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EVALUATION OF COMMERCIAL AND COLLECTION VARIETIES OF BARLEY FOR RESISTANCE TO MAJOR FUNGAL DISEASES IN FIELD CONDITIONS

Abstract

Barley is an important grain feed crop. A significant amount of it is also used for the production of cereals and beer. Barley ranks fourth in the world in terms of sown area (about million hectares) and grain harvest. The volume of barley crops in the Republic of Kazakhstan is reaching 2 million hectare. In 2021-2023 on the experimental field of the Kazakh Research Institute of Agriculture and Plant Growing conducted a field assessment of the resistance of 216 varieties of winter and spring domestic barley origin to the most common fungal diseases in Kazakhstan Over three years of field research, it was possible to obtain objective data on the reaction to infection with a pathogen. Based on the results of phytopathological assessment, sources of resistance to major fungal diseases were selected among barley varieties. We divided the studied varieties into groups based on the degree of resistance (susceptibility) to the causative agents of fungal diseases, highly resistant (damage rate 0%) not detected, resistant: were discovered 59 varieties of winter and spring barley resistant to fungal diseases.

Key words: *barley, variety, sample, fungal diseases, spreading, resistance.*

Introduction

Barley (*Hordeum vulgare* L.) is a universal crop for distribution and use in agricultural production. According to the Agriculture and Food Agency of the United Nations, in world agriculture, the sown area of barley is 60 million hectares, which is the fourth largest after wheat, rice and corn [1]. Barley is one of the main forage that are grown everywhere in all regions of Kazakhstan[2]. According to local executive bodies, in 2022 the area sown with barley in Kazakhstan amounted to 2.3 million hectares, which is 9 percent more than last year [3].

The efficiency of growing barley decreases in some years due to the intensive development of fungal diseases that affect the plant throughout the entire growing season from germination to harvest and significantly reduce yields. Among the diseases caused by the fungus, the most dangerous and common for the barley crop are leaf spot and powdery mildew [4].

The causative agent is *Blumeria graminis f.sp. hordei* (syn. Powdery mildew disease (*Erysiphe graminis* DC), a fungus of the class of ascomycetes, is considered one of the most harmful pathogens of barley crops in many regions of the world. This disease develops mainly on the leaves, but the fungus affects all above-ground organs of the plant[5].

Rhynchosporium blight, or striped leaf disease (caused by Rhynchosporium commune), has been reported in more than 50 countries in Asia, Europe, Africa, North and Latin America. In general, this disease is observed in areas where barley is grown and is more common in cool and semi-humid regions, resulting in a 35-40% reduction in yield[6].

Barley net spot (caused by *Pyrenophora teres Drechsler* (anamorph: *Drechslera teres* (Sacc.) Shoem.)) is a pathogen of economic importance in many countries around the world. The pathogen has two forms: *P. teres f. maculata* and *P. teres f. teres*. These two forms of fungi are morphologically identical, but genetically and symptomatically different [7].

The next type of barley leaf disease is an outbreak of dark brown spot, caused by the fungus *Cochliobolus sativus* (anamorph: *Bipolaris sorokiniana*). In addition, this pathogen causes rotting of plant roots and burns of shoots. The fungus has a wide habitat, meaning that it is a pathogen of barley, bread and durum wheat, triticale, rye, corn, rice and some plant species [8].

All of the above diseases of barley crops are found in the grain regions of Kazakhstan, and the pace of their development and distribution varies depending on climatic conditions, the internal structure and racial composition of pathogen populations, and the ability of commercially grown barley varieties to protect themselves from diseases. Many commercial varieties of spring and winter barley grown in Kazakhstan suffer greatly from spot diseases, rhynchosporiosis, dark brown spot and powdery mildew, caused by the fungus. Therefore, it is necessary to strengthen research work aimed at identifying varieties and lines of spring barley resistant to these diseases [9].

The main goal of the research work is to assess the resistance of new and collection barley varieties to major fungal diseases.

Methods and materials

Varietal samples and collection varieties of winter and spring barley were used as research materials in a trial variety trial. The total number of barley sample varieties used for immunological evaluation is 216, of which 141 are spring barley sample varieties and 75 are winter barley sample varieties.

