UDC 633.11: 631.547 https://doi.org/10.31867/2523-4544/0165

ADAPTIVE PROPERTIES OF THE WINTER WHEAT VARIETY AS FACTOR INCREASING THE GROSS GRAIN YIELD

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It was proved that the main reasons for decreasing the winter wheat yield are plant damage in the autumn-winter season by low temperatures when a snow cover lacks, and a lapped ice crust, which is formed due an alternation between long-term thaws and frosts.

It was found that Smuhlianka, Lymarivna, Oriika, Mudrist odeska, Askaniiska varieties of winter wheat are the best according to adaptability indicators for cultivation in the Steppe zone. All of them are characterized by the sufficient winter hardiness, frost and drought resistance. Over the years of research, the average yield of these varieties was: Smuhlianka – 5.31 t/ha, Lymarivna – 6.04 t/ha, Oriika – 6.08 t/ha, Mudrist odeska – 5.84 t/ha, Askaniiska – 6.90 t/ha.

We established that the best varieties for cultivation in arid conditions of the Steppe zone considering the adaptive and plastic properties of winter wheat were such as: Bohynia, Oleksiivka, Donetska 48, Smuhlianka, Epokha Odeska, Kiriia, Zolotokolosa, Blahodarka Odeska, Bohdana, List 25, Rozkishna.

It was determined that an important element to improve an agricultural technology for winter wheat cultivation in the eastern part of the Northern Steppe of Ukraine is the genetic potential of modern varieties, namely adaptive properties for increasing yield by 11–50 % and gross grain yield. In particular, plastic varieties of winter wheat are characterized by the formation of consistently high yield in different weather conditions.

We established that it is advisable to grow the winter wheat varieties of Ukrainian selection with different maturity groups in a Steppe zone. The share of sown areas under early ripening and mid-late ripening varieties should be 10–15 %, and mid-early and mid-ripening varieties – 30–45 %.

Key words: *variety, yield, weather conditions, productivity, winter hardiness, varietal characteristics.*

Today, agriculture in Ukraine faces a very important and strategic task – to increase the gross grain yield of winter wheat. However, there are a number of negative factors that prevent solving it, as: the wrong choice of predecessor (cereals, sunflower), sowing seeds of low reproduction, overstating sowing rates, violation of sowing dates, reduction of fertilizer application, avoidance of certain agronomic measures, certain climate changes etc., but the vast majority of these factors can be eliminated by optimizing the cultivation technology.

According to many scientists, varietal resources play a leading role in increasing the yield and, accordingly, the gross grain yield, as the share of their influence is 30–70 % in recent decades [1]. According to scientific forecasts for 2010–2020, the increase in crop production will be obtained by selection and efficient use of varietal resources. It is proved that the cultivation of high-yield winter wheat varieties considering their adaptive properties and when the agrotechnologies is observed allows to increase grain yield by 11–50 %. Therefore, the development of high-yielding and environmentally plastic varieties with high adaptive potential and high stress resistance is relevant issue [2].

Aim. To clarify the specific manifestation of adaptive properties of the variety and their impact on plant growth and development to increase the gross grain yield of winter wheat.

Materials and Methods. In the course of the work, we used the general scientific methods: measuring and weight method – for determination of parameters of the yield structure elements and the grain yield; calculation-comparative method – for estimation of economic efficiency. For scientific substantiation of the purpose and implementation of the given tasks and generalization of experimental work results along with well-known methods some special methods were used: dialectical, hypothesis, synthesis, induction, statistical, observation, economic and mathematical methods.

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Results. In Western European countries, winter wheat yields have increased by 60 % over the past 25–30 years due to the introduction of new varieties. When the results of growing domestic strong varieties were evaluated, we state the fact that with the same technology, labor costs and funds and in similar soil and climatic conditions, they provide an increase in grain yield of only 20–25 % compared to foreign selection varieties. It is known that winter and drought hardiness, the duration of the growing season, plant height, resistance to diseases and pests significantly affect the grain yield of winter wheat varieties, product quality and resistance to environmental stressors.

