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THE EFFECT OF SOWING TIME AND FERTILIZATION ON THE WINTER WHEAT YIELD AND THE PHYSICAL CHARACTERISTICS OF ITS GRAIN QUALITY UNDER UKRAINIAN NORTHERN STEPPE CONDITIONS

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Abstract

The current article reports on the research results determining the effect of the sowing time and fertilization on the yield and the physical characteristics of winter wheat grain quality after bare fallow and spring barley. In this article, it has been determined that under conditions of the Ukrainian Northern Steppe, the highest yields of all the varieties are observed when sowing is performed at the middle term (22nd September). The shift in the sowing time towards the early date (7th September) or the late date (7th October) causes the drastic reduction in the yields. In comparison with the other genotypes under the study, the variety of Holubka Odeska shows the highest flexibility in terms of sowing time. It has been defined that locally applied N_{30} fertilization permits the increase in the grain yield as much as additional 0.79-1.18 t/ha in comparison against the control group plants (without application of any fertilizers) on condition that fertilization is carried out at the end of the plant tillering stage after bare fallow at the pre-sowing application of $N_{30}P_{60}K_{30}$; the application of the nitrogen fertilizers (N_{30} in early spring into thawing frozen soil + N_{30} locally) at the pre-conditioning with $N_{60}P_{60}K_{30}$ after spring barley brings the increase of 2.17-2.47 t/ha. The grain units of the winter wheats planted after the two predecessors increase, as a rule, from the early sowing time towards the later one. The durum wheat of Burshtyn variety has shown the higher values than the soft wheat varieties of Lastivka Odeska and Holubka Odeska. We also report on the positive effect of the plant fertilizing on grain glassiness development in both the durum wheat variety and the soft wheat variety, however, the favour of the durum wheat variety is higher than that of the soft wheat from the standpoint of this property.

Key words: *fertilization, grain quality, sowing time, variety, winter wheat, yield.*

INTRODUCTION

The winter wheat (*Triticum* L.) is a principal grain cereal grown on the territory of Ukraine. Its crops occupy 6-7 million ha and account approximately 40% of the grain cereal total areas. The winter wheat allows high yield, its grains are important raw materials for flour-and-cereals industry, bread processing, animal feed industry and other processing branches. There are several kinds of it and a plenty of varieties and forms. The principle kinds of wheat are the two: soft wheat (*Triticum aestivum* L.) and durum wheat (*Triticum durum* Desf.). The grains of soft wheat are applied, as the rule, for flour production and further bread processing. The grains of durum wheat contain more proteins than those of the soft wheat, however, the bread produced from durum wheat is smaller in its volume and stales faster. Along with it, it worth mentioning that the flour produced from the durum wheat is an indispensable raw material for pasta products (Petrychenko & Lykhochvor, 2020).

The significant importance in the technology of grain processing into flour or into cereals is attributed to physical and structural properties of the grain, in particular, the grain size (expressed in the mass of 1000 grains), grain unit (grain mass within a certain volume), endosperm consistency (glassiness) and so forth. The previous researches conducted in different climate zones of Ukraine evidence on noticeable dependence of the above-mentioned parameters on the wheat variety features and weather conditions during grain formation, grain ripening, and overmaturing (Hasanova & Konop-lova, 2011; Liubych, 2013). However, agricultural techniques of growing also have a significant effect on physical properties of wheat grain (Zhemela & Shakalii, 2012; Cherenkov et al., 2015).

Due to the good potential for the grain yield, capability of bringing high incomes on condition of proper cultivation plus the growing demand for winter wheat on both the domestic market and the external one, this kind of wheat holds its position as a promising cereal crop in Ukraine. Among the agricultural factors to determine the harvest amount, the sowing time is extremely important, it defines the duration of autumn plant vegetation when the plant growth and development occur. The correctly determined sowing time ensures the sufficient development for root system, tillering node and over-land vegetation mass. The highest grain yield of winter wheat is obtained provided that the optimal sowing time is observed: the sowing time is to be defined with the account of soil and climate conditions, winter wheat variety specific features, agricultural techniques of plant growing, and weather conditions in the pre-sowing period (Cherenkov et al., 2008; Gandjaeva, 2019; Kryvenko, 2019).

