiv National Agrarian University and the educational-scientific-practical center of the Mykolaiv National Agrarian University (hereinafter ESPC MNAU) during 2011-2016 years.

The technology of winter wheat growing in the experiment, with the exception of the studied factors, was generally accepted to the existing zonal recommendations for the Southern Steppe of Ukraine. The territory of the farms is located in the third agro-climatic region and it belongs to the subzone of the Southern Steppe of Ukraine. The climate is temperate continental, warm, dry, with unstable snow cover. Weather conditions for hydrothermal indicators in the years of research varied, which made it possible to obtain objective results, but, in general, they were typical for the location of the farm.

The soil of the research sites of the new Odessa state variety research station is southern low-humuschernozem, it is light-loam on the loesses of wide poorly drained watershed plateau, being typical for the Southern Steppe zone. Theirarable layer on averagecontains of 2.4% humus (GOST 26213-91 for Tyurin), it contains of light-hydrolized nitrogen as 16 mg/kg (GOST 26951-86 for Kravkov), mobile phosphorus as 160 mg/kg and exchangeablepotassium as 187 mg/kg of soil (GOST 26204-91 for Chirikov).

The soil of the ESPC MNAU was represented by the southern, resiliently weakly sunny, heavy-sooty black soilon the loesses. The reaction of the soil solution was neutral (pH 6.8-7.2). The content of humus in the 0-30 cm layer was 123-125 g kg^{-1}. The arable layer of soil contained moving forms of nutrients on average: nitrates (by Grandval Liagou - this method is based on interactions between nitrates and disulpfo-phenolic acid from which trinitrophenol (picric acid) is formed. In alkaline environment it gives us yellow coloring due to formation of potassium trinitrophenolate (or natrium, depending from alkali used) in quantity equivalent to nitrates content) as 15-25 mg kg^{-1}, mobile phosphorus (by Machigin - this method is based on extraction of mobile phosphorus and potassium compounds from the soils with 1% ammonium carbonate solution, pH 9.0, at $25 \pm 2^{0}C$) as 41-46 mg kg^{-1}, exchangeable potassium (on a flame photometer) as 389-425 mg kg^{-1} of soil.

For performing the tasks, 2 field experiments were conducted:

1). Double factor experiment. Which schemes included the following factors: factor Awas sowing terms - September 10th, September 20th, September 30th (control), October 10th, October 20th; factor Bwas seeding rates such as 3.4 (control) and 5 million germinating seeds per hectare. The total area of the sowing plot was 48.6 m^2, total area of theaccounting plot was 25 m^2. The repetition was fourfold. The predecessor was black steam;

2). Single factor experiment: factor A was nutrition: 1. Control (without fertilizers); 2. $N_{30}P_{30}$ - for pre-sowing cultivation-background; 3. Background + urea K1 (1 l/ha); 4. Background + Urea K2 (1 l/ha); 5. Background + Escort-bio (0.5 l/ha); 6. Background + urea K1 + Urea K2 (0.5 l/ha); 7. Background + Organic D2 (l/ha).

Preparations to be used for foliar application of barley crops were listed in the listof pesticides and agrochemicals authorized for use in

Ukraine. Preparations of Urea K1 and Urea K2 are registered as fertilizers containing respectively N as 11-13%, P_2O_5 as 0.1-0.3%, K_2O as 0.05-0.15%, micronutrients as 0.1%, succinic acid as 0.1% and N as 9-11%, P_2O_5 as 0.5-0.7%, K_2O as 0.05-0.15%, sodium humate as 3 g l^{-1}, potassium humate as 1 g l^{-1}, trace elements as 1 g l^{-1}. Organic D2 is organo-mineral fertilizer containing N as 2.0-3.0%, P_2O_5 as 1.7-2.8%, K_2O as 1.3-2.0%, total calcium as 2.0-6.0%, organic matter as 65-70% (in terms of carbon). Escort-bio is a natural microbial complex that contains strains of microorganisms of genera *Azotobacter, Pseudomonas, Rhizobium, Lactobacillus, Bacillus*, and biologically active substances produced by them.

