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THE STRUCTURE OF THE WORLD COLLECTION OF WINTER SOFT WHEAT IN TERMS OF DISEASE RESISTANCE IN THE SOUTHERN FOREST-STEPPE OF UKRAINE

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Abstract

To prevent crop losses from pathogens, new varieties with a broad genetic basis of group resistance should be introduced into the production process. The purpose of research was to describe the collection of soft winter wheat in terms of resistance to the most common diseases in the conditions of the southern forest-steppe of ukraine. 1406 samples of soft winter wheat (Triticum aestivum L.) From 33 countries were taken for research. The significant influence of the amount of precipitation and the level of hydrothermal coefficient (HTC) on the indicator of the number of susceptible samples of wheat to specific pathogens of soft winter wheat was established. Selection work has significantly influenced the creation of more stable varieties in recent years compared to the 70's of the twentieth century. The method of remote hybridization using foreign genes helps to obtain lines more resistant to specific pathogens of soft winter wheat. Creating a special collection of samples resistant to the most common diseases of soft winter wheat allows you to systematize the selection of parental lines on specific grounds.

Key words: *collection of winter wheat, diseases, meteorological conditions, remote hybridization method, resistance.*

INTRODUCTION

The immunological properties of many varieties of winter wheat are lost due to the emergence of new races and pathotypes of the main pathogens. Yield losses from diseases, which are one of the many factors of grain shortages, amount to 15-32% annually, and with epiphytoties – 50% or more. To prevent crop losses from pathogens, new varieties with a broad genetic base of group resistance should be introduced into the production process. This allows these varieties to be used longer in intensive production without the use of chemical protection agents and to obtain a significant economic effect, as well as reduce the negative impact of agricultural production on the environment. The success of selection work in this area largely depends on the attraction and use of new source material with the best indicators of resistance to pathogenic factors. In this regard, the gene pool of the collection of the National Center for Plant Genetic Resources of Ukraine (NCPGRU) is of decisive importance. The world collection of winter wheat of the NCGRRU, constantly replenished with new samples, requires careful study for resistance to the main pathogens. A comprehensive study, analysis and systematization of the collection material of wheat will allow obtaining new sources of stability and creating a sign of the collection, which in turn will greatly increase the status of the national collection of the NCPGRU. All this determines the relevance of research and is of undoubted scientific and practical interest.

The analysis of recent publications has shown the constant attention on the part of domestic and foreign wheat breeders to the problem of finding resistant forms of winter wheat in the collections of genetic resources in order to create resistant varieties suitable for cultivation in various ecological zones of Ukraine.

During 2001-2004 scientists of the sector of genetic resources of cereal crops of the Plant Production Institute named after V.YA. Yuriev of National Academy of Agrarian Sciences of Ukraine studied 602 accessions of wheat, of which 403 were soft winter wheat and 15 were hard winter wheat. A catalog was issued containing information on wheat samples resistant to pathogens (Leonov, 2004; 2005).

Disease-resistant soft wheat source material originated mainly from Ukraine, Russia, Hungary, Serbia, Bulgaria, Romania, Austria, Turkey, Kyrgyzstan, China, Canada, USA and Mexico. From the isolated material, 10 soft winter wheat lines resistant to hard soot were created (Leonov & Streltsova, 2004; Rabinovich, 1972).

Researchers of the laboratory of resistance to biotic factors of the Plant Production Institute named after. V.Ya. Yuryeva NAAS in the period from 2004 to 2008 conducted research on the resistance of 312 varieties of winter wheat to the causative agent of leaf septoria (*Septoria tritici* Desm.) and identified 8 samples as a source of moderate resistance to this pathogen (Chernyaeva et al., 2009).

During 2009-2011 in this laboratory, a collection of soft winter wheat was studied in the amount of 495 pcs. on resistance to pathogens of foliar and smut diseases, as a result of which three sources of group resistance to these pathogens were identified, namely, Yavorina, Zagrava Odessa from Ukraine and Torrild from Germany (Chernyaeva et al., 2012). Even earlier, namely during 2001-2005, they tested 358 samples of winter wheat for resistance to the main pathogens common in the zone of the North-Eastern Forest-Steppe (Catalog of source material of cereals, legumes, crops and sunflower for resistance to major diseases and pests in the Forest-Steppe of Ukraine, 2006).

Out of 613 samples, 85 samples with individual resistance to a particular disease, 65 samples with group resistance, and 100 immune samples against the background of high productivity were isolated (Kiryan, 2009).