It is defined that sowing at optimal time with meeting certain conditions ensures not only high yield but also promotes obtaining excellent physical characteristics of the wheat grains, namely increased weight of 1000 wheat grains and grain unit. Sowing at the earlier time results in worse protein characteristics and bread-baking constituents of the winter wheat grain quality (Petrychenko & Lykhochvor, 2020; Shakalii et. al., 2020). Later sowing for winter wheat shows higher contents of proteins and gluten than those at optimal date since grain ripening occurs at higher temperatures and lower humidity of the soil and of the air; these shorten the period of grain formation and the yield as the resultant of it. If there is no drastic difference in the yields within the tolerable time period of sowing, the differences in wheat grain quality are insignificant (Zhemela & Musatov, 1989).

According to the researches carried out within 2009-2011 in the Ukrainian Northern Steppe, the highest winter wheat yields were obtained at sowing on 20th September both after bare fallow and after sunflower while the lowest yields were received at early date of sowing, namely 5th September. The yields of the different winter wheat varieties were somewhat lower after sowing on the later date of 5th October as compared with the harvest of the optimal sowing date but the grain units after sunflower crop were notably higher than those with the two crops sown earlier. The crops after bare fallow gave insignificantly change in grain units dependently on sowing time (Solodushko et al., 2016).

Further, an important event to encourage both winter wheat yield increase and its grain quality is fertilization; the greater part of its positive effect is stipulated by the fact that the nutrients content gradually decreases in the soil, the nutrients are in the forms difficult for dissolving while the physiological activity of the winter wheat root system is not sufficient (Maathus & Diatloff, 2013; Usova et al., 2018; Berdnikova, 2020).

In (Hirzel et al., 2010; Lytovchenko, 2017; Litke & Gaile, 2018; Hasanova et al., 2019; Bilousova, 2019), it is suggested that nitrogen fertilizers are supreme in importance for the grain quality and the development of its physical characteristics. If the amounts of phosphorous and potassium are balanced in the soil at the beginning of vegetation, they improve the plant growth and support nitrogen com-pounds accumulation in the vegetative organs of the plant. At the next stage of the plant development, these compounds play a vital role in grain formation and improvement of such characteristics as the weight of 1000 grains, grain unit, glassiness, protein accumulated.

Furthermore, we also cannot ignore the data which evidence on the decrease in the weight of 1000 grains and in grain unit when the increased mineral fertilization was applied: there was greater productive plant density observed at land plots with their increased mineral fertilization forming smaller spikes and smaller grains. In particular, the experiments with winter durum wheat under irrigation in Ukrainian Southern Steppe showed that the application of nitrogen fertilizers permitted the higher yield, increase in protein content in the grains, their better glassiness, however the values of the weight of 1000 grains and grain unit showed the regular decrease at the fertilized land plots (Bazalii et al., 2011).

The analysis conducted on the scientific papers by different authors evidences that the relevant data obtained are of ambiguous character and are controversial for certain cases. This could be explained by the facts that the researches devoted to the study how agricultural techniques of growing and weather conditions influence the winter wheat yield and its grain quality have been performed under different conditions of soil and climate zones, with different wheat varieties and the weather conditions were also not the same. This stipulates the urgent character and the necessity for the further experiments in the indicated scientific direction.

The aim of the current research is to reveal the specific effect of sowing time and mineral fertilization on the yield and grain quality of the most demanded varieties of winter soft wheat and winter durum wheat under conditions of sowing after bare fallow and after spring barley in the Ukrainian Northern Steppe.

MATERIALS AND METHODS

The reported research has been carried out within 2017-2019 in experimental farm "Dnipro" belonging to the Institute of Grain Crops of National Academy of Agrarian Sciences of Ukraine. The experimental farm is located in the northern subzone of Ukrainian Steppe. The soil of the experimental plots of the farm is common steppe black soil, low in humus, full cross-section, medium loam. The humus content within the arable layer is close to 3.2%, general nitrogen (N) - 0.18-0.20%, mobile phosphorus (P_2O_5) is within 90-120 mg/kg, exchangeable potassium (K_2O) is within 70-120 mg/kg (according to Chirikov). The maximal value of the nitrification capability of the experimental farm black soil is within the arable layer and makes 17-20 mg/kg soil.

Soil solution reaction of the black soil humus horizon is close to the neutral (pH of aqueous suspension is 6.75). The ground water depth is within 8-12 m, therefore soil moisturizing for the experiments was performed only by the atmospheric precipitations. The climate of the zone is moderate continental with insufficient and unstable moisturising.