The material for the research was Kolchuga, early maturing soft winterwheat variety of Ukrainian selection, intensive type, universal use. The average yield in the Steppe zone during the years of state variety testing was 5.70 t/ha, which exceeded the national standard by 0.23 t/ha. The variety was included in the State Register of plant varieties suitable for distribution in Ukraine for the Steppe zone since 2007.

In the process of research, the method it was used the state variety testing of agricultural crops (Volkodav et al., 2001). The yield structure was determined by the method of continuous harvesting of each accounting area (grain harvester "Sampo-130").

Technological and biochemical indicators of quality of soft wheat grain intended for food needs use were established in accordance with DSTU 3768:2010 "Wheat. Technical conditions", with reference to the standards: the crude gluten content by a manual method according to DSTU ISO 21415-1:2009, "Wheat and wheat flour"; the protein content of grain according to DSTU 4117:2007; the nature of grain according to DSTU 4234:2003 "Crops".

RESULTS AND DISCUSSIONS

The height of wheat plants is determined by the genotype and it has a high heritability, but the height can vary significantly depending on the agroecological conditions of cultivation (Orlyuk et al., 2003).

As a result of research, we found the height of winter wheat plants significantly influenced on the sowing time. The highest rate was formed in wheat plants of early sowing time (September 10) and it ranged from 88.7 up to 89.5 cm depending on the seeding rates, and the lowest rate was formed in the late sowing time (October 20) as 78.0-80.1 cm. In fact, the height of winter wheat plants of the Kolchuga variety decreased from early to late sowing times by 9.4-11.0 cm (Figure 1).

By sowing Kolchuga winter wheat variety in all the studied times, the plants formed the highest altitude with a seeding rate of 5 million germinating seeds/ha, which was more by 0.4-2.1 cm than for sowing with a seeding rate of 3 million germinating seeds /ha.

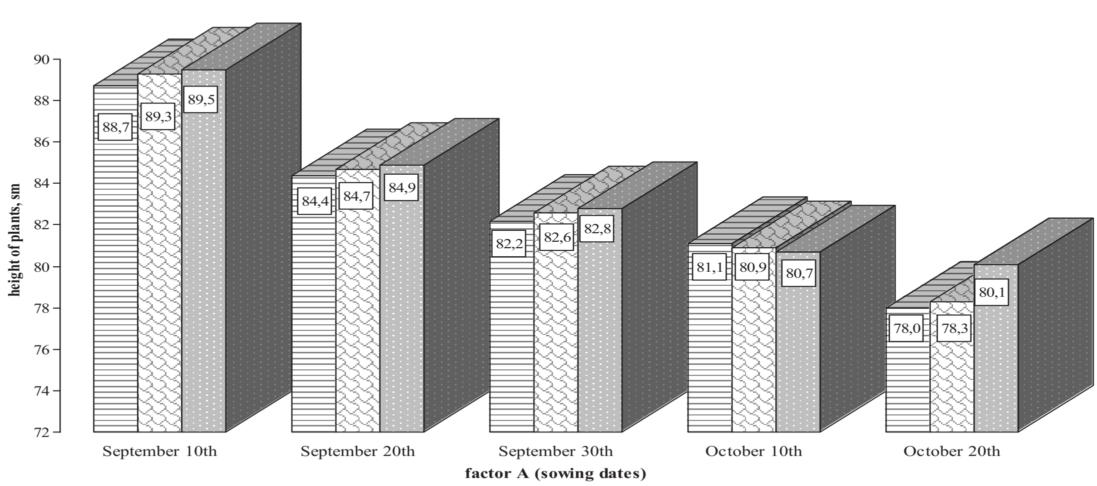


Figure 1. Height of winter wheat plants depending on sowing time and seeding rates, average for 2011-2013 years

On average, over the years of research, the application of mineral fertilizers for pre-sowing cultivation and foliar fertilizing of plants in the main vegetation periods with modern growth-regulating preparations contributed to the increase in the height of winter wheat plants. Thus, the use of only mineral fertilizers at a dose of $N_{30}P_{30}$ increased the height of Kolchuga variety plants by 2.5 cm or 2.9% compared to the control variant of the experiment (Figure 2).