Scientists are constantly looking for immune samples as a starting material for winter wheat breeding. Out of 264 variety formations studied during 2005-2006, 39 variety samples resistant to lace rot and brown rust, as well as 14 varieties resistant to lace rot and septoria were identified (Kiryan & Vyskub, 2015).

Kovalyshyna during 2005-2009 conducted a study of resistance to powdery mildew pathogens, brown rust and hard soot samples of soft wheat of different ecological and geographical origin. Resistant to solid smut, she identified the following samples: Ferruginum 220/85, Erythrospermum 4318/88, Erythrospermum 60-89, Ferruginum 124-88 (Ukraine), Zorya (Russia). Resistant to powdery mildew, the author identified the following samples: Avalon, Rendezvous (UK), Pi 170911 (USA). The following samples of soft winter wheat are resistant to brown rust: Arthur 71, Abe, Mc Nair 2203, Flex, Agrus, Century, TAM-2000 (USA), 203-238 (Bulgaria), Grana x Agent 14-1 (Czech Republic), NS 18-30 (Yugoslavia), Rendezvous (UK) (Kovalishyna et al., 2017).

Researchers of the Laboratory of Immunity to Agricultural Diseases of the Institute of Plant Protection during 2008-2011 studied 114 varieties of winter wheat for resistance to pathogens of brown rust, powdery mildew, septoria, septoria, cercosporelza, resulting in 23 varieties selected in which certain pathogens (Afanasieva et al., 2012; Vyskub, 2019).

In a large body of scientific literature devoted to the study of the collection of wheat for stability, the main focus was on the selection of specific samples or the creation of collections of samples in a particular area of use. However, we did not find a work that would raise the question of the characteristics of the entire collection of wheat on a specific basis, in this case on disease resistance, establishing the structure of the entire world collection, concentrated in a particular genetic center.

MATERIALS AND METHODS

The aim of the work is to characterize the structure of the world collection of soft winter wheat in terms of resistance to diseases in the conditions of the Southern Forest-Steppe of Ukraine.

Basic research methods: field, laboratory, measuring, calculation and comparison, analysis.

The research was carried out in 2011-2019 at the Ustymivka Research Station of Plant Breeding IR of NAAS of Ukraine (Ustymivka Research Station). 1406 samples of soft winter wheat (*Triticum aestivum* L.) from 33 countries were taken for research, including 53.1% from Ukraine, 10.1% - from Turkey, 8.6% - from the United States, 6.9% - from Russia, 17.0% - from Europe. Research methods: field, dialectical, hypothesis, synthesis, induction, statistical, observation.

The layout of repetitions in the variants of experiments is sequential. Such a scheme was chosen to preserve the maximum authenticity of the sample, since the collection is mechanized, and the third replication is selected for storage at the National Center for Plant Genetic Resources of Ukraine, which is free from impurities of the previous sample.

According to the literature data, the most common diseases in the Forest-Steppe zone of Ukraine are powdery mildew, leaf septoria, leaf rust (Leonov, 2016; Gorbacheva, 2004).

The assessment of resistance to wheat diseases was carried out according to the methodological guidelines adopted in the CMEA member countries (Methods of breeding and assessing the stability of wheat and barley to diseases in the member countries of the CME, 1988; Babayants & Babayants, 2014).

Agrotechnics in the collection nursery is generally accepted for the Southern Forest-Steppe zone. The forerunner for wheat was black fallow. Fertilizer (ammonium nitrate) was applied as a spring top dressing at the rate of 1.5 q/ha. The seeds were not treated. In the collection nursery, every 20 numbers, blocks of national standards and reference varieties were sown in three repetitions: Donskaya polukarlykovaya, Ukrayinka odeska, Albatros odeskyy, Albydum 114, Myronovskaya 808, Bezostaya 1, Smuhlyanka, Yednist, Bunchuk, Podolyanka, TX95V4926, Redut.

RESULTS AND DISCUSSIONS

Meteorological conditions have a significant impact on the manifestation and development of pathogens.

Diseases such as powdery mildew require high humidity, while brown rust, on the other hand, has a higher level of development in droughty conditions.

Therefore, meteorological conditions are one of the main factors in the development of diseases, and the ability of plants to adapt to specific soil and climatic conditions also determines its resistance to specific phytopathogens.

Field resistance to major diseases determines the economic value of the variety in a particular area, as well as determines its viability in use as a parent form in the selection process.