The wheat sowing was carried out with seeder CH-16 as continuous row sowing, the rate of seeding was 5 000 000 viable seeds/ha, depth of seed wrapping was 5-6 cm. The plots were locate in systematical order. The area of a simple plot was 30 m^2, the research repetition - three times. The varieties of the winter soft wheat of Holubka Odeska and Lastivka Odeska and winter durum wheat of Burshtyn were sown on 7^{th} September, 22^{nd} September and 7^{th} October after bare fallow and spring barley.

According to the description of the originator (Plant Breeding and Genetics Institute, NAAS of Ukraine), Lastivka Odeska variety is long stemmed wheat of intensive type, possesses increased positive response to the improvement in agricultural conditions, and along with the mentioned, it is rather tolerable to disadvantageous agricultural conditions and growing after unpaired predecessors. Holubka Odeska variety is middle stemmed wheat, it is also of intensive type, shows a good response to the fertilization, is tolerable to poor or moderate soil fertility, and perfectly adapted to the dry conditions of growing. In connection to the prolonged vernalisation (54-56 days), this wheat variety adapts better to the early sowing time. Burshtyn variety refers to the species of hordeiformes, it allows high yield, belongs to short-stemmed type, undergoes the middle vernalisation (22-25 days).

The fertilization modes applied in the reported experiment were as follows: 1 - without application of any fertilizers (control lot); 2 - pre-sowing application of the fertilizers (after bare fallow - $N_{30}P_{60}K_{30}$ while after spring barley - $N_{60}P_{60}K_{30}$); 3 - the fertilizing system (N_{30} was applied locally at the end of the plant tillering stage on the background of the pre-so-wing mineral fertilization after bare fallow while N_{30} was introduced into thawing frozen soil + N_{30} locally after spring barley). All the observations were performed according to the widely accepted recommendations (Vovkodav, 2001).

The account of the yield was carried out by continuous mowing, grain threshing from all the area under observation, from each plot at the stage of ripe grain and further the grain yield was weighed. Combine Sampo-500 was employed for this. On the harvesting day, such parameters as the humidity of grain and impurities were defined. The data obtained were processed into standard grain humidity value (14%) and 100% purity.

The parameters of the grain quality were determined by the methods prescribed in the valid Ukrainian national standard on wheat (DSTU 3768-2019).

RESULTS AND DISCUSSIONS

The weather conditions in the years under study for the current article were, in general, advantageous for winter wheat. However, it should be noted that the years were different in the amounts of precipitation, temperature regimes and considerable distortions were observed for these factors from average multi-year recordings. Thus, the air temperature in 2016/17 vegetation year was +0.5°C higher than the average temperature having been recorded for many previous years while, in 2017/18 it was +2.6°C higher than the average value, in 2018/19 the temperature recording was +1.9°C higher than the average one.

The precipitation amounts during the years of the study were also higher than the normally recorded ones. In 2016/17, the amount of precipitations was 10.3 mm higher than the average multi-year values, 2018/19 vegetation year obtained 8.2 mm more of precipitations than on average, 2017/18 was described as the vegetation year of high humidity as the amount of precipitation exceeded the conventional values as much as 123.2 mm.

The fact that the research on the winter wheat was conducted under different weather conditions allows better understanding of its productivity potential.

Thus, the grain yields of various winter wheat varieties at all the research variants both after bare fallow and after spring barley were the highest in 2019 as compared with the results of 2017 and 2018.

The above-mentioned result was attributed to the better humidity for the winter wheat during the spring months (March, April and May); this stipulated the increase in the productive spikes number per the unit of the area and had a positive effect on the yield. Therefore, the richest harvest was developed under conditions of 2019 in spite of hot weather influence during the stage of grain filling, in June sickly grain development was noticed. The weight of 1000 grains was somewhat lower than in the previous years. The highest grain weight from the spike was grown in 2017, this positively influenced the winter wheat yield indexes of the year.

In 2019, the yields of the winter wheat after bare fallow showed differences per the wheat variety, sowing time and fertilization system, the range was from 4.72 to 7.36 t/ha; after spring barley – from 2.49 to 6.20 t/ha. In other years, the yield indexes were lower.

