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GENETIC SOURCES OF RESISTANCE BREAD WINTER WHEAT TO LEAF (BROWN) RUST AND THEIR VALUE IN JUVENILE STAGE OF GROWING

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Topicality. *Loss of resistance in soft winter wheat plants occurs due to rising prices for fungicides, the ecological crisis of the biosphere, the lack of a wide range of donors and the constant variability of the pathogen. Therefore, it is important to find new effective sources of resistance to brown rust and involve them in breeding.* ***Purpose.*** *To compare genotypes of different ecological and geographical origins and identify the best genetic sources of brown rust resistance for effective breeding.* ***Methods.*** *The experiment was carried out in laboratory; common winter wheat samples were contaminated with leaf (brown) rust spores in the juvenile stage.* ***Results.*** *Four genetic sources of resistance of different ecological and geographical origin were analyzed. The best average resistance indicator was observed for genotypes developed by other Ukrainian breeding institutions, their average resistance indicator was 6.5 points on a 9-point scale, and for genotypes of Western European origin – 5.2 points, the worst indicator was shown by genotypes bred by Plant Breeding and Genetic Institute - National Center for Seed Breeding and Variety Research and Turkey-CIMMYT-ICARDA – 4.6 and 3.4 points.* ***Conclusions.*** *The fact that the best common winter wheat genotypes belong to other Ukraine and Western European breeding institutions can be explained that these genotypes were formed under optimal conditions for development of leaf (brown) rust that served as a natural infectious background for improving resistance to this disease. However, among genetic sources with low resistance, there are samples with high resistance, which, in combination with other adaptive traits, can be successfully used in the winter wheat breeding for resistance to leaf (brown) rust in the southern Ukraine.*

Key words: *common winter wheat, leaf (brown) rust, sources of resistance, genotypes-representatives, resistance*

Introduction. Brown leaf rust, caused by the fungus *Puccinia recondita* (syn. P. Triticina Eriks), is the most widespread of all wheat rust diseases. This is a widespread disease in most regions of the world, which is much more common than wheat stem rust (P. graminis f. Sp. Tritici) or wheat yellow rust (P. striiformis f. Sp. Tritici) [1]. Yield losses due to this disease can be up to 20% in highly susceptible varieties, about 1–3% in resistant varieties, and 10% in tolerant varieties. In years of brown rust epiphytoties, these losses can reach up to 23–35% in highly susceptible varieties, about 12% in tolerant varieties, and less than 1% in resistant varieties. In addition, brown rust also affects grain quality indicators, such as grain unit, grain hardness, flour yield, gluten, flour strength, etc. [2, 3].

The most economical, environmentally friendly, appropriate and necessary means of protecting wheat from pests is the development and introduction of disease-resistant varieties. At the same time, successful development of breeding work in this area is impossible without a gene pool of resistant varieties In recent years, against the background of rising prices for fungicides and the ecological crisis of the biosphere, the search for new effective sources of disease resistance has become particularly important [4, 5]. Difficulties are caused by the lack of a wide range of resistance donors, as well as the high variability of the pathogen in the constant cultivation of resistant varieties, which leads to the loss of resistance to this disease [6, 7].

Breeding work on resistance to brown rust has been carried out for many years in the Plant Breeding and Genetic Institute - National Center for Seed Breeding and Variety Research, resistant varieties have been developed by hybridizing Western European varieties with different genetic resistance systems, breeding material

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with wheat-rye translocations 1AL/RS and 1BL/RS, as well as material originating from wild relatives and with a separate genetic construct Lr 34. The purpose of our work was to compare genotypes with different ecological and geographical origins and to identify the best genetic sources of resistance to brown rust for their effective use in breeding.

Materials and Methods. The object of research was varieties and lines of soft winter wheat *(Triticum aestivum)* with genetic systems of resistance to brown rust of different ecological and geographical origin, which bred by Plant Breeding and Genetic Institute – National Center for Seed Breeding and Variety Research, other breeding institutions of Ukraine, Western Europe and material from CIMMYT-ICARDA-Turkey.

In the winter of 2021, seedlings at the juvenile stage were evaluated for resistance on a 9-point scale in the laboratory.

In the laboratory, in winter, two weeks after sowing seeds, in the two-leaf stage, lines varieties) were inoculated with the brown rust pathogen. Before inoculation, the spores were prepared, heated for 15 minutes at 45 ℃ in a thermostat to bring them out of anabiosis [16], then mixed with talcum powder (100 g of talc per 2 g of spores) to a homogeneous state, and poured into a bulb. The next step, the plant was to prepare by washing off the wax layer of leaves. We sprayed distilled water on the plants until dew formed on the leaves, used a bulb with a tip to evenly spray the spores with talcum powder, and covered the vessels with plants with plastic bags for one day.