The experiments were carried out in 2021-2023 in the irrigated field of the Kazakh Research Institute of Agriculture and Plant Growing, located in the village of Almalybak, Karasai district, Almaty region. Grains of barley sample varieties were sown manually from 25 grains per plot with a row spacing of 15 cm. The Aydin (winter barley) and Arna (spring barley) varieties, approved for cultivation in Kazakhstan, were used as a control variety in practice. When conducting research work, methodological instructions were used for testing barley and oat crops in field conditions [10]. The resistance of adult plants to fungal diseases of barley varieties used for research in field conditions, i.e., the degree of their development was taken into account at the stages of milky and waxy ripening of the crop (development phases GS75 and GS85 on the Zadoks scale) [11]. The degree of damage to barley varieties by blight, rhynchosporia, dark brown spot and powdery mildew diseases was determined using methods and scales that meet international requirements. Plants with a level of disease damage of 0% turned out to be immune, 1-10% - resistant, 11-30% - moderately resistant, 31-50% - moderately unstable, 51-100% - unstable [12,13].

Statistical and correlation analysis of barley disease resistance data includes GraphPadPrism 8 software packages (GraphPad Software, Inc., LaJolla, CA, USA). In this case, the Pearson linear correlation coefficient (r) was used to determine the relationship between the variables. At $P<0.05$, differences were considered statistically significant.

Results and discussion

The degree of disease development in barley sample varieties under field conditions varied depending on the type of pathogen and the form of plant development. In the sample varieties of winter barley, there is a significant difference between the degrees of development of leaf spot, dark brown spot and powdery mildew with rhynchospora diseases ($p<0.03$-0.008) (Figure 1A). That is, during the years of research, the degree of development of powdery mildew in the sample varieties of winter barley generally ranged from 0-30% (average 8.44-19.06%), while this indicator of other fungal diseases was 5-50% (on average 13.44-26.69%)

A relatively high incidence of net spot, dark brown spot and rhynchosporosis compared to powdery mildew was also observed in the sample varieties of spring barley (Figure 1B), respectively, the level of accuracy between them is $p<0.0003$-0.0001. In practice, the diseases net spot, dark brown spot, rhynchosporium and powdery mildew developed most intensively in the sample varieties of spring barley compared to breeding materials of the winter form, i.e., the average degree of their development was in the range of 22.17-34.17 % (Figure 1B). However, the results of statistical processing of the obtained data showed that there was no significant difference between the degree of development of outbreaks of barley leaf spot (net spot, dark brown spot, rhynchosporium blight).

Correlation analysis showed an average and upper positive correlation between the degree of development of all diseases identified in winter barley ($r = 0.326$-0.818, $p <0.001$-0.0001). Similarly, the vast majority of diseases occurring in spring barley also had a strong correlation by development level (r = 0.512-0.753, p < 0.0001), only in this crop a weak positive correlation was found between the pathogens *Rhynchosporium commune* and *Cochliobolus sativus* (r = 0.205, p < 0.05).