It was proved that the main reasons for decreasing the winter wheat yield are plant damage in the autumn-winter season by low temperatures when a snow cover lacks, and a lapped ice crust, which is formed due an alternation between long-term thaws and frosts [2]. This issue is covered in the S. Popov's publications. In particular, for the last 100 years in the eastern Forest-Steppe and Steppe of Ukraine unfavorable wintering conditions were observed almost every third year. Their influence was particularly detrimental in 1928, 1932, 1934, 1956, 1960, 1964, 1967, 1969, 1972 and 2003 that caused the resowing area from 1.5 to 4.5 million ha in Ukraine.

Thus, for reduction of the negative influence of weather conditions, it is necessary to develop ecologically plastic varieties with high yield when growing in favorable conditions and keep yield stability in stressful conditions.

In order to increase the winter wheat yield and obtain high quality grain in an unstable climate and economic situation in the Steppe zone, it is advisable to introduce a differentiated approach to the varieties selection. In particular, many scientists consider that it is required to sow 3–4 varieties of different maturity groups with different agrobiological properties, and the share of sown areas of early–ripening and mid-late ripening varieties was 10–15 %, and mid-early ripening and mid-ripening – 30–45 % [5–9].

In arid conditions of the Steppe zone, considering the adaptive properties of varieties, it is advisable to grow such as: Bohunia, Oleksiivka, Donetska 48, Smuhlianka, Epokha odeska, Kiriia, Zolotokolosa, Blahodarka odeska, Bohdan, List 25, their grain yield varies within 5–7 t/ha in favorable years [2, 4] (Fig. 1).

Varieties of foreign selection are quite popular for study and implementation in the Steppe zone of Ukraine. Thus, at the Synelnykove Breeding and Research Station of the Institute of Agriculture of the Steppe zone of NAAS during 2009–2013, we studied Pegasus, Akratos, Astron varieties of German selection. At the same time, 34 domestic varieties of winter wheat were also studied on the landfill. Based on our research results, it was found that yield of foreign selection varieties compared to the average for domestic selection varieties was lower by 1.24, 1.62, 2.03 t/ha, respectively. The reasons for low yield of these varieties compared to domestic varieties were unsatisfactory winter hardiness, susceptibility to many diseases, late ripeness, which caused a lag for 7–14 days in the beginning of the heading stage, dough and full ripeness and lead to such negative phenomena as grain windburn and formation of unfilled and fine grain, and hence reduced yield [4].

It should be noted that the potential productivity of different varieties is implemented quite unevenly, as it largely depends on weather conditions. High-yielding varieties remove much more nutrients and moisture from the soil, so they require high cultivation techniques (placement after the best predecessors, observation of optimal sowing dates, application of sufficient nutrients, proper moisture supply, etc.). When such conditions absent, a potentially more productive variety can reduce grain yield and is inferior to less productive variety but more plastic and undemanding to growing conditions.

According to M. M. Solodushko, due to adverse weather conditions in 2012 (prolonged autumn drought, late sowing, placement after nonfallow predecessors) winter wheat plants of Podiaka, Scarbnytsia and Zolotokolosa varieties began wintering before the tillering stage, at 1–3 leaves stage. With the growth resumption in spring, plants lost a significant vegetative mass, in addition, a large number of them died (from 20 to 60 %), as a result, grain productivity of varieties was lower by 20–40 % (only 0.71–1.21 t/ha) compared to standard varieties [4].