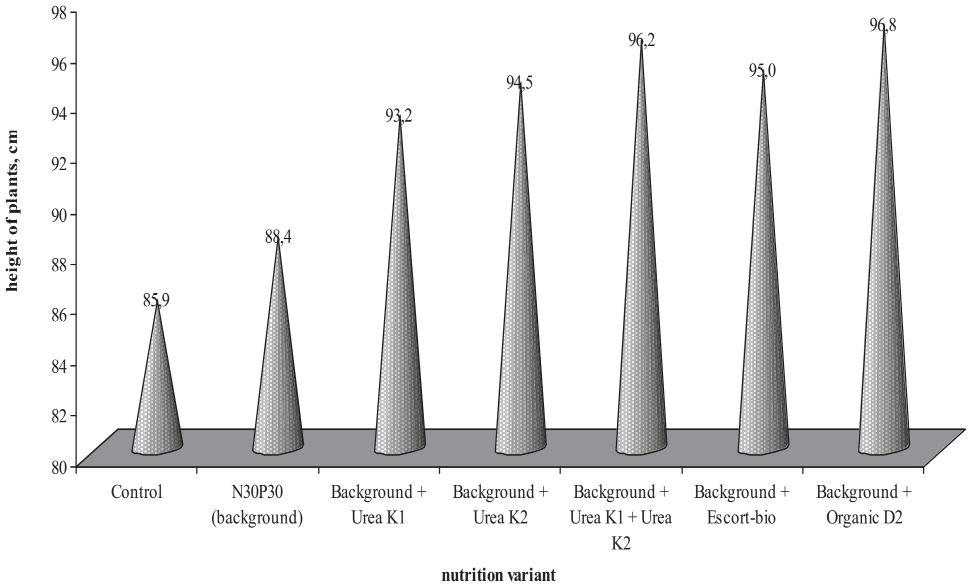


Figure 2. The height of winter wheat plants in the phase of full grain ripeness depending on the nutrition optimization, the average for 2012-2016 years

The use of modern preparations on the background of the application of a moderate dose of mineral fertilizers for pre-sowing cultivation contributed to the strengthening of growth processes of winter wheat plants. Thus, the combined use of urea K1 and Urea K2 on the background of fertilizers increased the height of winter wheat plants by 10.3 cm or 10.7% compared to the control. The highest rates of height (96.8 cm) of winter wheat plants reached in the experiment variants such as background + Escort-bio and background + Organic D2, which was more by 10.9 cm for control.

It was established the seeding rates and terms of sowing were integral parts of creating the optimal structure of the winter wheat crops (Dergachov, 2010; Korkhova, 2015; Korkhova et al., 2019; Oleksiak et al., 2014). The results of our studies found the productive stalk standing of Kolchuga variety winter wheat plants in the areas of late sowing (October 20) was the least dense as 451 PCs/m^2 sowing with a seeding rate of 3 million germinating seeds/ha. With an increase in the seeding rate from 3 up to 5 million germinating seeds/ha, the number of productive stems of the studied variety increased by 11.0-20.8% on average (Table 1).

The largest number of productive stems of winter wheat plants (657-696 PCs/m^2) was formed during sowing on September 30th, depending on the seeding rates, which was more by 89-176 PCs/m^2 than for sowing on October 20th.

It was established there was a strong correlation between the seeding rates and the number of productive stems - r = 0.99. Through years of research, plants of Kolchuga variety formed 31.9, 37.1 grains per spike on average. The highest number was formed for sowing on October 10 with a reduced seeding rate (3 million germinating seeds/ha) and it amounted to 34.9 PCs/ear. With an increase in the seeding rate to 4 and 5 million germinating seeds / ha, the number of grains in the ear of the studied variety decreased by 0.8-1.5 PCs/ear on average.

