



Sources of resistance to diseases of soft winter wheat (*Triticum aestivum* L.)

Oksana Chetveryk¹, Alla Bahan¹, Svitlana Yurchenko¹, Svitlana Shakaliy^{1*}, Anna Zviahintseva²

¹ Poltava State Agrarian Academy, Skovorody Str, Poltava, Ukraine

² The Plant Production Institute Nd VYa Yurieva of Naan, Moskovskiy Ave, Kharkiv, Ukraine

Abstract

The research aiming to identify the sources of group resistance to the main diseases of soft winter wheat was carried out during the period of 2016-2020 in the Eastern Ukraine. Among the main pathogens, the resistance of varieties to septoria blight, hard smut, powdery mildew and tan spot or yellow spot was investigated. On infectious and provocative backgrounds, the sources with stable manifestation of trait of disease resistance under different meteorological conditions were identified according to the hydrothermal coefficient. The sources characterized by individual and group resistance (7 scores) and high resistance (8 points) to tan spot, septoria blight, powdery mildew and hard smut were identified. 35 varieties of soft winter wheat with individual resistance and 12 varieties with group resistance to diseases were selected. Varieties of soft winter wheat L 77-19, Koshova and Krasa Laniv were singled out. They are valuable as the sources with high yield and grain quality and complex resistance to diseases. During the research period, 12 sources with group resistance to diseases were identified: L 139-03 (resistance to hard smut and powdery mildew); L 165-02, LUV 148, Dobirna, Koshova, Ilona and Matrix (resistance to tan spot and powdery mildew); L 77-19, L 77-27 and Darunok Podillia (resistance to tan spot and hard smut); Krasa Laniv (resistance to tan spot, hard smut and powdery mildew); Figura (resistance to septoria blight, tan spot and powdery mildew). Among the sources with group resistance to diseases, the varieties of soft winter wheat L 139-03, L 165-02, L 77-19, LUV 148, Koshova, Krasa Laniv and Figura were characterized by high productive potential, the average yield of these varieties was over 800 g/m².

According to grain quality of soft winter wheat, the varieties with group resistance can be singled out: by protein content in grain – Darunok Podillia, L 165-02, L 77-19, L 77-27, Krasa Laniv and Matrix (over 13.5%); by gluten content – L 165-02, L 77-19, L 77-27, Krasa Laniv and Matrix (over 29%); by the quality of gluten – L 139-03, Koshova and Krasa Laniv (less than 76 units), which belong to the first quality group.

Keywords: infectious background, septoria blight, tan spot, powdery mildew, hard smut

Introduction

Soft winter wheat (*Triticum aestivum* L.) is one of the most productive and valuable food crops. This crop is gaining an increased importance in the state balance of Ukraine and the world. Pathogenic organisms endanger the wheat from the moment of sowing to harvesting, and even after that. The value of variety is a decisive factor for obtaining high and stable yields under intensification of agricultural production. The main attention should be paid to the creation of new highly productive varieties and hybrids of crops, adapted to growing conditions, resistant to pathogens and pests (Kovalyshyna *et al.*, 2018; Tryhub *et al.*, 2020) ^[1, 2].

It is known that in Ukraine, there is the annual yield shortfall because of the harmful effects of pathogens and pests is 12-14%. The most common and harmful diseases of winter wheat are hard smut, septoria blight, powdery mildew, tan spot, or yellow spot.

In recent years, the helathsituation in winter wheat crops on the territory of Ukraine has changed slightly. A number of factors contributed to this. Firstly, for several years in a row, there have been rather extreme conditions for the autumn sowing campaign: sowing in dry soil and lack of moisture during the emergence of winter crops. Secondly an early renewal of vegetation, a gradual temperature increase, its sharp fluctuations during the day and spring frosts have been taking place throughout Ukraine in recent years. As a result, winter grain crops form additional stems in spring