Determination of field resistance of collection samples of soft winter wheat to the manifestation of major leaf diseases was carried out in the following phases of organogenesis: in the phase of autumn tillering; in the phase of spring tillering; in the phase of the plants in the tube; in the phase of the beginning of earing; in the phase of milk-wax ripeness.

In the early stages of growth and development of wheat plants (sprouts-ears) there was a slight defeat of plants by powdery mildew (Figure 1).

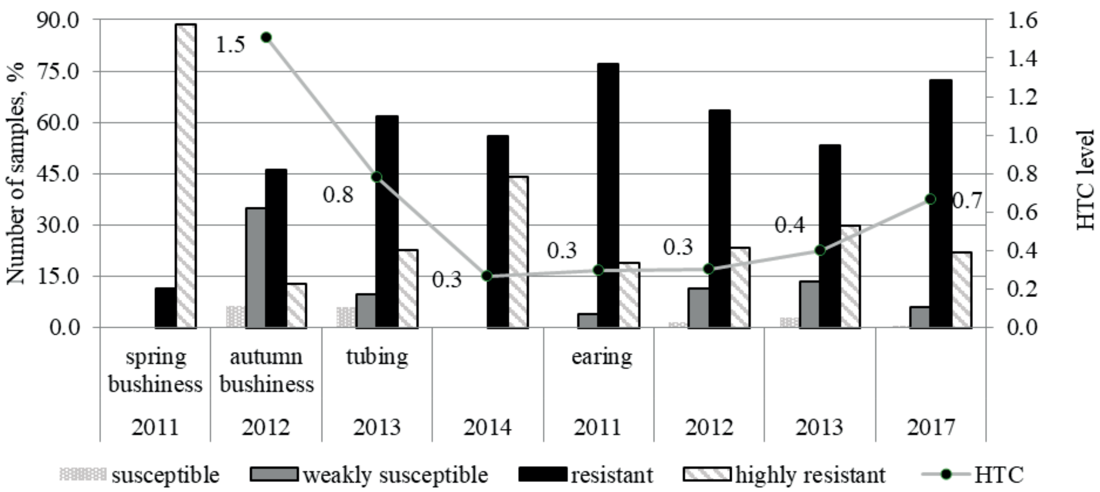

Figure 1. Distribution of the collection of soft winter wheat on the basis of resistance to powdery mildew in the period of germination, 2011-2017

The significant influence of the amount of Precipitation and the level of hydrothermal coefficient (HTC) on the indicator of the number of susceptible samples of wheat to powdery mildew during earing (r = 0.83 and r = 0.91, respectively) was established.

The average level of correlation between the indicators of the number of highly susceptible wheat samples to this disease and the level of HTC (r = 0.33) was noted.
In the autumn tillering phase, out of 234 samples, 5 samples were found that were not affected by powdery mildew: 831/10, 853/10 (UKR), Pesma (YUG), Gruia, Gloria (ROU) (Table 1).

Table 1. The level of juvenile resistance of samples of soft winter wheat to powdery mildew, 2012

№	Name of the sample	Origin	Powdery mildew, score
1.	831/10	UKR	9
2.	853/10	UKR	9
3.	Pesma	YUG	9
4.	Gruia	ROU	9
5.	Gloria	ROU	9
6.	Blaho	UKR	3
7.	467/10	UKR	3
8.	Lord	UKR	4
9.	Zorepad	UKR	4
10.	Kokhana	UKR	4
11.	Albydum 114	RUS	4
12.	TX95V4926	USA	4
13.	Tupaeh	MDA	4
14.	Barvina	UKR	4
15.	Shestopalivka	UKR	4
16.	Bezostaya 1	RUS	4
17.	Vatazhok	UKR	4
18.	945/10	UKR	4