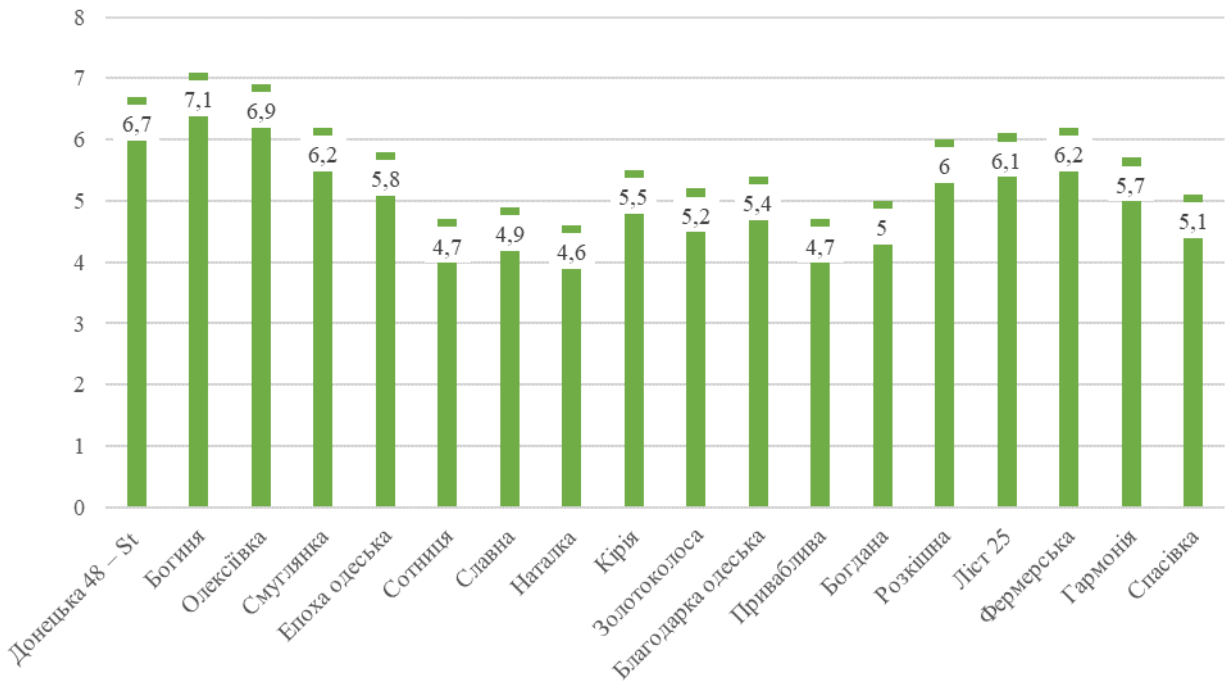

Fig. 1. Grain yield of different varieties of winter wheat in arid conditions of the Steppe zone depending on their adaptive and plastic properties, t/ha.

When researches were conducted in 2016–2018 at the Kirovohrad Variety Research Station, we stated that it is advisable to cultivate in the Steppe zone considering the adaptability indicators such varieties as: Smuhlianka, Lymarivna, Oriika, Mudrist Odeska, Askaniiska. They are characterized by sufficient frost, winter and drought resistance, and the average grain yield in the research years was 5.31 t/ha (Smuhlianka), 6.04 t/ha (Lymarivna), 6.08 t/ha (Oriika), 5.84 t/ha (Mudrist Odeska), 6.90 t/ha (Askaniiska) (Fig. 2) [15].

According to S. M. Kalenska, it is found that extreme weather conditions are the basis for the development of varietal adaptive technologies for winter wheat cultivation. In the zone of unstable and insufficient moistening in years with dry spring due to the impossibility of full nitrogen absorption by plants, it is needed to optimize nitrogen nutrition. This study also highlighted the problems of shortage of winter wheat grain yield due to lodging plants on high nitrogen nutrient backgrounds, so to avoid this and potentially maintain high yields of Capo, Poliska 90 and Josef varieties at 6–7 t/ha, it is recommended to use retardants. [19].

High-intensive varieties are characterized by significant natural productivity potential (over 10 t/ha), high quality of food grain and improved morphobiological properties. They are mostly short-stemmed with thickened culm, and they are characterized by high resistance to lodging, increased nutrients absorption, consequently, high yields, but require the introduction of appropriate agricultural technologies. The following varieties can be included in the new high-intensive and intensive groups: Spasivka, Lymarivna, Kniahynia Olha, Lastivka Odeska, Nebokrai, Shchedra Nyva, Kalyta, etc.

Semi-intensive varieties are characterized by slightly lower productivity potential, but they have the high adaptive properties (frost, winter, and drought resistance and regenerative capacity after adverse growing conditions). Plastic varieties include such as: Komertsiina, Statna, Holubka Odeska, Pylypivka, Vatazhok, Zluka, Charodiika Bilotserkivska.

Plastic varieties of winter wheat consistently form high yield in different weather conditions (both in optimal and in later sowing dates) due to better regenerative capacity in the early spring. Postponement of sowing dates to later dates is due to organizational reasons or autumn droughts, when the top layer of soil is dry and it is impossible to conduct a sowing campaign in a timely manner. In such cases, it is better to sow the semi-intensive varieties or varieties of alternate wheat – Khutorianka or Zymoiarka.