Table 1. The main elements of productivity and productivity of winter wheat plants depending on sowing times and seeding rates, the average for 2011-2013 years

Factor A	Factor B	Number of productive stems (PCs/m²)	Grain weight of 1 ear	Number of grains, PCs/ear	1000 seeds weight, g	Yield, t/ha^{-1}
September 10th	3 mln pie/ha	638	0.94	35.4	38.1	3.92
	4 mln pie/ha	653	0.96	36.7	39.5	3.90
	5 mln pie/ha	662	1.05	32.9	40.7	3.73
September 20th	3 mln pie/ha	648	1.14	34.9	41.7	4.07
	4 mln pie/ha	665	1.25	36.8	41.6	4.00
	5 mln pie/ha	672	0.92	35.0	37.2	3.85
September 30th	3 mln pie/ha	657	0.94	36.3	38.3	4.60
	4 mln pie/ha	680	0.98	32.5	40.0	4.64
	5 mln pie/ha	696	1.03	34.4	41.1	4.49
October 10th	3 mln pie/ha	616	1.12	36.0	41.0	4.83
	4 mln pie/ha	665	0.89	34.5	36.6	4.85
	5 mln pie/ha	696	0.90	35.2	37.9	4.92
October 20th	3 mln pie/ha	481	0.95	32.0	39.4	4.29
	4 mln pie/ha	540	0.99	33.6	40.5	4.43
	5 mln pie/ha	607	1.05	34.5	40.5	4.90

To a large extent, the productivity of the ear depends on the characteristics of sowing, in particular the sowing time. In our studies, the mass of grain from one ear of winter wheat increased as the shift of sowing times towards later ones.

The weight of grain per 1 ear on average fluctuated depending on sowing time and seeding rates from 0.89 g/ear of seeding on October 10 with seeding rate of 4 million germinating seeds/ha to 1.25 g/ear of seeding on September 20 with seeding rate of 4 million germinating seeds/ha.

It was found the seeding rate also influenced on the formation of the mass of 1000 grains. With increasing in the seeding rate from 3 to 5 million germinating seeds/ha, the weight of 1000 grains decreased slightly by 1.1-4.5 g depending on the sowing time. So, for sowing on October 10 with the seeding rate of 3 million germinating seeds/ha, the weight of 1000 seeds was 41.7 g; with 4 million germinating seeds/ha it was 41.1 g, with 5 million germinating seeds/ha it was 40.5 g.

It was found the sowing time significantly influenced on the weight of 1000 grains, which was more dependent on weather conditions during the loading of grain. But, nevertheless, it should be noted that for sowing on October 10, the plants of the studied variety formed the smallest mass of 1000 grains such as 36.6 - 41.0 g.

It was found with the shift of sowing terms from September 10th to October 10th, the yield level of the studied variety increased from 3.73 t/ha^{-1} up to 4.92 t/ha^{-1}. Sowing 10 days later (October 20th), the yield of wheat grain decreased slightly and it averaged 4.29-4.90 t/ha^{-1}, which was less by 0.02-0.54 t/ha^{-1} than for sowing on October 10th, but it was more by 0.21-0.41 t/ha^{-1} than for sowing on September 30th.

We found the seeding rates had a significant impact on the grain yield formation of winter wheat and they were closely related to the sowing time. According to research, in early sowing times (September 10th, 20th) Kolchuga variety on the average for 2011-2013 yrs, the highest yield (3.92-4.07 t/ha^{-1}) formed with a reduced seeding rate of 3 million seeds/ha. For sowing September 30th the higher yield (4.64 t/ha^{-1}) was formed with the seeding rate of 4 million seeds/ha, and when sowing in the later period (October 10th and 20th) the optimal seeding rate increased up to 5 million seeds/ha, while providing the highest level of grain yield in the variety it was 4.90-4.92 t/ha^{-1}, respectively.

Nutrition variants of winter wheat plants also had a significant impact on the indicators of the yield structure (Table 2).

The largest number of productive stems in the studied winter wheat variety was formed on the background of mineral fertilizers at a dose of $N_{30}P_{30}$ for pre-sowing cultivation and foliar fertilizing of crops in the main phases of plant growth and development with Organic D2 and Escort-bio preparations.

Table 2. The structure of winter wheat yield depending on the nutrition optimization (average for 2012-2016 years)

Nutrition variant	Number of productive stems (PCs/m²)	Grain weight of 1 ear	Number of grains, PCs/ear	1000 seeds weight, g	Yield, t/ha^{-1}
Control	473	0.88	24.9	35.0	2.89
$N_{30}P_{30}$ (background)	500	1.00	27.0	36.8	3.44
Background + Urea K1	538	1.08	28.0	38.3	4.23
Background + Urea K2	541	1.11	28.2	39.2	4.33
Background + Escort-bio	561	1.25	29.8	41.9	4.48
Background + Urea K1 + Urea K2	550	1.15	28.7	31.1	4.38
Background + Organic D2	556	1.19	29.3	40.5	4.42

Thus, 556 and 561 pieces/m^2 of productive stems were formed respectively in these variants of winter wheat plants nutrition, which exceeded the control by 14.9-15.7%, respectively.