Varieties Blago and 467/10 (UKR) had the lowest score of juvenile resistance to this pathogen, which significantly reduced their winter hardiness and, consequently, selection value.
There were also 11 samples of wheat, which is 4.7% of the total number of studied collection samples favorable to the disease: 945/10, Barvina, Zorepad, Lord, Vatazhok, Kokhana, Shestopalivka (UKR), Albidum 114, Bezostaya 1 (RUS), Tupaeh (MDA), TX95V4926 (USA).
Due to favorable weather conditions for the development of powdery mildew during the tube period, 12 samples of soft winter wheat susceptible to the manifestation of this disease in this phase of organogenesis were identified: 467/10 (UKR), Albidum 114 (RUS), Dunavka (BGR), Xiao Yan107 (CHN), TX95V4926, KS93U161, KS93U194, KS93U59, KS93U61, KS93U62, KS93U63 (USA), Vienna (CAN). In most of the collection material during the studied years for the period of this phase of plant development no noticeable damage was observed.
To differentiate the collection of wheat by disease resistance during the earing period, 2012 and 2013 were more favorable, in which the percentage of favorable and weakly favorable samples studied was approximately 14%. Selected 20 samples with the lowest score of juvenile resistance to disease (score 3-4): Albidum 114 (RUS), Dunavka (BGR), Sonmez-2001, 362K2.111 // TX71A1039.VI * 3 / AMI / 3 / ES14 / 130L1.12 // MNCH (IU067603), Jagger / Cetinel (TUR), Xiao Yan107 (CHN), KS93U161, KS93U60, KS93U194, KS93U59, KS93U61, KS93U62, KS93U63, Thunderbird, 2180 * K / 2163 //? / 3 / W1062A * HVA114 / W3416 (UA0108862), Madsen / Malcolm / 6 / Hill / 3 / Cer // Ymh / Hys / 4 / Cer // Ymh / Hys / 5 / Rossini / Ysatis // Oracle (IU067766), N95L189, Rawhide (USA), Vienna (CAN), PYN / BAUSWM15182-61WM-0WM-030WM-030WM-2WM-0WM (UDS02897) (MEX).
During the period of milk-wax ripeness, when the maximum damage to plants by powdery mildew pathogens occurs, the distribution of wheat samples by the level of resistance by years was as follows.
In 2011, due to heavy rainfall in the first half of the second decade of June (the amount of precipitation for 6 days was 103.9 mm) with subsequent hot days, there were favorable conditions for reproduction and development of powdery mildew. The percentage of favorable samples of wheat to the pathogen was 57.5%.
A similar situation was observed in 2014, when for nine days in late May-early June, 50.3 mm of precipitation fell, respectively, the percentage of favorable samples of wheat to the disease was 41.0%.
In 2012 and 2013, a large group of samples was noted as poorly susceptible.
In 2018, despite the arid conditions of wheat vegetation, there was an intensive spread of the

disease. In 2017, most wheat samples showed moderate resistance to this disease.

In 2015 and 2019, due to unfavorable conditions for the development of powdery mildew pathogens and, as a consequence, the almost complete absence of plant powdery mildew, it was not possible to objectively differentiate the collection on the basis of resistance to this disease (Table 2).

Table 2. Distribution of the collection of soft winter wheat on the basis of resistance to the powdery mildew pathogen during the period of their maximum damage, 2011-2019

Number of samples,%	Years of research								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
Highly susceptible	5.0	0.9	0.6	0.9		0.0	0.0	1.6	
Susceptible	57.5	18.8	10.3	41.0		8.0	20.5	33.2	
Weakly receptive	22.0	46.9	35.8	29.1		21.4	23.2	34.1	
Stable	13.2	30.8	32.0	25.6		53.6	48.2	28.5	
Highly resistant	2.3	2.6	21.4	3.4		17.0	8.0	2.6	
The sum of active temperatures during the spring-summer period of disease development, °C	1176.0	1244.1	1176.6	1114.2	993.1	1087.2	995.4	1216.9	1165.7
The amount of precipitation for the spring-summer period of disease development, mm	127.4	80.4	41.3	102.1	83.9	115.5	47.8	40.7	194.9
HTC during the spring-summer period of disease development	1.1	0.6	0.4	0.9	0.8	1.1	0.5	0.3	1.7
Relative humidity for the spring-summer period of disease development, %	62.7	68.9	61.1	62.1	61.1	66.9	57.8	57.3	66.4

