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COMPARATIVE ASSESSMENT OF YELLOW AND BROWN RUST DISEASES IN CULTIVATED BARLEY (*Hordeum vulgare* L.) SAMPLES

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Abstract. In the current study, the rates of yellow and brown rust diseases were comparatively analyzed as a result of phenological observations made in 70 cultivated barley (*Hordeum vulgare* L.) samples planted in 2023 in the field of the Absheron Experimental Farm Base under the Institute of Genetic Resources. Among the samples, the numbers that showed high resistance to both diseases were selected. Samples selected according to durability indicators were recommended to be used as starting material for creating high-yielding and disease-resistant varieties in the future.

Keywords: *Barley, yellow rust, brown rust, disease resistance.*

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1. Introduction

One of the most important ways to develop and achieve high results in plant breeding is the creation and production of new varieties of cereal crops, distinguished by their high quality and resistance to diseases caused by adverse environmental conditions. One of the main goals in the field of grain growing in modern times is to eliminate the losses caused by various diseases and to create qualitatively new varieties of cereals that allow obtaining a stable yield. In our republic, barley is a leading grain fodder crop and takes the second place after winter wheat in terms of cultivated area among common grain crops. The average productivity of the republic is 25.8 s/ha. According to the literature data, the failure to obtain a harvest in the amount of sown material increases every year (Musaev & Babaev, 2005; Tamrazov *et al*., 2012). Various rust diseases take an important place among the factors that reduce productivity (Orujev, 2003). Therefore, the tolerance of barley against various fungal diseases is important in modern breeding. Plant resistance to various diseases is a very complex process and depends on a number of factors: soil moisture, precipitation, relative humidity, air temperature, nutrients, planting density, radiation, etc. (Nasibova & Khalilov, 2016; Nasibova *et al*., 2021; Nasibova *et al*., 2016). According to G.S. Huseynov, yellow and brown rust, elmintosporium, powdery mildew cause significant damage to barley in the republic (Guseinov, 1978).

Barley rust disease is caused by fungi belonging to the Urediniales order of the Basidiomycetes class. Rust fungi that damage barley belong to the genus Puccinia. These fungi have a complex life cycle (Peresypkin, 1982). Almost every year, 15-20% of the

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crop is destroyed due to fungal diseases (Nasibova, 2020; Kazimli *et al*., 2022). Yield loss in sensitive cultivars can range from 32% to 50% (Meshkova & Sabaeva, 2009). The causative agent of yellow rust disease is the fungus Puccinia striiformis West. Mass manifestation of the disease occurs in years with cold weather and heavy rainfall (Stepanov, 1975). Spores of the disease (uredinispores) are found in different types of plants, even in wild forms. Uredomyceles can spread over large distances through wind, precipitation and insects. During the strong development of the disease, the yield loss can be 15-20% or more. The disease can be found in all parts of the plant - leaves, calyces, as well as grains. Yellow rust disease first covers the surface of the leaves in the form of yellow lines-pustules, and then gradually spreads to the entire surface of the leaf and to the depth of its tissue (Peresypkin, 1979). Uredomyceles can overwinter in the seeds of wild and cultivated plants, as well as in the grain of an infected plant. Yellow rust likes high humidity and heat. The ideal conditions for microspores to spread with maximum frequency are air humidity of more than 90% and temperature of 10-15°C. During this period, it is necessary to check the plant regularly to prevent the formation of pustules. The disease does not damage the cereal plant in dry and hot summer months. Due to the long life cycle of disease carriers, the disease can damage the plant from early spring to autumn.

Rust disease is a widespread fungal disease that causes great damage to barley in the conditions of Azerbaijan. The plant infected with the disease lags behind in height development, as well as the photosynthesis process in the leaves of the plant is disturbed. The causative agent of brown rust disease is the fungus Puccinia recondita. The initial symptom of the disease is the formation of very small dark-brown spots on the leaves. They gradually turn into short maroon lines, and if we look closely at those lines, we can see that they consist of a collection of short maroon lines. The disease can be spread by air-droplet or raindrop. Cold, damp weather and early sowing are the main causes of the disease. Every year, brown rust disease causes 30-35% yield loss in barley. Disease resistance depends on humidity, amount of precipitation, air temperature, nutrients, density of sowing, etc. depends on factors. The most effective way to protect plants from disease is to create and breed resistant varieties (Kadyrov, 2002). Vavilov (1935) noted that primary material plays a major role in the creation of new high-yielding and disease-resistant varieties. During the evaluation of the primary material, it is possible to reveal a wide intraspecies polymorphism of the barley plant according to the mentioned signs (Afanasenko & Rol, 2009; Ershova & Velibekova, 2009; Garkavy *et al*., 1985; Khohlova, 1990).