After 10 days, in case of large-scale manifestation of the disease, the number of infected plants was counted separately for each vessel, according to the 9-point integrated scale of CMEA, where 9 points is very high resistance, and 1 point is very high susceptibility [15].

Results and Discussions. The degree of manifestation of this trait in the analyzed genotypes was determined by the group of sources origin of brown rust resistance (Table and Fig.).

Table 1. Ecological and geographical origin and value of genetic sources of soft winter wheat resistance to brown rust

Plant Breeding and Genetic Institute – National Center for Seed Breeding and Variety Research		Other breeding institutions of Ukraine		Western Europe		CIMMYT–ICARDA–Turkey	
Genotype	Resistance, points	Genotype	Resistance, points	Genotype	Resistance, points	Genotype	Resis-sistance, points
Vidpovid Od.	7	Lybid	9	Turandot	9	Konya (tci)	4
Veteran	7	Muza	9	Jersey	9	GANSU–1/MEZGIT–4 (tci)	4
Katrucia Od.	4	Erytrosperm	9	Rebel	6	F5(Viktor.*Alhambra)	4
Pylypivka	4	Kesariia	9	Etana	4	BAYRAKTAR 200 (Tr–Ank)	4
Missiia Od.	4	Svitanok Myr.	9	Arkeos	4	F5(39/13(ci)*Zastava) Istina	3
Mudrist Od.	4	Kvitka laniv	4	Reform	4	F5(82/13*Istina)* Istina	3
Shchedrict Od.	4	Slavna	4	Koloniia	4	F5(L2343/06*9933/13)* Lybid	3
Odeska 51	4	Bohdana	4	Baletka	4	F5(132/13* Istina)* Istina	3
Viktoriia Od.	4	Shchedra Nyva	4	Matchball	4	F5(132/13* Istina)* Istina	3
Blahodarka	4	Vodohrai	4	Hlaukus	4	F5(39/13(ci)* Zastava)* Zastava	3
Xmin	4	**Xmin**	4	**Xmin**	4	**Xmin**	3
Xmax	7	**Xmax**	9	**Xmax**	9	**Xmax**	4
$\bar{X}$	4.6 ± 0.40	$\bar{X}$	6.50 ± 0.83	$\bar{X}$	5.20 ± 0.66	$\bar{X}$	3.40 ± 0.16
C_{var}, %	0.27	C_{var}, %	0.41	C_{var}, %	0.40	C_{var}, %	0.15

Accrding to the average point of resistance to brown rust (Table, Fig.), the best genetic sources are genotypes of other breeding institutions of Ukraine (6.5 points on a 9-point scale). The variability for this trait ranges from 4 points (the lowest value) to 9 points (the highest one).