Slightly less density of productive stalk was formed at joint processing of crops of winter wheat by preparations Urea K1 and Urea K2 on a background of application of mineral fertilizers. Thus, on average, over the years of research, there were 550 productive stems per 1 m^2.

Nutrition variants to some extent influenced on the number of grains in the ear of the studied winter wheat variety. So, if without fertilizers on average for the years of research in the winter wheat ear the number of grains amounted to 24.9 grains, the application of only mineral fertilizers in the main fertilizer provided an increase in this indicator by 2.1 grains, and carrying out on their background foliar feeding it increased by 3.1-4.9 grains, depending on the variant.

We found, on average, over the years of research, nutrition variants were reflected in the mass of grain from one ear. So, when applicating of moderate recommended doses of mineral fertilizers under Kolchuga winter wheat variety the weight of grain per spike increased by 13.6 % compared to control none-fertilized one. Carrying out foliar fertilizing provided an increase in this indicator of the crop structure by 22.7-42.0% compared to the control.

Depending on the nutrition optimization the weight of 1000 grains fluctuated, on average, over the years of research, within 35.0-41.9 g. At the same time, there was a clear tendency to increase this indicator of the crop structure for the use of foliar feeding with Escort-bio and Organic D2.

Our studies found the yield of winter wheat grain varied under the influence of the background nutrition and weather and climatic conditions of the cultivation yea, in particular the provision of plants with moisture during the growing season. Thus, the lowest yield of winter wheat grain was formed in 2012 yr as 1.71-3.04 t/ha^{-1} depending on the nutrition. Favorable weather conditions in 2015 yr and 2016 yr during the growing season of plants provided the highest yield of winter wheat regardless of the nutrition.

Thus, on average for nutrition, 5.38 t/ha^{-1} grains were formed in 2015 yr, and in 2016 yr they were formed as 5.45 t/ha^{-1}, which exceeded the level of 2012 yr, which was the least favorable, by 2.75-2.82 t/ha^{-1}.

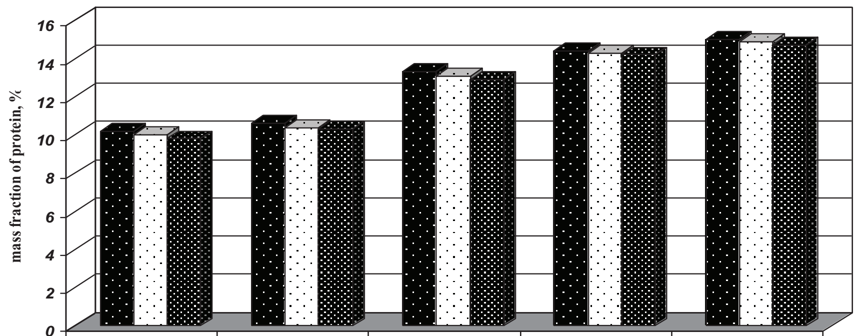
In all the years of research it was clearly observed a positive effect of the main joint application of moderate doses of mineral fertilizers and foliar application in the main vegetation periods of winter wheat variety plants. Thus, on average, during the years of research, 3.44 t/ha^{-1} grains of winter wheat were obtained on the background of $N_{30}P_{30}$ application, which exceeded the control by 0.55 t/ha^{-1} or 19.0%. The same dependence was observed on spring barley (Panfilova et al., 2019).

At the same time, studies (Ammanullah, 2014; Sedlar et al., 2017) showed that moderate doses of nitrogen fertilizers had little effect on grain yield. More significant grain growth formed in the variants for their background fertilizing crops with Organic D2 and Escort-bio. Their use contributed to the increase in the yield of Kolchuga winter wheat variety by 1.53-1.59 t/ha^{-1} or 52.9-55.02%.