and due to this we have good yields. But weakening of plants at the initial stage and under spring extreme conditions leads to a weakening of crops and, as a consequence, to change of the usual phytopathological balance of pathogens (Retman *et al.*, 2011) ^[3]. Today, among the leaf spot of wheat, septoria blight takes one of the first places in terms of harmfulness and distribution and is one of the most progressive diseases in Europe and in the world. Septoria blight develops in two stages: anamorph-*Septoria tritici*, teleomorph – *Mycosphaerella graminicola* (Fuckel) J. Schröt. In Cohn. All aboveground plant organs are affected. The first signs are observed on the coleoptile in the form of separate brown spots. The pathogen can affect an ear. The infection sources are plant residues, seedlings and seeds. The disease develops especially intensively under conditions of frequent precipitation, temperatures at a level of 20-25°C and moderate wind. The incubation period range from 6 to 25 days depending on weather conditions. Insufficient moisture in spring and following summer months can reduce the spread of the disease. The potential yield losses can reach 15-50% depending on a level of the phytopathogen development (Retman, 2010; Sukhomud, 2013; Mukha and Zaima, 2013; Zadoks, 2004) ^[4, 5, 6, 7].

The harmfulness of the disease is that significant changes in physiological and biochemical processes take place in the affected plant. The main indicators of yield structure are deteriorated under the influence of the disease. The yield

shortfall can reach up to 30% or more (Retman, 2010; Sukhomud, 2013; Mukha and Zaima, 2013; Zadoks, 2004) [4, 5, 6, 7]. Tan spot or yellow spot is also a common and harmful disease in all wheat growing areas. It develops in two stages: teleomorph - *Pyrenophora tritici-repentis* and anamorph - *Drechslera tritici-repentis*. The beginning of intensive development and spread of the disease occurs during the period of ear formation - the beginning of flowering of winter wheat. Symptoms of ascospore formation on the leaves appear in the form of rounded spots of bright yellow color with a diameter of 2-5 mm (Stankevych *et al.*, 2020) [8].

The epidermis rises slightly in the center of the spot. In the future, the spots may grow in the longitudinal direction, acquiring the irregular shapes and color of the drying tissue. With a secondary infection of plants with conidia, dark brown oval spots are formed on the leaves, growing and leading to drying of the leaves. In addition to leaves, leaf sheaths, stems and spikelets can also be affected, where the symptoms are in the form of small dots or lines, do not grow. Increased attention to tan spot in recent decades has been connected with significant disease damage. The loss of grain during the epiphytotic development of the disease can reach 40-60%. This is due to a decrease in grain weight and a decrease in the number of grains in an ear (Stankevych *et al.*, 2020) [8].

Powdery mildew (*Blumeria graminis* (DC.) Speerf. sp. *Tritici* March) (teleomorph - asci with ascospores, anamorph - conidia) mainly affects winter wheat varieties with a high yield potential, as well as crops with high stem density. Visual signs of the disease appear at the early stages of organogenesis. Plants are affected at a temperature of 0 to 20°C and a relative humidity of 50-100%. The harmfulness is primarily manifested in a decrease of the assimilative surface of leaves and the destruction of chlorophyll. There is a direct impact on the effectiveness of photosynthesis in a plant. Bushiness and the number of productive shoots are reduced because of pathogenic effect on the plant. The intensive crops damage in autumn slows down the development of root system and plants overwinter poorly. In some years, the loss of plants in wheat crops due to the harmfulness of the disease is 15-30% (Holiachuk Kosylovych, 2019; Osmachko and Vlasenko, 2015) [9, 10].

Hard smut (*Tilletia tritici* Tul.) (teleomorph - teliospores, anamorph - basidiospores) is a widespread disease in winter wheat crops. The most disease symptoms appear at the beginning of the period of milky ripeness of grain. Signs of the disease are: slightly flattened ear of intense green color with a blue tint, spikelets in an ear unnaturally loosened, chaff is open.

The harm of hard smut is caused by a yield decrease, both as a result of the formation of spore mass instead of grain in an ear, and thinning of crops, because of the death of affected plants. Affected plants are usually lower in height than healthy plants due to shortening of internodes (Kyrychenko *et al.*, 2012) [11].

Concealed yield losses are caused by a 30-40% decrease in the productivity of the aboveground part of the plant, a 15-20% reduction in the size of the stem and ear, compared with uninfected plants; fewer grains are formed in an ear by 10-15% and the weight of 1000 grains decreases (Kyrychenko *et al.*, 2012) [11].