According to the data obtained, the yields of the winter wheat varieties in 2017-2019 were higher on average from the sowings after bare fallow than those after spring barley. The increased yields of Lastivka Odeska and Burshtyn were obtained from the variants with sowing on 22nd September. Depending on the fertilizers, the yield indexes varied after bare fallow from 6.4 to 7.10 t/ha and 5.22-6.40 t/ha per winter wheat varieties, while after spring barley – from 3.39 t/ha to 5.75 t/ha and 3.11-5.53 t/ha. The sowings conducted early (7th September) or at late time (7th October) caused 0.70-1.06 t/ha decrease in the yield of Lastivka Odeska after bare fallow and 0.12-0.42 t/ha decrease after unpaired predecessor; Burshtyn variety also reacted with the decrease as much as 0.35-0.91 t/ha and 0.35-0.80 t/ha, respectively (Figures 1, 2).

The yield of Holubka Odeska was less dependent on sowing time but its sowing at the optimal date gave higher results of 6.18-7.16 t/ha after bare fallow and 3.82-6.05 t/ha - after spring barley. When sowing at early but allowable time, the yields of this variety were also rather high: they totaled 6.14-7.04 t/h and 3.74-5.91 t/ha depending of the predecessor.

Further, it has been established that the application of the mineral fertilisers had a considerable effect on yield creation in winter wheat, especially after stubble predecessor.

Compared to the control lots, the increases in average yields of experimental winter wheat grain for the period of three years after bare fallow varied from 0.51 t/ha to 0.81 t/ha (depending on the wheat variety and sowing time) at the mode of pre-sowing application of complex fertilizer ($N_{30}P_{60}K_{30}$) while the increases from 0.79 to 1.18 t/ha were observed at the fertilization system, in which pre-sowing complex fertilization was followed by nitrogen fertilization N_{30} performed locally at the end of winter wheat tillering stage.

After spring barley, we found large increases of the winter wheat yields to the application of mineral fertilizers than those after bare fallow, that was conditioned by the difference in the nutrients contents left after these predecessors different in their agronomic conditions.

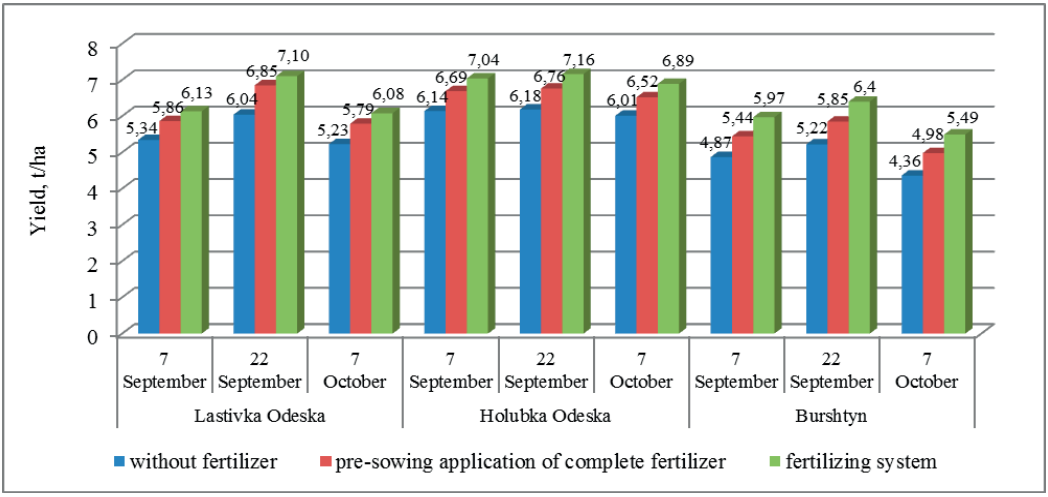

Figure 1. The effect of sowing time and fertilization on the winter wheat yield after bare fallow, t/ha, 2017-2019