2. Material and methods

Evaluation of yellow and brown rust diseases was carried out in April and May 2023 on 70 cultured barley samples as a research object. The study of the most important signs for the farm and phenological observations were carried out according to the generally accepted methodology (Musaev *et al*., 2008). These samples were taken from the National Genbank under the Institute of Genetic Resources, and were sown in November 2022 in the field of the Institute's Absheron Scientific Experimental Farm Base. The method of sowing was done by randomization method in 3 replicates. All plants were observed and the degree of yellow and brown rust diseases was determined according to the international descriptor.

3. Results and their discussion

Based on numerous observations made in different barley populations, the degree of yellow and brown rust diseases in the plant was determined. The obtained results are listed in Table 1.

Table 1. Evaluation of yellow and brown rust diseases in 70 samples of cultivated barley (*Hordeum vulgare* var. nutans)

Barley sample		Yellow rust disease	Rust disease
1.	TYB-132 Az	10 S	5 S
2.	TYB-111/2 Az	20 S	5 S
3.	TYB-129/3 Az	30 S	10 S
4.	TYB-126/2 Az	30 S	10 MR
5.	TYB- 7412 Az	10 S	10 MR
6.	TYB-2917 Az	20 S	R
7.	TYB-140/2 Az	30 MS	R
8.	TYB-148 Az	30 S	R
9.	TYB-133 Az	R	R
10.	TYB-149/2 Az	90 S	10 S
11.	AG-2631 Az	10 MR	R
12.	AG-2630 Az	30 MS	R
13.	AG-2635 Az	30 S	10 MR
14.	AG-2637 Az	30 S	10 MR
15.	AG-2640 Az	10 MR	R
16.	AG-2634 Az	10 S	R
17.	AG-2638 Az	10 MR	R
18.	AG-2632 Az	R	R
19.	AG-2641 Az	R	R
20.	AG-2639 Az	R	R
21.	AG-2633 Az	10 S	R
22.	AG-1586 Az	10 S	R
23.	AG-1561 Az	R	R
24.	AG-1587 Az	R	R
25.	AG-1543 Az	R	R
26.	AG-1537 Az	R	R
27.	AG-1535 Az	10 S	R
28.	AG-1533 Az	60 MR	R
29.	AG-1530 Az	10 S	10 MR
30.	AG-1527 Az	10 MR	R
31.	AG-1517 Az	10 S	10 MR
32.	AG-1513 Az	R	R
33.	AG-1512 Az	5 S	10 MR
34.	HO(i) 16 Rus	R	R
35.	HO(i) 20Netherlands	10 MR	R
36.	AG-594 Germany	R	R
37.	AG-590	30 MS	R
38.	AG-595 Kazakhstan	20 S	R
39.	AG-598 Czech Rep.	R	R
40.	HO(i) 29Netherlands	R	R
41.	HO(i) 30 Rus	10 S	20 S
42.	HO(i) 35 Ukraine	R	R
43.	AG-593 Turkey	30 S	R

44.	HO(i) 43 France	70 S	30 S
45.	AG-587 Georgia	70 S	20 S
46.	HO(i) 42 Mexico	R	R
47.	HO(i) 48 UK	10 MR	R
48.	AG-586 Kazakhstan	R	R
49.	HO(i) 27 Sweden	R	R
50.	TYB-26217 France	10 MR	10 S
51.	HO(İ) 12 Rus	R	R
52.	HO(i) 1 Denmark	30 S	10 S
53.	HO(i) 13 Germany	R	R
54.	TYB-27470 Poland	R	R
55.	TYB-27458 France	10 MR	R
56.	TYB-29229 Hungary	R	R
57.	HO(i) 2 UK	R	R
58.	HO(i) 4 Rus	R	R
59.	HO(i) 23 UK	5 S	R
60.	TYB-29097 Bulgaria	30 S	10 S
61.	TYB-25956 Sweden	10 MR	R
62.	HO(i) 25 Rus	10 MR	R
63.	HO(i) 10 Rus	R	R
64.	AG-596 Turkey	10 MR	R
65.	15-19 Nutans (Sato)	10 MR	R
66.	20-24NutansFitotron	R	R
67.	50-54 46 yerliNaza	60 MR	R
68.	55-57 Nutans yerli21	60 MR	R
69.	167-168 49 Naza	30 S	R
70.	№25-29St.Qarabağ 7	10 S	5S

Here R- resistant, MR- less resistant, S- sensitive, MS-less sensitive.