High resistance to negative factors, including droughts and droughts, and at the sam

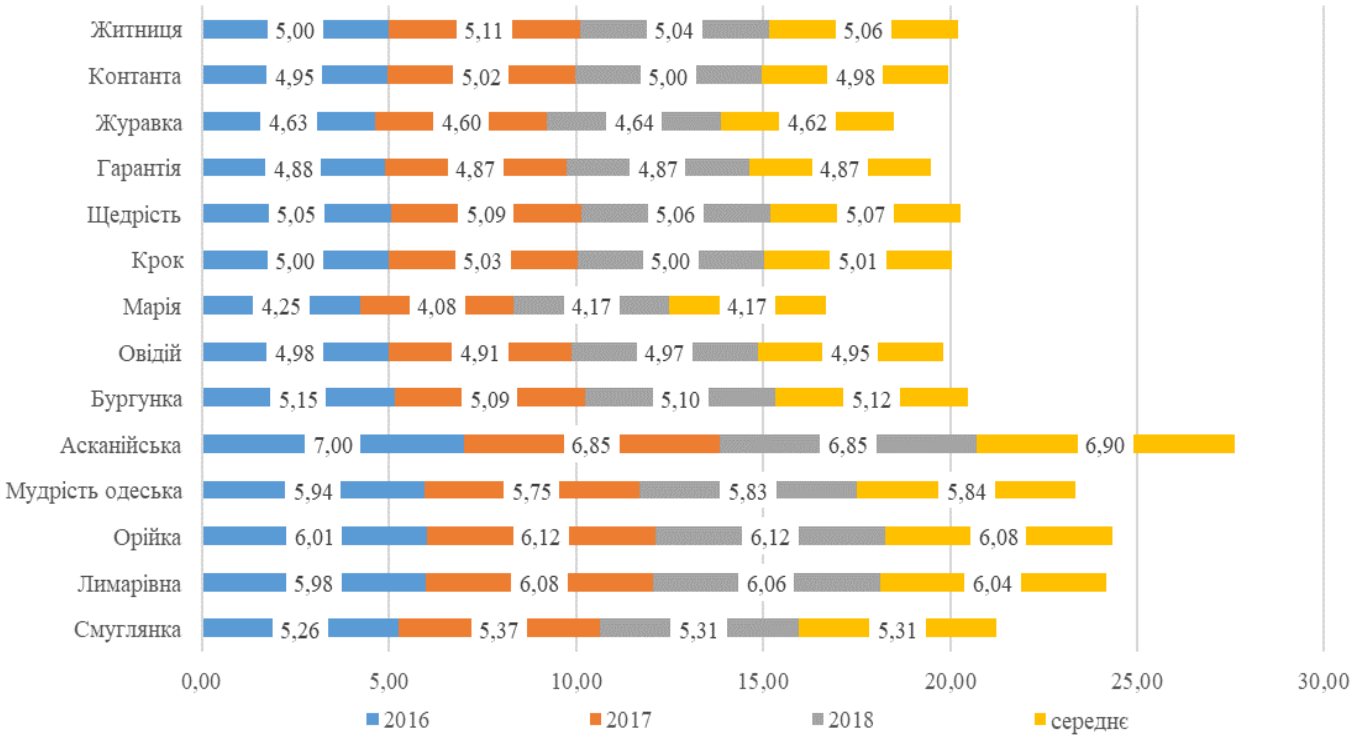

Fig. 2. Yield of winter wheat varieties in the Steppe zone depending on adaptability (2016–2018)

time ability to form a fairly high yield is characteristic of such varieties as: Koleha, Lebed, Kniahynia Olha, Lastivka Odeska, Zorepad, Pylypivka, Nebokrai, Spasivka, Lazurna, Lymarivna, etc.

The development and spread peculiarities of powdery mildew and brown rust on winter wheat plants in the Steppe zone of Ukraine in 2009–2011 were studied. Research showed that a high resistance to these diseases was found in such varieties as: Lebed, Blaho, Statna, Kniahynia Olha, Lastivka Odeska, Spasivka, Lymarivna, Shchedra Nyva. The plant leaf surface of these varieties remains intact during long time, so the process of assimilation is prolonged, which leads to increase grain productivity (Fig. 3) [14].