An important task in the breeding of soft winter wheat is to create varieties with comprehensive resistance to diseases

and pests. Breeders use the theoretical achievements of immunologists to determine the mechanisms of plant resistance. The transfer of resistance genes in the breeding of new varieties and hybrids provides control over the resistance trait that does not require any chemical treatments. And this, in turn, improves the environmental situation.

The peculiarity of disease resistance selection is that new genotypes as donors can quickly lose this ability due to changes in virulence of pathogen and weather conditions (Luchna, 2014) [12]. Therefore, there is a need to constantly search for new sources of resistance to pathogens, which is relevant and requires further study of genofond (Kyrychenko *et al.*, 2012) [11].

The effectiveness of breeding for immunity depends on the availability of comprehensively studied source material and a scientifically based approach to its use. The main components of the method for creating such material are regular monitoring of the pathogenic complex, morphological and physiological properties of populations of particularly dangerous species of pathogens, objectivity in assessing the immunological properties of varieties and hybrids, establishing relationships in the plant-host-pathogen system, identifying and selecting highly effective, adapted to zonal conditions, sources and donors (Morhun *et al.*, 2014) [13].

The forms which are characterized by resistance at the early stages of development and retain it during the growing season are of practical interest for breeding for immunity (Kovalyshyna, 2011) [14].

Therefore, it is important that disease resistance is combined with high productivity and good grain quality. Accordingly, the forms identified according to a complex of traits by years with a strong development of the disease are the most valuable for breeding (Demydov *et al.*, 2019; Leonov *et al.*, 2013; Basalii *et al.*, 2020) [15, 16].

Materials and Methods

The research material was 54 collection varieties of soft winter wheat from 12 countries of the world: Ukraine, Romania, Switzerland, Slovakia, Russia, Turkey, Poland, Sweden, the Netherlands, Croatia, France and Germany. The research was carried out during the period of 2016-2020 at the Plant Production Institute Nd.V.Ya. Yurieva National Academy Agrarian Sciences of Ukraine in the eastern part of Ukraine (temperate-continental climate with elevated temperatures and unevenly distributed precipitation during the spring-summer period). The collection material was studied in an infectious nursery on infectious and provocative backgrounds for powdery mildew, septoria blight, tan spot and hard smut. The predecessor crop was pea. Crop was sown in the optimal terms – the second half of September. Each sample was sown in three repetitions with plot size of 1 m², with a row spacing of 15 cm. The seeding rate was 3,800,000 seeds per hectare. The standard was a mid-season high-intensity soft winter wheat variety Darunok Podillia. Creation of artificial infectious and provocative backgrounds, recordings of plant damage were performed according to the generally accepted methods (UIPVE, 2016) [18]. Spore material collected from varieties, zoned for this area was used for the artificial background of hard smut. Provocative backgrounds of leaf diseases were created by sowing the varieties susceptible to infection along the experimental plots and adjusting the sowing terms.

The studied indicators were determined from a sample of 25 plants. Diseases on plants were determined visually on a nine-point scale according to the methods.

The results of laboratory and field studies: yield (g/m²), protein and gluten content (%), gluten quality (units) were analyzed in accordance with the method of B.A. Dospekhov (Dospekhov, 1985) ^[19] using statistical analysis packages ANOVA. Yield was determined in the field conditions in four repetitions. In the laboratory, grain quality indicators (protein content, gluten content, gluten quality) were determined in two repetitions. The following indicators were determined: hydrothermal coefficient (HTC) and coefficient of variation (V).

Hydrothermal coefficient (HTC) was determined by the formula:

$$HTC = \frac{\sum R + 10}{\sum t > 10^{\circ}} \quad (1)$$

$\sum R$ -precipitation amount, mm,

$\sum t > 10$ -sum of active temperatures.

Coefficient of variation (V) was determined by the formula:

$$V = \frac{s}{x} * 100, (\%) \quad (2)$$

S-standard deviation,

X-Arithmetic mean (Dospekhov, 1985; Maruhnayak *et al.*, 2010) ^[19, 20].