The quality of wheat grain is influenced by the interaction of a number of factors, including variety, soil, climate, grain cultivation practices and grain storage conditions (Buráňová et al., 2016).

On average, in 2011-2013 yrs the highest mass fraction of protein in winter wheat grain (14.7-15.0%) was formed for sowing on October 20th, and the lowest one was formed for sowing on September 10th - 9.8-10.2%.

Our studies found with an increase in the seeding rate from 3 to 5 million germinating seeds/ha, the mass fraction of protein in winter wheat grain in all studied sowing times decreased by 3.9-1.4% (Figure 3).



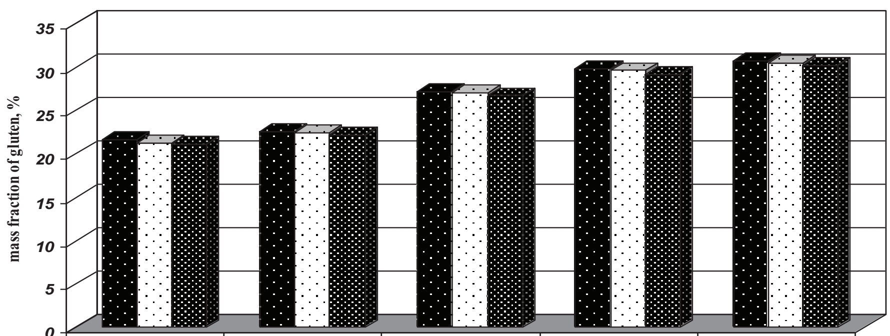
	September 10th	September 20th	September 30th	October 10th	October 20th
3 mln pieces / ha	10,2	10,6	13,3	14,4	15,0
4 mln pieces / ha	10,0	10,4	13,1	14,3	14,9
5 mln pieces / ha	9,8	10,3	12,9	14,2	14,7

seeding rates

Figure 3. Mass fraction of protein in winter wheat grain (%) depending on sowing time and seeding rates, average for 2011-2013 years

This indicator was formed as the lowest (9.8-14.7%) in all variants of sowing terms with the seeding rate of 5 million seeds/ha, and it was formed as the highest (10.2-15.0%) with the rate of 3 million seeds/ha.

The highest mass fraction of gluten (30.7%) on average for 2011-2013 years was formed by sowing on October 20th with the seeding rate of 3 million germinating seeds/ha (Figure 4).



	September 10th	September 20th	September 30th	October 10th	October 20th
3 mln pieces / ha	21,6	22,6	27,2	29,8	30,7
4 mln pieces / ha	21,3	22,4	27,0	29,6	30,5
5 mln pieces / ha	21,1	22,2	26,7	29,1	30,2

sowing dates

Figure 4. Mass fraction of gluten in winter wheat grain (%) depending on sowing time and seeding rates, average for 2011-2013 years

As a result of our studies found the quality of winter wheat grain depended on the nutrition of plants (Figure 5). Variety selection is a key factor in obtaining high technological quality grain, although recently it is associated with a decrease in yield (Visioli et al., 2018). On average, during the years of our research, the content of crude gluten in the grain of non-fertilized plants was less by 6.1% compared to the variant of the main application of mineral fertilizers in the dose of $N_{30}P_{30}$. Carrying out foliar fertilizing of crops in the main vegetation periods of winter wheat plants on the background of fertilizer contributed to an increase in this indicator by 7.0-11.5% compared to the control.