During the years of observations, no autumn accumulation of the pathogen was observed, so in the early stages of the spring vegetation of wheat plants, a significant lesion of septoria leaves of the samples was not observed. Only in 2017 and 2018, during the earing period, one wheat sample favorable for this phase was isolated: N95L160 (USA) and 17 weakly susceptible samples: L146-02KH-0-3-3, L146-07KH-0-2-1, Orzhytsia, Polyanka, Lelya (UKR), Kazanskaya 234, CV.Rodina / Ae. Speltoides (10 KR) (IU067649) (RUS), F00628G34-1 (ROU), Son64 / 4 / Wr51 / mida // Nt.h / 3 / K117 / 5 / Anza / 3 / Pi // Nor / Hys / 4 / Sefid (IU067626), ALMT * 3/7 / VEE / CMH77A.917 // VEE / 6 / CMH79A.955 / 4 / AGA / 3 / SN64 * 4 / CNO67 // INIA66 / 5 / NAC (IU067634) (IRN), KRASNODAR / FRTL / 6 / NGDA146 / 4 / YMH / TOB // MCD / 3 / LIRA / 5 / F130L1.12 (IU067611), KS920709-B-5-1-1 / Burbot-4 (IU067615), KRASNODAR / FRTL / 6 / NGDA146 / 4 / YMH / TOB // MCD / 3 / LIRA / 5 / F130L1.12 (IU067607), YU MAI30 / ZANDER-13 (IU067672), Rina-6 / Orkinos-7 (IU066050) (TUR), KS92WGRC21, KS92WGRC22 (USA) (Figure 2).

During the period of maximum damage of plants by the disease which is necessary for milk and milk-wax maturity, the majority of samples of wheat are noted at the level of average resistance to display of this pathogen (Table 3). In 2014, the percentage of resistant varieties was 93.0%. In 2012, 2013 and 2017, the number of cultivars that were resistant to leaf septoria was over 72%. The lowest percentage of resistant varieties of soft winter wheat to this pathogen was observed in 2016 (18.8%) and in 2019 (16.5%).

Disease resistance is primarily determined by the genetic characteristics of soft winter wheat plants, but the weather conditions of a particular growing season have a very significant effect on the spread and damage of plants. Thus, in the years with the lowest percentage of resistant varieties to leaf septoria, the highest amount of precipitation was observed (in 2016 - 115.5 mm; in 2019 - 194.9 mm).

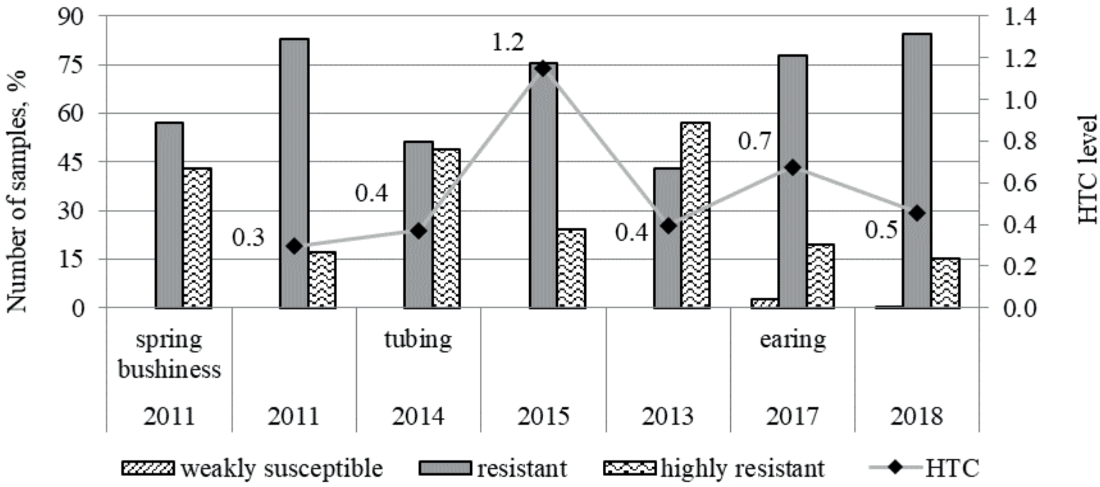

Figure 2. Distribution of the collection of soft winter wheat on the basis of resistance to septoria of leaves in the period of germination, 2011-2019

Table 3. Distribution of the collection of soft winter wheat on the basis of resistance to pathogens of septoria leaves in the period of their maximum damage, 2011-2019

Number of samples, %	Years of research								
	2011	2012	2013	2014	2015	2016	2017	2018	2019
Highly susceptible	0.5					1.8			3.3
Susceptible	18.5	1.0	2.8		9.8	35.7		8.3	42.4
Weakly receptive	54.0	17.1	19.1	6.3	17.9	43.8	21.4	48.8	37.8
Stable	24.9	79.6	72.4	93.0	65.2	18.8	76.8	42.6	16.5
Highly resistant	2.1	2.3	5.7	0.7	7.1	0.0	1.8	0.4	0.0
The sum of active temperatures during the spring-summer period of disease development, °C	1176.0	1244.1	1176.6	1114.2	993.1	1087.2	995.4	1216.9	1165.7
The amount of precipitation for the spring-summer period of disease development, mm	127.4	80.4	41.3	102.1	83.9	115.5	47.8	40.7	194.9
HTC during the spring-summer period of disease development	1.1	0.6	0.4	0.9	0.8	1.1	0.5	0.3	1.7
Relative humidity for the spring-summer period of disease development, %	62.7	68.9	61.1	62.1	61.1	66.9	57.8	57.3	66.4

A similar trend can be traced by analyzing the hydrothermal coefficient. The highest, during the years of research, it was also in 2016 (1.1) and in 2019 (1.7).