Results

Having analyzed the results of immunological studies of soft winter wheat, the differences in the weather conditions of the growing season of the crop by years were revealed. The hydrothermal coefficient (HTC) confirmed this as well. According to HTC, the largest deviations from the long-run annual averages towards the significant overwetting were observed in May 2016 and 2020, April 2017 and July 2016 and 2020 (HTC>1.3).

April 2016 and 2019, May 2019, June 2020 were optimal in terms of humidity (HTC 1.0–1.3). Other months were arid by years (Fig. 1).

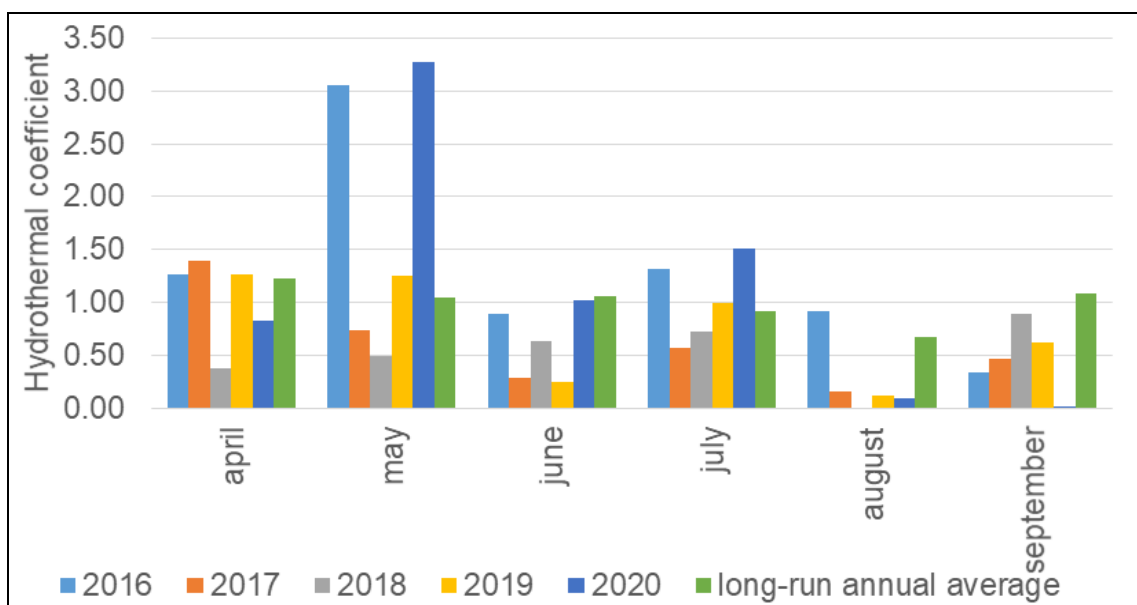


Fig 1: Hydrothermal coefficient throughout the research years (2016–2020)

The temperature indicators exceeded long-term annual average in the research years. April-May 2017 and 2020 and July 2019, September 2016, on the contrary, were lower in terms of the average monthly air temperature.

Over the research years, significant fluctuations in the amount of precipitation were observed compared to the long-term annual averages. The driest were: September 2016 (33% of the norm), June and August 2017 (28% and 26% of the norm), April 2018 (38% of the norm), June and August 2019 (30% and 19%), August and September 2020 (14% and 2% of the norm). August 2018 was marked by a complete absence of precipitation. The highest amount of precipitation was observed in May 2016 and 2020 (296% and 274% of the norm). The levels of infectious backgrounds of powdery mildew, septoria blight, tan spot and smut diseases in the research years, in most cases, were sufficient to differentiate varieties resistance (Tab. 1).

Table 1: The level of infectious background of soft winter wheat diseases (*Triticumaestivum* L.) (average for 2016-2020)

Year	The background level, %			
	Septoria blight	Tan spot	Hard smut	Powdery mildew
2016	40	40	59	10
2017	100	100	96	65
2018	25	25	65	25
2019	10	65	68	10
2020	85	25	67	40

The level of infectious background of wheat diseases was determined from a sample of 25 plants in four repetitions in terms of percentage. Over the research years, susceptibility of soft winter wheat varieties to the pathogen of septoria blight was 25-100%. The exception was 2019, when the level of infectious background was 10%.