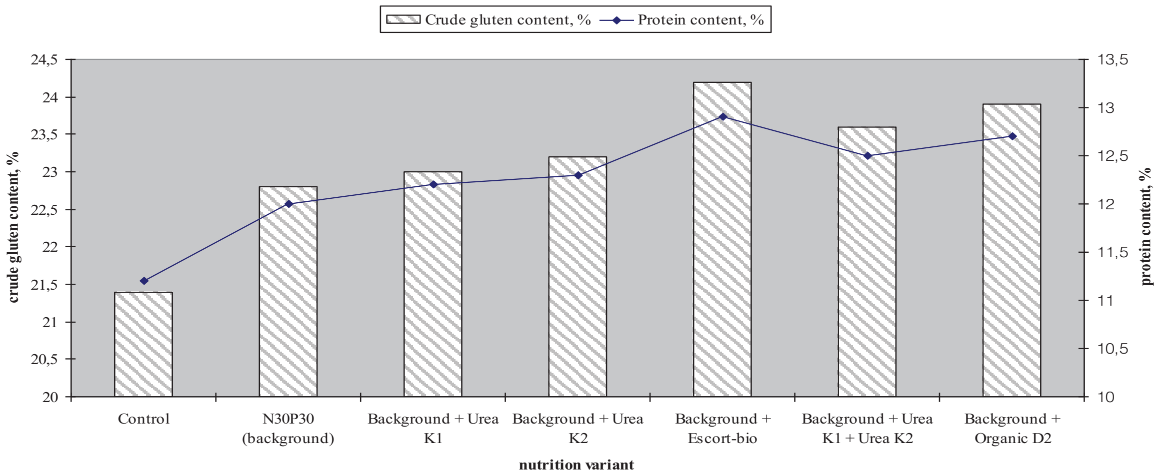


Figure 5. Influence of nutrition optimization on grain quality of winter wheat (average for 2012-2016 years)

To some extent nutrition variants influenced on the protein content of winter wheat grain. Thus, if without fertilizers on average for the years of research the grain of Kolchuga variety contained of 11.2% protein, the application of only mineral fertilizers before sowing provided an increase in this indicator by 6.7%, and the carrying out of foliar fertilizing on their background provided an increase by 8.2-13.2%. It was determined that some better quality indicators of different grains of the investigated winter wheat variety for joint application of $N_{30}P_{30}$ and foliar dressing of winter wheat crops twice during the vegetation season with Escort-bio preparation. Thus, for this nutrition variant the content of crude gluten in winter wheat grain was 24.2%, and the protein content was 12.9%.

The research of sowing time and seeding rates in the world has been studied for a long time. But the research results of scientists are somewhat different. Thus, as a result of 30 - year studies conducted in the practical production of Poland farms it was found that early planting did not lead to a decrease in the yield of winter wheat and even in many cases it increased the yield of winter wheat compared to the optimal time (Oleksiak, 2014). By research conducted in 2006-2009 yrs in the conditions of forest-Steppe of Ukraine it was found that the sowing time such as "the end of September – the middle of the first decade of October" contributed to a significant increase in the productivity of winter wheat (Dergachov, 2010). Our research also confirmed this fact.

The use of plant growth-regulating drugs on winter wheat is a common practice. Thus, in the UK, the use of plant growth-regulating drugs in the spring vegetation period contributed to the growth of grain yield by 4.0 t/ha^{-1}, compared with the natural background (Griffin and Hollis, 2017). Nutrition is an important factor in the cultivation of wheat, as it affects the growth, yield and quality of grain. Studies by Yuxue Zhang et al. conducted in the greenhouse at the Ottawa Research and Development Centre (ORDC) showed that growth-regulating drugs contributed to an increase in plant height, but the grain yield decreased. It is known that the protein content in the grain, perhaps shemost important quality characteristics of the wheat, is influenced by weath errand climaticcon ditions of plant grow than development, especially the provision of moisture during the grain loading, variet al characteristics, the presence and time of application of nutrients, especially nitrogen

(Abad et al., 2004; Buráňová et al., 2016). This also was observed in our studies.

CONCLUSIONS

As a result of the conducted researches it was established that optimum elements of productivity of plants of winter wheat Kolchuga variety, in which the highest grain yield (4.92 t/ha^{-1}) was formed, was received for sowing on October 10th with the seed rate of 5 million similar seed/ha. In addition, seed sowing rates were closely related to the timing of seeding. It has been proved that seeding rates and sowing terms significantly influenced the formation of winter wheat grain quality. The highest mass fraction of protein (15.0%) and gluten (30.7%) in winter wheat grain was formed for sowing on October 20th.

The use of Organic D2 and Escort - bio biological products contributed to an increasement in the yield of winter wheat grain at 1.53-1.59 t/ha^{-1} or 52.9-55.0%. It was determined that some better quality indicators of different grains of the investigated winter wheat variety for joint application of $N_{30}P_{30}$ and foliar dressing of winter wheat crops twice during the vegetation season with Escort-bio preparation.

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