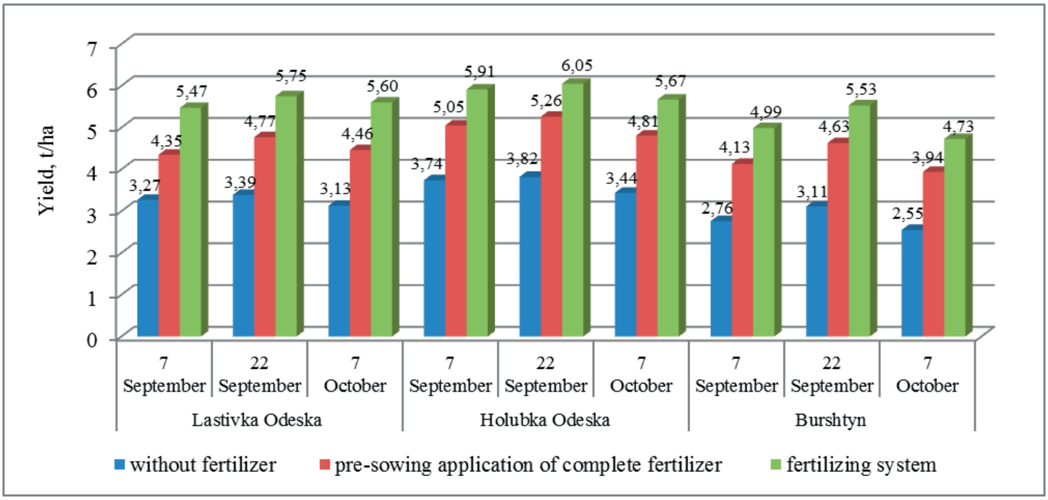

Figure 2. The effect of sowing time and fertilization on the winter wheat yield after spring barley, t/ha, 2017-2019

More-over, the content of that complete fertilizer which was applied in pre-sowing after unpaired predecessor was richer in nitrogen. The higher doses of this element were also used for spring fertilization of the winter wheat.

Thus, after spring barley, the increases in the winter wheat yields were 1.08-1.52 t/ha on condition of pre-sowing fertilization with complex fertilizer of $N_{60}P_{60}K_{30}$, the difference in the indexes depended on the winter wheat variety and sowing time. The results of the yield increases were obtained as compared against the control lot. These indexes were changing within the range of 2.17-2.47 t/ha at the fertilization system in which nitrogen fertilization (N_{30}) was conducted in thawing frozen soil on the background of pre-sowing fertilization with complex fertilizer plus local application of N_{30} at the end of plant tillering stage.

The analysis on the data obtained would not be complete without mentioning that within the years of the researches the highest grain yields were obtained from winter soft wheat of Holubka Odeska, while the lowest ones from winter durum wheat of Burshtyn after the both predecessors.

Further, it worth noting that the existing Ukrainian standard on wheat imposes the limits on such parameters as grain unit and glassiness (DSTU 3768-2019). Thus, the food grain requirement is to possess grain units of not less than 775 g/l for soft wheat grains of the first class, 750 g/l - for the second class, 730 - for the third one. The gain of the forth class, mainly utilised as coarse grains, is not restricted in this parameter. Glassiness value demands are to be equal or more than 50% for soft wheat of the first class, 40% for the second class, the other classes are not prescribed to undergo the limitations in this parameter.

For durum wheat grains, classified into five classes by the set of its parameters, grain unit values for the first and the second classes are to be not less than 750 g/l, for the third - 730 g/l, for the fourth - 710 g/l, no limitation in grain unit for the fifth class. Considering the certain application purpose for the durum wheat, the parameter of grain glassiness is one of the most significant parameters to attribute the wheat to the class. Therefore, for the durum wheat, the glassiness values are as follows: not less than 70% for the first class, 60% - for the second class, 50% - for the third class, 40% - for the forth class, only the fifth class is free from glassiness limitations.

Note, that all the varieties of the winter wheat under the research had the highest values of both the weight of 1000 grains and the grain unit in the humid year of 2018. We have deter-mined that these parameters respectively were 40.5-50.9 g and 803-845 g/l after bare fallow, while 42.0-49.2 g and 803-831 g/l after spring barley with no fertilizers applied but with the dependence on the wheat variety and the so-wing time. The lowest values of the weight of 1000 grains (33.9-43.3 g after bare fallow and 32-42.3 g after stubble predecessor) and grain unit (750-818 and 759-806 g/l with respect to the predecessor) were received in 2019.

The correlation analysis of the data obtained has pointed to the close positive connection between the parameters of the weight of 1000 grains and the grain unit in winter wheat. Thus, the correlation coefficient (r) after bare fallow was varying in the research years within the range of 0.74-0.79, while after spring barley it was 0.91-0.95. Further, the closest interconnection of the two quality parameters was revealed in 2019.