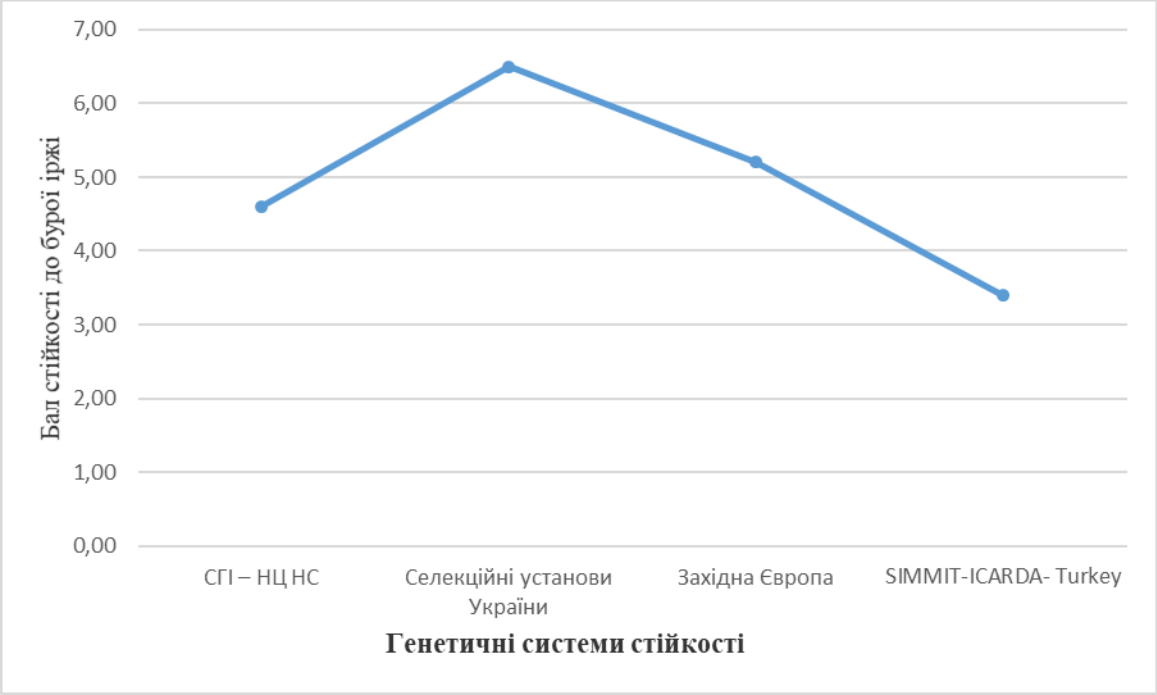

Fig. 1. Origin of the brown rust resistance genetic systems.

Genotypes of Western European origin are on the second place in terms of the average point of resistance to brown rust – 5.2 points. It is obvious that the genotypes representing these two ecological and geographical groups have both increased resistance to brown rust and high yield potential, which can be successfully used in breeding winter wheat in the southern Steppe of Ukraine.

The representative genotypes from Plant Breeding and Genetic Institute – National Center for Seed Breeding and Variety Research and CIMMYT-ICARDA - Turkey have a low average resistance of 4.6 and 3.4 points, respectively, compared to groups from other breeding institutions in Ukraine and Western Europe. However, among these ecological groups, there are genotypes with high 9-point resistance, which in combination with high adaptive traits and properties, have the potential to be valuable donors for breeding in conditions of snowless winters and spring and summer droughts in southern Ukraine.

Conclusions. The best genetic sources of resistance to wheat brown rust are genotypes representing other breeding institutions in Ukraine and Western Europe. This is due to the fact that they were formed in natural conditions that are optimal for the brown rust development, which could serve as a natural infectious background in breeding resistance to this trait. However, among the genotypes of Plant Breeding and Genetic Institute – National Center for Seed Breeding and Variety Research and CIMMYT-ICARDA - Turkey, there are representatives with high resistance to brown rust, which in combination with other adaptive traits can be successfully used in the soft winter wheat breeding in southern Ukraine.

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Кірчук Є. І., Алєксєєнко Є. В. Генетичні джерела стійкості пшениці м'якої озимої до бурої іржі та їх цінність в ювенільний період розвитку. *Зернові культури. 2022. 6 (2). 27–30.*

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Актуальність теми. При зростанні цін на фунгіциди, екологічної кризи біосфери, відсутність широкого асортименту донорів та за постійної мінливості патогену, відбувається втрата стійкості у рослин пшениці м'якої озимої, тому актуальним є пошук нових ефективних джерел стійкості та залучення їх до селекційної роботи на стійкість до бурої іржі. **Мета дослідження –** порівняння генотипів, що мають різне еколого-географічне походження, та визначення кращих генетичних джерел стійкості до бурої іржі для ефективного використання їх в селекції. **Методи.** Дослід проводився в лабораторних умовах; контамінування спорами бурої (листової) іржі проводили у ювенільний період розвитку пшениці м'якої озимої. **Результати та обговорення.** Серед чотирьох проаналізованих генетичних джерел стійкості різного еколого-географічного походження за середнім показником стійкості найкращими виявились генотипи-представники з інших селекційних установ України, їх середній рівень стійкості знаходився на рівні 6,5 балів за 9-бальною шкалою та генотипи західноєвропейського походження – 5,2 балів, гірший бал мали генотипи-селекції від СГІ-НЦНС та CIMMYT-ICARDA- Turkey – 4,6 і 3,4 бали. **Висновки.** Те, що кращими являються генотипи пшениці м'якої озимої з інших селекційних установ України та західноєвропейського походження можна пояснити формуванням цих генотипів в оптимальних умовах розвитку бурої іржі, що послужило природнім інфекційним фоном для селекції на стійкість до цієї ознаки. Однак серед генетичних джерел з низькою стійкістю зустрічаються зразки з підвищеною стійкістю які в поєднанні з іншими адаптивними ознаками можна успішно використовувати в селекції пшениці м'якої озимої на стійкість до бурої іржі для півдня України.

Ключові слова: *пшениця м'яка озима, бура іржа, джерела стійкості, генотипи-представники, стійкість*