Susceptibility of soft winter wheat varieties to the pathogen of tan spot ranged from 25% to 100%.

Susceptibility of wheat varieties to the pathogen of hard smut was 59-96%.

Soft winter wheat varieties showed the highest resistance to the pathogen of powdery mildew from 25% to 65%. The exceptions were 2016 and 2019 with an infectious background level of 10%.

The phytosanitary conditions of soft winter wheat crops in the summer of 2017 was characterized by a significant development of leaf spots, smut diseases and powdery mildew on winter wheat plants.

The sources of individual and group resistance to the main pathogens of soft winter wheat diseases were identified according to the results of long-term research (each sample was studied for five years) (Tab. 2).

Table 2: Sources of individual and group resistance of soft winter wheat (*Triticum aestivum* L.) to diseases (average for 2016–2020)

№	Variety	Origin of variety	Resistance to diseases, score				Comprehensive assessment of resistance to diseases, score
			Septoria blight	Tan spot	Hard smut	Powdery mildew	
1.	Darunok Podillia (st)	UKR	4	8	7	5	6.0
2.	L 103*-25 KA	UKR	4	8	5	4	5.3
3.	L 137-26	UKR	5	5	6	5	5.3
4.	L 139-03	UKR	5	4	8	7	6.0
5.	L 145-0-5	UKR	5	6	5	6	5.5
6.	L 159-07	UKR	5	8	5	6	6.0
7.	L 163-02	UKR	5	5	4	7	5.3
8.	L 165-02	UKR	5	8	4	8	6.3
9.	L 168-27	UKR	4	8	5	3	5.0
10.	L 77-19	UKR	5	8	7	4	6.0
11.	L 77-27	UKR	5	8	7	4	6.0
12.	LUV 148	UKR	4	8	4	8	6.0
13.	Berehynia Myronivska	UKR	4	8	4	6	5.5
14.	Harmonika	UKR	4	8	8	6	6.5
15.	Horlytsia Myronivska	UKR	4	8	4	6	5.5
16.	Hospodynja Myronivska	UKR	5	8	4	5	5.5
17.	Dobirna	UKR	4	8	3	7	5.5
18.	EP 864-10	UKR	4	8	5	6	5.8
19.	Zhytnytsia Odeska	UKR	5	8	5	6	6.0
20.	Zdobna	UKR	5	6	3	6	5.0
21.	Koshova	UKR	4	8	5	8	6.3
22.	Krasa Laniv	UKR	5	8	8	7	7.0
23.	JIC 252-13	UKR	5	7	4	6	5.5
24.	Metalist	UKR	5	8	3	6	5.5
25.	Moskal	UKR	4	5	4	6	4.8
26.	Novosmuhlianka	UKR	4	8	5	6	5.8
27.	Obriad	UKR	5	8	4	5	5.5
28.	OHD 82	UKR	5	5	4	6	5.0
29.	Oriika	UKR	5	8	5	6	6.0
30.	PSV 63	UKR	4	8	3	5	5.0
31.	Raiska	UKR	4	8	4	6	5.5
32.	Ustyvytsia	UKR	4	8	4	5	5.3
33.	Nikifor	ROU	5	8	6	6	6.3
34.	Simano	CHE	5	8	5	6	6.0
35.	Viglanka	SVK	5	8	5	6	6.0
36.	Dyvo	UKR	5	6	4	7	5.5
37.	Metelytsia	UKR	5	5	2	7	4.8
38.	Dizhon	UKR	5	7	2	6	5.0
39.	Valensiia	UKR	4	3	2	7	4.0
40.	Raihorodka	UKR	7	6	2	4	4.8
41.	Polisianka	UKR	5	4	2	8	4.8
42.	Zorepad Biloserkivskyi	UKR	5	3	2	7	4.3
43.	Nasnaga	UKR	4	7	2	6	4.8
44.	Askaniiska	UKR	4	7	2	4	4.3
45.	Kazachka	RUS	4	5	2	5	4.0
46.	Veha	RUS	4	5	2	5	4.0
47.	Fotima	TUR	4	6	3	6	4.8
48.	Ilona	SVK	4	7	5	7	5.8
49.	Figura	POL	7	7	2	8	6.0
50.	Toras	SWE	4	6	2	7	4.8
51.	Manella	NLD	4	7	2	5	4.5
52.	Annitsa	HRV	3	8	3	5	4.8
53.	Bodycek	FRA	2	2	2	8	3.5
54.	Matrix	DEU	5	8	2	8	5.8