The evaluation of the collection for resistance to brown rust was performed in the period from the end of milk-wax ripeness to the beginning of wax ripeness. There was an average inverse correlation between the indicators of the number of highly susceptible wheat cultivars to brown rust and the sum of active temperatures (SAT), there was an average inverse correlation (r = -0.36) and a weak inverse correlation between the indicators of the number of highly susceptible wheat cultivars and wheat to r = -0.18) and the amount of precipitation (r = -0.21).

In most samples of soft winter wheat, a weak lesion of this disease or its complete absence was detected (Table 4).

Table 4. Distribution of soft winter wheat collection on the basis of resistance to brown rust pathogens during the period of their maximum damage, 2011-2018

Number of samples, %	Years of research					
	2011	2012	2013	2014	2016	2018
Highly susceptible	0.5					1.8
Susceptible	18.5	1.0	2.8		9.8	35.7
Weakly receptive	54.0	17.1	19.1	6.3	17.9	43.8
Stable	24.9	79.6	72.4	93.0	65.2	18.8
Highly resistant	2.1	2.3	5.7	0.7	7.1	0.0
The sum of active temperatures during the spring-summer period of disease development, °C	1176.0	1244.1	1176.6	1114.2	993.1	1087.2
The amount of precipitation for the spring-summer period of disease development, mm	127.4	80.4	41.3	102.1	83.9	115.5
HTC during the spring-summer period of disease development	1.1	0.6	0.4	0.9	0.8	1.1
Relative humidity for the spring-summer period of disease development, %	62.7	68.9	61.1	62.1	61.1	66.9

Analysis of meteorological conditions of the spring-summer period during the years of research also shows us the significant influence of weather factors on the development of brown rust. With a decrease in SCC and precipitation, more favorable conditions are created for the defeat of plants by this pathogen. Thus, the most favorable conditions for brown rust were in 2013 (the number of favorable varieties was 8.1%).

In general, most of the presented varieties have high field resistance to brown rust. Monitoring plant damage over the years allows us to control the spread of this disease by selecting the most stable parental forms.

The collection of soft winter wheat is represented in most of the samples created in the period from the 70's of the XX century to the present day.

Among the earlier varieties, the average resistance to powdery mildew and brown rust was observed in the samples Radosinska rana 594 (SVK) of 1948 and Kharkiv 159 (UKR) of 1969. Also, average resistance to brown rust was observed in the Dunavka (BGR) samples of 1948 and Webster (CAN) of 1912. High resistance to brown rust was observed in the samples of Arthur (USA) of 1968 and Caprimus (DEU) of 1969.

The average resistance to septoria of leaves was noted in the sample Narymchanka 1156 (RUS) of 1944. Average resistance to powdery mildew and leaf septoria was observed in Odessa 16 (UKR) of 1953. Medium resistance to leaf septoria and brown rust was observed in the specimens Coker 68-19 (USA) of 1970 and Capitole (FRA) of 1964.

Among the samples of the 70's of selection, the average resistance to powdery mildew was noted in "Myronivska 808 improved" (UKR) and UH 202 (CZE), Noroit (FRA), Hiplains (USA), Kiten (BGR).

Varieties of the 80's of selection high resistance to the disease was observed in Atla (GBR). Varieties of the 90's of selection high resistance to the disease was observed in Cartago (FRA), Beauford (GBR), Snezhynka (RUS).

Among the samples of the 70's selection average resistance to septoria leaves was observed in "Myronivska 808 improved" (UKR) and UH 202 (CZE), Severodonskaya (RUS), Fredrick (CAN), Artnur 71 (USA).

In the samples of the 80's of selection, the average resistance to the disease was observed in Marabu (DEU), Mukhrani (GEO), Srpanjka (HRV), Lutescens 1131 (RUS), Karasu 90 (TUR), Charmany, Arapahoe, TAM 107 (USA).