Furthermore, it was found that during the three years of the research, the physical parameters of winter durum wheat Burshtyn were on average higher than those of winter soft varieties. Thus, after bare fallow and with the dependence on sowing time and fertilization, Bursh-tyn's weight of 1000 grains was within 39.3-45.9 g, its grain unit - 796-826 g/l, its glassiness - 76.5-97.7%. The variety of Lastivka Odeska showed the values of these parameters within 39.4-42.4 g, 776-803 g/l and 66.6-80.9%, respectively; Holubka Odeska – 38.7-42.1 g, 781-806 g/l and 61.5-78.8%, respectively. After the stubble predecessor, the difference in the grain unit and in the development of its grain glassiness was less manifested, however, the durum wheat appeared to be more advantageous per the parameter of 1000 grain weight than the soft wheat (Tables 1, 2).

The grain unit parameter of all the winter wheat varieties under the study both after bare fallow and after spring barley showed the increase in most cases from the early sowing time (7th September) towards the later one (22nd September and 7th October). As for the weight of 1000 grains, such regularity became a charac-teristic feature for winter durum wheat of Burshtyn while winter soft wheat varieties expressed less dependence of this parameter on sowing time. The higher values of glassiness at sowing on the optimal data or on tolerably later date after bare fallow were registered with all the wheat varieties, however after the stubble predecessor such a result was obtained only with Lastivka Odeska.

The research results have determined that such parameters as the weight of 1000 grains and the grain unit are insignificantly dependent on the fertilization variation but the exception is the cases when Burshtyn's 1000 grains had lower weight with the application of the fertilization system to include N_{30} local fertilization at the end of wheat tillering stage on the background of pre-sowing introduction of complete $N_{30}P_{60}K_{30}$ fertilizer.

However, such fertilization after bare fallow allows winter durum wheat to develop the best glassiness of 96.7-97.7%. It also worth noting that this fertilization produces positive effect on grain glassiness also after spring barley in Burshtyn.

Table 1. The effect of sowing time and fertilization on the winter wheat physical characteristics of its grain quality after bare fallow, 2017-2019

Variety	Sowing time	Fertilizer option		
		without fertilizer (control lot)	pre-sowing application of complete fertilizer*	fertilizing system**
1000 grain weight, g				
Lastivka Odeska	7 September	39.7	40.9	40.8
	22 September	39.4	39.6	39.4
	7 October	39.9	41.0	42.4
Holubka Odeska	7 September	38.8	40.0	39.2
	22 September	39.3	42.1	38.8
	7 October	38.7	39.5	40.6
Burshtyn	7 September	45.0	43.4	41.5
	22 September	40.9	44.0	39.3
	7 October	44.8	45.9	43.6
Grain unit, g/l				
Lastivka Odeska	7 September	777	776	779
	22 September	787	787	794
	7 October	800	800	803
Holubka Odeska	7 September	784	789	782
	22 September	791	800	786
	7 October	796	806	781
Burshtyn	7 September	804	796	812
	22 September	808	807	813
	7 October	826	821	815
Grain glassiness, %				
Lastivka Odeska	7 September	68.9	66.6	68.7
	22 September	76.7	79.9	80.3
	7 October	75.9	74.9	80.9
Holubka Odeska	7 September	61.5	62.9	70.0
	22 September	77.7	77.5	74.7
	7 October	73.9	70.4	78.8
Burshtyn	7 September	76.5	79.1	96.7
	22 September	92.5	92.9	97.7
	7 October	93.7	92.6	97.4

Notes: *Pre-sowing application of complete fertilizer - $N_{30}P_{60}K_{30}$; **$N_{30}P_{60}K_{30}$ + N_{30} locally.

Thus, on the background with no fertilizers application, the values of glassiness were 69.4-81.5% (depending to the sowing time), the range of 79.0-84.0% was reached with pre-sowing fertilization while the enhance in glassiness up to 84.5-96.6% was attained at the fertilization system when N_{30} was applied for fertilization into thawing frozen soil + N_{30} local introduction on the background of $N_{60}P_{60}K_{30}$.

In general, the most cases (75%) evidence that the grain glassiness values of winter wheat varieties were better after the both predecessors under study provided that pre-sowing fertilization followed by the describe fertilization system, the comparison was made against the variants with no fertilizers employed.