According to the research results, varieties of soft winter wheat with a resistance score of 9 to leaf diseases and hard smut were not revealed. The sources which are characterized by individual and group resistance (7 scores) and high resistance (8 scores) to tan spot, septoria blight, powdery mildew and hard smut were identified, in particular:

- -source of individual resistance to septoria blight-Raihorodka;
- -sources of individual resistance to tan spot – LS 252-13, Dizhon, Nasnaha, Askaniiska, Manella, L 103*-25 KA, L 159-07, L 168-27, Berehynia, Harmonika, Horlytsia, Hospodynia, EP 864-10, Zhytnytsia Odeska, Metalist, Novosmuglianka, Obriad, Oriika, PSV 63, Raiska, Ustyvytsia, Nikifor, Simano, Viglanka, Annitsa;
- source of individual resistance to hard smut – Harmonika;
- sources of individual resistance to powdery mildew – L 163-02, Dyvo, Metelytsia, Valensiia, Zorepad, Toras,

Polisianka, Bodycek;

- source of group resistance to hard smut and powdery mildew (*Erysiphegraminis*) – L 139-03;
- source of group resistance to tan spot (*Pyrenophoratrifici-repentis*) and powdery mildew – L 165-02, LUV 148, Dobirna, Koshova, Ilona, Matrix;
- sources of group resistance to tan spot and hard smut – L 77-19, L 77-27;
- source of group resistance to tan spot hard smut and powdery mildew – Krasa Laniv;
- source of group resistance to septoria blight tan spot and powdery mildew – Figura. Therefore, 35 sources with individual resistance and 12 sources with group resistance to soft winter wheat diseases were identified during the research period.

The varieties with group resistance to disease and a combination of valuable economic traits are the most valuable for the creation of new source material (Tab. 3).

Table 3: Characteristics of soft winter wheat (*Triticum aestivum* L.) varieties with group resistance to diseases according to economically valuable traits (average for 2016–2020)

№	Variety	Comprehensive assessment of resistance to diseases, score	Yield, g/m ²	Protein content in grain, %	Gluten content, %	Gluten quality, units.
1.	Darunok Podillia (st)	6.0	792.5	13.8	29.0	78
2.	L 139-03	6.0	805.5	12.2	25.2	62
3.	L 165-02	6.0	862.6	13.8	29.4	87
4.	L 77-19	6.3	812.8	13.9	29.8	79
5.	L 77-27	6.0	796.4	14.0	30.1	80
6.	LUV 148	6.0	818.0	13.5	28.8	83
7.	Dobirna	5.5	713.5	13.3	28.2	88
8.	Koshova	6.3	849.3	13.5	28.5	71
9.	Krasa Laniv	7.0	912.4	14.3	30.8	75
10.	Ilona	5.8	768.3	12.7	27.6	76
11.	Figura	6.0	809.7	13.0	27.0	83
12.	Matrix	5.8	773.2	14.0	30.5	96
By group of study						
arithmetic mean (X)			809.5	13.5	28.7	80
min			697.4	11.6	24.3	60
max			928.9	14.6	31.2	98
variation coefficient (V, %)			16.9	5.0	5.7	11.5

The yield (g/m²) and indicators of grain quality: protein content in grain (%), content (%) and quality of gluten (units) of selected varieties with group resistance to diseases were also studied.

According to the average data, the complex assessment of disease resistance of the selected samples scored 5.5-7.0. Varieties 77-19, Koshova, Krasa Laniv (scored more than 6) were distinguished according to this indicator.

The yield of the experimental material ranged from 697.4 to 928.9 g/m² (809.5 g/m² – average in the group). The varieties of soft winter wheat L 139-03, L 165-02, L 77-19, LUV 148, Koshova, Krasa Laniv and Figura had high productive potential, the average yield of these varieties was over 800 g/m² with an average level of variation (V = 16.9%).