Varieties of the 90's of selection high resistance to the disease was observed in KS93U63, KS93U61, KS93U60, KS93U59 (USA).

In varieties of the 70's selection high resistance to brown rust was observed in Fredrick (CAN), Comtal (FRA), Stavropolskaya 38 (RUS),

Lutescens 4665, Polesskaya 70 (UKR), Artnur 71, Weston (USA).
Among the samples of the 80's selection high resistance to the disease noted Hope (BLR), Xiao Yan107 (CHN), Aubaine (FRA), Ostara (GBR), Hybrid KOS-17 (RUS), Odesskaya ostystaya, Erythrosperm 3582/82 (UKR)), Thunderbird (USA), Korana (YUG).
Varieties of the 90's of selection showed high resistance to the disease in Hunter, Aristocrat (GBR), MV Palma (HUN), Sfera, Donskoy mayak, Polovchanka (RUS), Barbara (SVK), 315-72 (UA0101926), Zlagoda, 57-75 (UA0103708), Myronivska 63, Donetska 89, Bilotserkivska polukarlykova, Fedorivka (UKR), KS93U63, KS93U61, KS93U60, KS93U59, KS93U194, KS93U161, KS93U62, N96L1224, TX95V4923, N95L2500, Pronghorn (USA).
Summing up the results of the analysis of the stability of varieties of soft winter wheat created in different years, we can conclude that selection work has significantly influenced the creation of more stable varieties in recent years compared to the 70's of the twentieth century. However, with the reduction of the manifestation of a disease, there were slight fluctuations to reduce the resistance of varieties, but due to the selection process it is possible to stabilize and control the development and spread of major diseases of soft winter wheat.
On the basis of resistance to powdery mildew, most highly susceptible varieties originate from Turkey, USA, Canada, Kazakhstan, China.
On the basis of resistance to leaf septoria, a relatively uniform distribution of both susceptible and stable specimens of different origin was observed.
On the basis of resistance to brown rust, most highly resistant varieties originate from the North American continent.
The resistance of varieties from different countries to the most common diseases primarily depends on the soil and climatic conditions of the region of origin, as well as the presence of this pathogen in the origin of the sample. Thus, the most resistant to the most common diseases of the Southern Forest-Steppe are varieties that are created in breeding centers, soil and climatic conditions of which coincide with the conditions of the location of the Ustymivka Research Station.
From the studied collection material, 25 samples with translocation from other species and genera of plants were isolated: *Ae. speltoides, Ae. cylindrica, Ae. taushii, Ae. peregrina, Ag. elongatum, S. cereale, Tr. durum, Tr. erebuni* + *Triticale*. Among the samples of soft winter wheat obtained by crossing with speltoid egylops (*Ae. speltoides* Tausch.) there are 2 sister lines with group resistance to diseases of Russian selection: CV. Rodina / *Ae. speltoides* (10 KR) (IU062132), CV. Rodina / *Ae. speltoides* (10 KR) (IU062133). There are also 3 sister lines with group resistance to diseases obtained by crossing with speltoid egylops (*Ae. speltoides* Tausch.) and rye (*S. cereale* L): CV. Rodina / *Ae. speltoides* (10 KR) /*S. cereale* (1.0KR) (IU061826), CV. Rodina / *Ae. speltoides* (10 KR) /*S. cereale* (1.0KR) (UA0108993), CV. Rodina / *Ae. speltoides* (10 KR) /*S. cereale* (1.0KR) (IU062135) (RUS).
Very high resistance to the appearance of brown rust was characterized by the American sample KS93U194, due to the action of the resistance gene Lr 41, the donor of which was taken *Ae. taushii* Coss. (Cox et al., 1997). Sample KS93U62 (USA) took the resistance gene Lr41 from *Ae. taushii* Coss. (Sun et al., 2009) proved to be at the level of medium stability. In other American specimens Elmo and Purdue 39120A-4-10-20-1, which in their pedigree have field wheatgrass (*Ag. elongatum* Host.) (Patterson et al., 1981; Rabinovich et al., 1996), low and medium susceptibility to powdery mildew and septoria of leaves was noted.
Resistance genes Lr34 / no-Lr34 and LrTe in Ukrainian varieties Lastivka odeska, Knyahynya Olha ta Vykhovanka odeska (Galaev & Sivolap, 2015; Karelov et al., 2011), which were created with the participation of *Ae. peregrina* (Hack.) and *Tr. erebuni* Gandilyan (Morgounov et al., 2010), showed high field resistance to brown rust.
In the variety Mayra (KAZ), created with the participation of durum wheat (*Tr. durum* Desf.) (Kokhmetova et al., 2016), the average field resistance to septoria of leaves and brown rust was noted. In the variety Milturum 1 (UKR), which was also created with the participation of durum wheat (*Tr. durum* Desf.)