In addition to varietal characteristics, the winter wheat yield is influenced by such an important factor as the sowing dates. According to the research of many scientists, in the arid conditions with moisture deficit, the optimal and acceptable sowing dates of modern varieties of winter wheat in the Steppe zone should be shifted to later period when the soil moisture is sufficient [12, 13]. Also, in the South of Ukraine, the later sowing dates of wheat is due to the expansion of sowing areas of such atypical crops as sunflower, maize and soybean, which are harvested at a later dates.

The genotypes with intensive growth and development, good tillering and sugars accumulation not less than 30 % in the tillering nodes at the growth arrest in autumn are preferred for late sowing. Such sugar content in tillering nodes is required for high frost resistance of wheat plants in the early stages of overwintering. According to M. A. Lytvynenko's analytical research, they are characterized by a winter type of development, but the term of vernalization is short (less than 20 days), and by low sensitivity to the day length (delay of heading stage up to 10 days in a short day). Such genotypes were obtained by crossing winter varieties with spring ones, but their main disadvantage is the unsatisfactory level of winter hardiness [16].

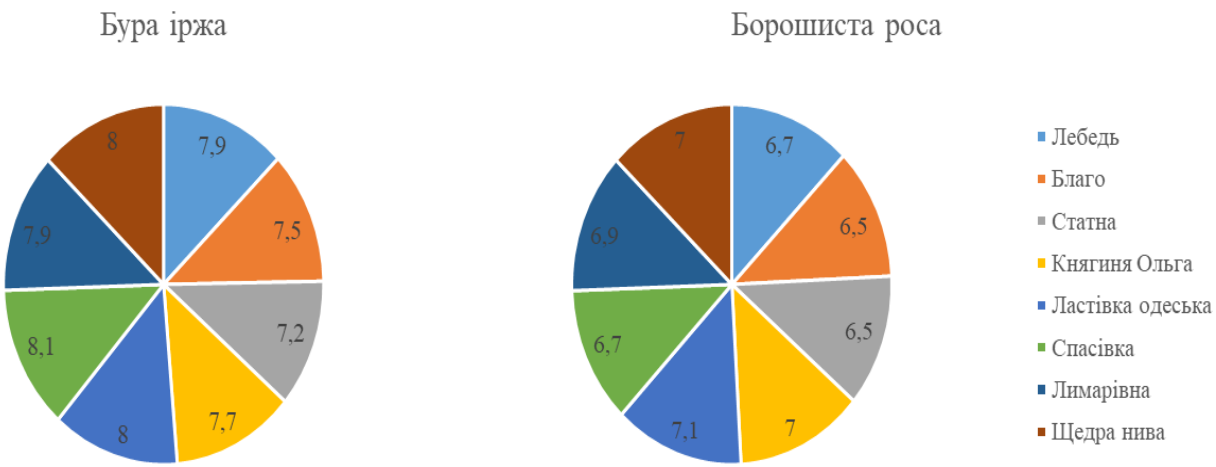

Fig. 3. Characteristics of collection cultivars of soft winter wheat on resistance to leaf and stem diseases, points (2009–2011).

Conclusions

We draw the following conclusions based on the research of Ukrainian and foreign scientists for the adaptive property peculiarities of varieties to increase yield and gross grain yield of winter wheat: varieties of foreign selection it is advisable to sow 3–4 varieties of different maturity groups with different agrobiological properties, for which later sowing dates are possible. High-intensity varieties have a higher yield potential, but they do not have stable adaptive properties, which is paramount. Considering the climate change, plastic varieties should be preferred.

An important element in improving agricultural technologies for growing winter wheat in the eastern part of the Northern Steppe is the genetic potential of modern varieties, namely their adaptive properties, as it is an important factor in increasing yields by 11–50 % and thus increasing gross grain yield. In particular, plastic varieties form a stable high yield under different weather conditions, due to their genetic adaptation to stress. The preference should be given to winter wheat varieties of Ukrainian selection with different maturity groups, and the share of sown areas of early ripening and mid-late ripening varieties should be 10–15 %, and midearly ripening and mid-ripening – 30–45 %.

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