It is necessary to take into account not only productivity but also quality indicators while selecting new sources of soft winter wheat. Protein content in wheat grain is also important indicator, which was 11.6-14.6% (group average – 13.5%) over the testing years. A stable manifestation of this trait was found with a low coefficient of variation (V) of

5.0%. Gluten content varied slightly from 24.3 to 31.2% (group average – 28.7%) with a low coefficient of variation of 5.7% during the period of 2016-2020.

The quality of gluten range from 60 to 98 units (average for the group – 80 units). The coefficient of variation was higher and amounted to 11.5%.

The varieties can be selected by grain quality of soft winter wheat as follows:

-by protein content in grain – Darunok Podillia, L 165-02, L 77-19, L 77-27, Krasa Laniv and Matrix (over 13.5%);

-by gluten content – L 165-02, L 77-19, L 77-27, Krasa Laniv and Matrix (over 29%);

-by the quality of gluten - L 139-03, Koshova and Krasa Laniv (less than 76 units), which belong to the first quality group.

Discussion

Based on the research results, the assessment of varietal material of soft winter wheat was carried out both in order to create a new source material and to be used in the

production conditions. For this purpose, the resistance of soft winter wheat varieties to such main diseases as septoria blight, tan spot, hard smut and powdery mildew was studied. The sources of individual and group disease resistance were identified. A comprehensive assessment of the selected samples that had group resistance to diseases was a final indicator.

In addition, we studied the varieties of soft winter wheat with group resistance according to the manifestation of economically valuable traits.

Yield is an important indicator for assessing breeding material and production needs. This is the main trait of the variety characteristics both in production conditions and in breeding work. The potential yield enables to determine the area of use of the variety depending on growing conditions. Study on indicators of grain quality is important for soft winter wheat as well. For wheat varieties, the protein content is one of the main traits since the technological properties of grain are determined not only by the amount but also the quality of protein which depend on genotype and growing conditions. The rheological properties of the dough mainly depend on the gluten content, as its content is also an important factor in the mixing strength of flour. In contrast to gluten content, its quality is determined by a combination of the following physical properties: elasticity, resilience, extensibility, viscosity, as well as the capacity to keep these properties in the process of making bread.

The indicator of gluten quality underlies the division of wheat into classes according to the strength of flour along with the indicators of gluten and protein content.

Therefore, study of the varietal composition of soft winter wheat of different ecological and geographical origin makes it possible to assess these varieties according to the economically valuable traits and recommend them for use as the initial forms for breeding as well as for cultivation in agricultural production.

Optimal conditions for growing disease-resistant varieties of soft winter wheat were identified on the basis of a HTC level during the growing season over the research years.

Among the sources with group resistance to diseases, varieties L 139-03, L 165-02, L 77-19, LUV 148, Koshova, Krasa Laniv and Figura had high productive potential under optimal growing conditions. These samples are able to form a high yield with an average level of this trait variation.

Varieties Darunok Podillia, L 165-02, L 77-19, L 77-27, L 139-03, Krasa Laniv, Matrix and Koshova have group resistance to diseases and high grain quality indicators with a stable manifestation of these traits.

Conclusion

A comprehensive assessment of a wide diversity of soft winter wheat varieties of different ecological and geographical origin allowed to identify sources with individual and group resistance to the main diseases – septoria blight, tan spot, hard smut and powdery mildew. 12 sources with group resistance to diseases were identified: L 139-03 (resistance to hard smut and powdery mildew); L 165-02, LUV 148, Dobirna, Koshova, Ilona and Matrix (resistance to tan spot and powdery mildew); L 77-19, L 77-27 and Darunok Podillia (resistance to tan spot and hard smut); Krasa Laniv (resistance to tan spot, hard smut and powdery mildew); Figura (resistance to septoria blight, tan spot and powdery mildew). Varieties of soft winter wheat L 77-19, Koshova and Krasa Laniv had high complex

resistance to diseases, as well as grain yield and quality. Selected sources are recommended to be used to create new breeding material.

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