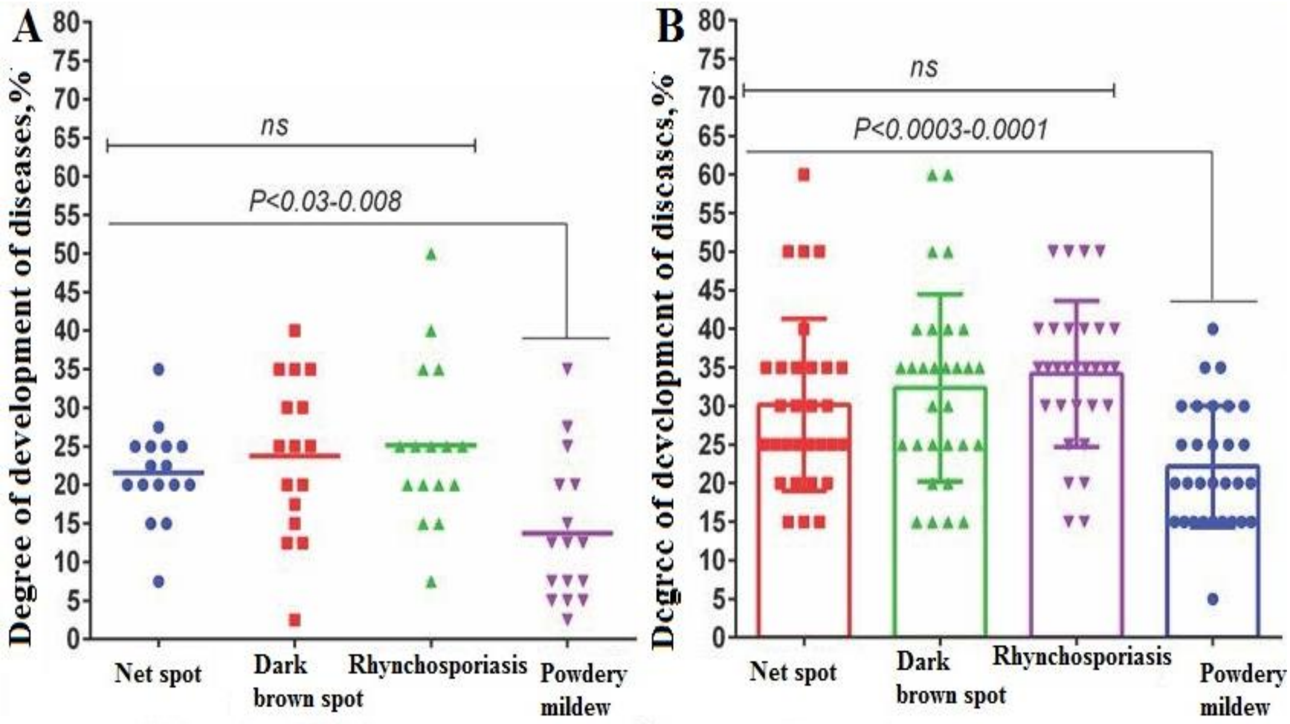


Figure 1- The degree of development of fungal diseases in sample varieties of winter (A) and spring (B) barley

In the sample varieties of spring barley there was a negative correlation (r = -0.098-0.196) between the degree of development of these diseases in the sample varieties of spring barley with a dark brown spot and the level of development of rhynchosporium diseases. A negative correlation was also noted between the level of damage to the sample varieties of spring and winter barley by powdery mildew and net blotch diseases (r = 0.042-0.106) (Table 1).