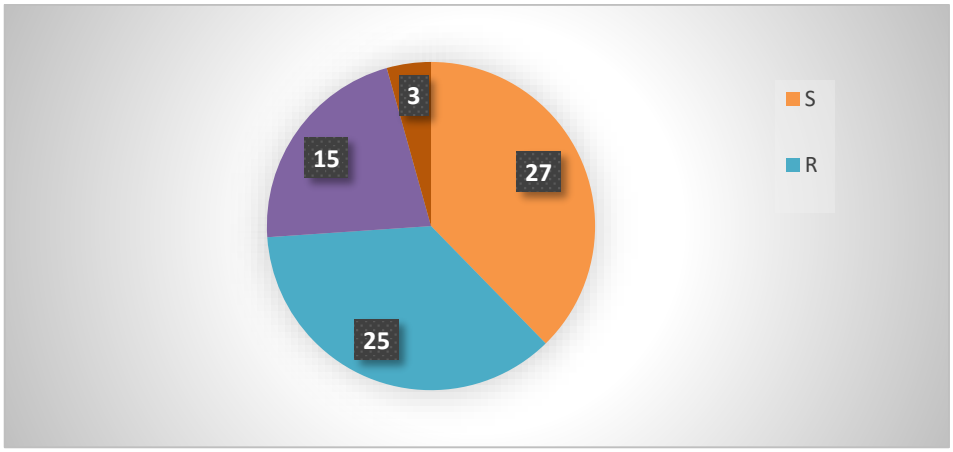

Figure 1. Indicators of yellow rust disease in barley samples

As it is clear from the diagram 1, 25 of the 70 barley samples grown in the field under Institute of Genetic Resources in 2023 showed high resistance to yellow rust disease, while 27 samples were susceptible to this disease. 15 of the remaining samples were less resistant. Pay attention to the table. In 12 of the 15 less durable samples, this indicator was only 10%, while in the remaining 3 it was slightly higher, making up 60%. Low sensitivity was found in 3 out of 69 samples, which was 30% in each case. Among the sensitive samples, sample TYB-149/2 has the highest sensitivity (90%). The

sensitivity indicators of HO(i)43 and AG-587 samples were 70%. HO(i)23 cultured barley sample showed the least sensitivity.

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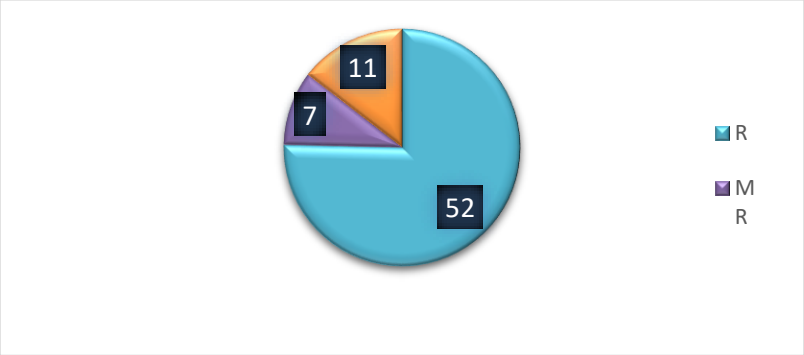

Figure 2. Indicators of brown rust disease in barley samples

As illustrated in Figure 2, 52 of 70 cultivated barley samples showed high resistance to brown rust, 11 samples were susceptible, and the remaining 7 samples showed low resistance. No examples of low sensitivity were found. If we compare Fig. 1 and Fig. 2, we can see that the number of samples resistant to brown rust disease is more than the number of samples resistant to yellow rust disease out of 70 barley samples selected for the experiment. TYB-133, AG-2632, AG-2641, AG-2639, AG-1561, AG-1587, AG-1543, AG-1537, AG-1513, HO(i) 16, AG-594, AG-598, HO(i) 29, HO(i) 35, HO(i) 42, AG-586, HO(i) 27, HO(I) 12, HO(i) 13, TYB-27470, TYB-29229, HO(i) 2, HO(i) 4, HO(i) 10, 20-24 Nutans Fitotron samples showed high resistance to both rust diseases. In the future, it was recommended to use these samples as a starting material for the creation of new varieties due to the signs of resistance to diseases and to create new collections.

4. Conclusion

In the current research work, as a result of phenological observations made in 70 cultivated barley (*Hordeum vulgare* L.) accessions planted in the field of the Absheron Experimental Station of the Institute of Genetic Resources in 2023 the rates of yellow and brown rust diseases were comparatively analyzed. Numbers, which show high resistance to both diseases among the samples are selected. It was recommended to use the samples selected according to the yield and disease-resistant elements as starting material for obtaining high-yielding varieties in the future.

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