CONCLUSIONS

Eventually, winter soft wheat varieties of Lastivka Odeska and Holubka Odeska as well as winter durum Burshtyn under conditions of the Ukrainian Northern Steppe are significantly influenced by sowing time and fertilization mode in terms of their yields and physical parameters of the grain quality.

The maximal parameter values of grain wheat after bare fallow and after spring barley are registered when the middle data of sowing was observed (22nd September). Sowing time shift both to the earlier data (7th September) or to the later data (7th October) causes the considerable decrease in the yield value.

In comparison with the other genotypes, Holubka Odeska variety shows the highest flexibility for the sowing time. The highest yields of the winter wheat within the years of the study are obtained when we applied the fertilization system in which pre-sowing fertilization is followed by complex nitrogen fertilizers.

Table 2. The effect of sowing time and fertilization on the winter wheat physical characteristics of its grain quality after spring barley, 2017-2019

Variety	Sowing time	Fertilizer option (faktor C)		
		without fertilizer (control lot)	pre-sowing application of complete fertilizer*	fertilizing system**
1000 grain weight, g				
Lastivka Odeska	7 September	40.9	40.9	41.7
	22 September	39.2	41.2	40.1
	7 October	40.9	40.2	40.9
Holubka Odeska	7 September	37.7	40.1	38.5
	22 September	41.7	40.1	40.4
	7 October	41.8	41.5	42.6
Burshtyn	7 September	40.6	40.2	41.3
	22 September	43.3	42.1	44.1
	7 October	45.8	48.6	46.3
Grain unit, g/l				
Lastivka Odeska	7 September	788	790	784
	22 September	789	789	791
	7 October	804	795	799
Holubka Odeska	7 September	778	779	779
	22 September	798	794	789
	7 October	800	798	802
Burshtyn	7 September	772	780	782
	22 September	801	805	806
	7 October	806	834	828
Grain glassiness, %				
Lastivka Odeska	7 September	72.0	74.2	72.9
	22 September	75.8	78.7	79.2
	7 October	84.6	82.5	79.9
Holubka Odeska	7 September	70.3	80.0	73.4
	22 September	72.7	86.9	80.4
	7 October	70.9	73.1	79.4
Burshtyn	7 September	81.5	84.9	84.5
	22 September	69.4	80.6	87.9
	7 October	69.7	79.0	96.6

Notes: *Pre-sowing application of complete fertilizer - $N_{60}P_{60}K_{30}$; **$N_{60}P_{60}K_{30}$ + N_{30} on frozen-thawed soil + N_{30} locally.

The increases in the harvest after bare fallow on the background of $N_{30}P_{60}K_{30}$ vary between the range of 0.51-0.81 t/ha as dependent on the sowing time; additional fertilization of N_{30} introduced locally at the end of the wheat tillering stage permits the yield increases as much as within 0.79-1.18 t/ha and specifically for Lastivka Odeska - 6.08-7.10 t/ha, for Holubka Odeska - 6.89-7.16 t/ha, for Burshtyn - 5.49-6.40 t/ha (all the mentioned increases in the grain yield are compared with the control lot where fertilization was not applied).

Winter wheat growing after spring barley and pre-sowing fertilization with $N_{60}P_{60}K_{30}$ enables the yield increase within 1.08-1.52 t/ha (as compared with the control lot) and shows the dependence on the wheat variety and sowing time; additional nitrogen fertilization (N_{30} in the early spring into thawing frozen soil + N_{30} locally) allows the increase of 2.17-2.47 t/ha. Thus, the variety of Lastivka Odeska at the application of the fertilization system gives the increase of 5.47-5.75 t/ha, Holubka Odeska - up to 5.67-6.05 t/ha, while Burshtyn - up to 4.73-5.53 t/ha.

The reported research has determined that grain unit values of winter wheats, as a rule, increase from the early sowing time towards the late time after the both predecessors under analysis. The variety of winter durum wheat (Burshtyn) has higher grain unit values than the winter soft wheat varieties (Lastivka Odeska and Holubka Odeska), this parameter is varying from 796 to 826 g/l after bare fallow while after the unpaired predecessors, the varying is within the range of 772-834 g/l (depending on sowing time and fertilization). The research has established the positive effect of fertilization on the development of winter wheat grain glassiness. The significantly notable advantage in this parameter has been shown by the durum wheat over the soft wheat.

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