(Borisenko, 1988), an average susceptibility to powdery mildew and leaf septoria was noted. In the variety Polovchanka (RUS), created with the participation of triticale (× *Triticosecale*), high resistance to brown rust was observed (Table 5).

Table 5. Disease resistance of samples of soft winter wheat obtained as a result of remoted hybridization

Culture	Samples	Resistance level
Aegilops speltoides **Tausch.**	CV. Rodina/Ae.Speltoides (10 KR) (IU062132), -//- (IU062133)	medium resistance to powdery mildew, leaf septoria and brown rust
Aegilops speltoides **Tausch.**, *Secale cereale* **L.**	CV. RODİNA/AE.SPELTOİDES (10 KR)/S.CEREALE (1.0KR) (IU061826), -//- (UA0108993), -//- (IU062135)	medium resistance to powdery mildew, leaf septoria and brown rust
Aegilops taushii **Coss**.	KS93U194	very high resistance to brown rust
	KS93U62	medium resistance to brown rust
Aegilops elongatum **Host.**	Elmo, Purdue 39120A-4-10-20-1	weak and medium susceptibility to powdery mildew and leaf septoria
Aegilops peregrina **(Hack.) Maire & Weiller**	Knyahynya Olha	high resistance to brown rust
Triticum erebuni **Gandilyan**	Vykhovanka odeska	high resistance to brown rust
Triticum durum **Desf.**	Mayra	medium resistance to leaf septoria and brown rust
Triticum migushovae **Zhir.**	Fysht	medium resistance to brown rust
Secale cereale **L.**	Polesskaya 70, Polesskaya 80, Analoh	medium resistance to brown rust
×*Triticosecale*	Polovchanka	high resistance to brown rust

In the variety Fisht (RUS), which has a pedigree of Triticum migushovae Zhir (Bespalova, 2005), low susceptibility to powdery mildew and leaf septoria, as well as moderate resistance to brown rust.

In the variety Poliska 70 (UKR), created with the participation of sowing rye (*S. cereale* L.) (Rabinovich, 1972), but the genes of resistance Lr34 and Pm38 identified in it were obtained from Bezostoy 1 (Zaika, 2015). This variety has a weak susceptibility to powdery mildew and medium resistance to brown rust.

Thus, the method of remote hybridization using foreign genes contributes to the production of lines more resistant to specific pathogens of soft winter wheat. Increasing the genetic resistance of plants to pathogens allows you to create varieties that at the genetic level can resist disease without reducing the quality of the products and the level of plant productivity.

CONCLUSIONS

Analysis of meteorological conditions over the years of research allows to differentiate varieties by resistance to specific pathogens of soft winter wheat. Thus, in 2011 (excessively humid conditions) the percentage of favorable samples of wheat to the pathogen was 57.5%; in 2012 and 2013 (arid conditions), a large group of samples was noted as poorly susceptible. Only 2% of the varieties presented in the collection in the autumn tillering phase were resistant to powdery mildew. Varieties Blago and 467/10 (UKR) had the lowest score of juvenile resistance to this pathogen. In the phase of milk-wax ripeness, when there is a maximum damage to this pathogenic plants, the distribution of samples by level of resistance significantly depended on the conditions of a particular year.

In 2012, 2013 and 2017, the number of cultivars that were resistant to leaf septoria was over 72%. In 2014, the percentage of resistant varieties was 93.0%. The lowest percentage of resistant varieties of soft winter wheat to this pathogen was observed in 2016 (18.8%) and in 2019 (16.5%).

Analysis of the stability of soft winter wheat varieties created in different years allows us to conclude that selection work has significantly influenced the creation of more stable varieties in recent years compared to the 70's of the twentieth century. It is determined that the resistance of cultivar samples from different countries to the most common diseases primarily depends on soil and climatic conditions of the region of creation of the variety, as well as on the presence of this pathogen in the origin of the sample.

It has been established that the method of remote hybridization with the use of foreign genes promotes the production of lines more resistant to specific pathogens of soft winter wheat.

Creating a special collection of varieties resistant to the most common diseases of soft winter wheat allows you to systematize the selection of parental lines on specific grounds, which will create more resistant lines.

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