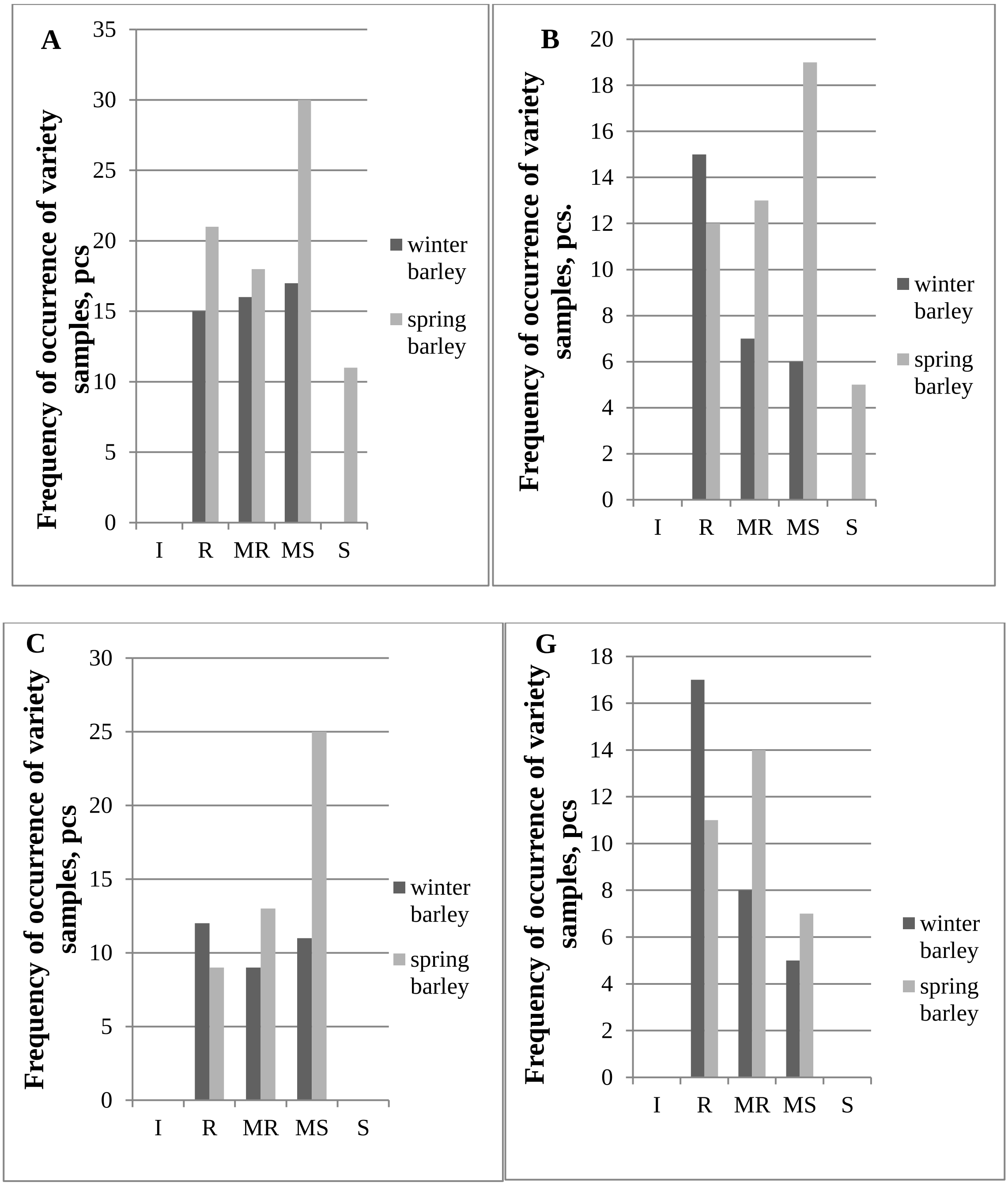
Table 1- Correlation between the degree of disease development in sample varieties of winter and spring barley

Crop- pathogen	WB-PT	WB-CS	WB-RC	WB-BG	SB-PT	SB-CS	SB-RC	SB-BG
WB-PT	1	0,511***	0,448**	0,818***	0,356**	0,196^{ns}	-0,189^{ns}	0,042^{ns}
WB-CS	0,511***	1	0,570***	0,326**	0,272*	0,363**	-0,137^{ns}	0,355**
WB-RC	0,448**	0,570***	1	0,590***	0,440**	0,164^{ns}	-0,321^{ns}	0,252*
WB-BG	0,818***	0,326**	0,590***	1	0,337**	0,058	-0,098^{ns}	0,106^{ns}
SB-PT	0,356**	0,272*	0,440**	0,337**	1	0,523***	0,514***	0,753***
SB-CS	0,196^{ns}	0,363**	0,164^{ns}	0,058^{ns}	0,523***	1	0,205*	0,641***
SB-RC	-0,189^{ns}	-0,137^{ns}	-0,321^{ns}	-0,098^{ns}	0,514***	0,205*	1	0,512***
SB-BG	0,042^{ns}	0,355**	0,252*	0,106^{ns}	0,753***	0,641***	0,512***	1

Notes: WB – winter barley, SB – spring barley, PT – *Pyrenophora teres*, CS – *Cochliobolus sativus*, RC – *Rhynchosporium commune*, BG – *Blumeria graminis*, * – p < 0.05, ** – p < 0.001, *** – p < 0.0001, ^{ns} – not significant

Among the winter and spring barley varieties tested in the field, no immune forms to leaf spot and powdery mildew diseases were detected (Figure 2). In the barley variety trials that pose a danger to the barley crop, 16 winter barley varieties showed resistance, 14 showed average resistance, and 26 showed average susceptibility, while 21 spring barley varieties were resistant to this disease, 18 showed average resistance, 30 showed average resistance, and 11 showed average resistance (Figure

2A). According to the resistance to dark brown spot disease, the frequency of occurrence of winter barley accession varieties was the same, i.e. 15 of them belong to the category of resistant, 17 - moderately resistant and 16 - moderately non-resistant forms. The proportion of spring barley accession varieties according to these immunological traits to this disease was high, respectively, 12 accession varieties were resistant, 13 - moderately resistant, 19 - moderately resistant, 5 - non-resistant (Figure 2B). The total frequency of occurrence of winter and spring barley accession varieties resistant to rhynchosporiosis disease was 21, and powdery mildew - 27. Accession varieties with moderate resistance to these diseases and moderate non-resistance were encountered with different frequencies (Figure 2C, 2G).



Notes: *I – immune, R-resistant, Mr – moderately resistant, MS –moderate susceptible, S-susceptible*

Figure 2 - Frequency of occurrence of winter and spring barley varieties by resistance to net spot (A), dark brown spot (B), rhynchosporiosis (C) and powdery mildew (G)

Samples were selected that showed more pronounced disease resistance reactions than the Arna control spring barley and the Aydin winter barley variety, widely used in grain fields in Kazakhstan (Table 2).

Table 2 - Phytopathological characteristics of barley varieties sorted by resistance to fungal diseases

Crop	Name of the variety-samples	Degree of disease development, %			
		net spot	dark brown spot	rhynchosporiosis	powdery mildew
Winter barley	Aydin, control	40	40	40	35
	77/12-5	20	10	10	15
	5/15-2	10	5	20	10
	71/13-13	20	10	15	10
	102/14-4	15	10	10	5
	414 x 35-7	10	15	10	10
	61/13-9	20	10	10	15
	71/13-10	10	5	10	10
	45/15-8	10	20	10	10
	64/12-3	15	10	15	10
	66/12-8	5	10	15	10
	64/12-3	10	10	15	5
	75/12-3	15	10	15	10
	66/12-5	10	5	10	15
	77/09-3	10	10	15	15
	114 x 34-1	10	10	15	5
	81/14-2	10	15	20	10
	66/12-6	10	10	15	10
	6/09-1	5	15	20	10
	64/12-3	5	10	15	10
Spring barley	Arna, control	35	25	20	15
	5/05-2	5	5	10	10
	54/80-5	10	10	20	15
	1/10-2	10	10	20	15
	38/10-2	10	15	20	10
	2/09-4	5	10	15	15
	40/10-6	10	10	20	10
	3/04-2	10	10	15	5
	1/05-4	5	10	10	10
	4/78-7	10	15	10	5
	1/05-3	10	10	20	10
	58/80-3	10	5	10	5
	49/11-9	10	10	15	10
	42/11-2	20	10	15	10
	42/11-1	10	15	15	10
	72/80-3	10	20	20	10
	58/16-3	5	10	10	10
	40/10-2	15	10	20	10
	32/08-9	10	10	20	10
	51/99-1	15	10	10	5
	63/16-3	20	10	15	10
	9/78-1	10	5	10	10
	22/11-3	10	20	15	10
	4/17-3	10	10	20	10
	13/09-4	20	10	25	10
	1/80-15	15	20	10	15
	5/05-1	10	15	10	15
	41/16-4	20	20	20	10
	21/09-9	10	15	15	10
	17/07-4	20	20	20	15

	9/17-6	15	10	15	15
	10/17-2	20	10	20	15
	20/17-5	10	10	20	15
	1/80-2	15	10	20	10
	8/17-8	10	10	10	15
	21/15-1	20	20	15	15
	10/06-2	20	20	20	10
	9/15-11	15	10	15	15
	58/16-1	10	10	20	15
	42/03-14	20	15	15	10
	3/04-2	10	10	20	10

Of the winter barley accessions used in the overall study, 19 accessions and 40 accessions of spring barley were slightly affected by spot, dark brown spot, rhynchospora and white powder diseases, i.e., the degree of disease development in them was within 5-20%.

To date, a set of individual barley varieties has been assessed in Kazakhstan for resistance to stem rust, net spot, dark brown spot and powdery mildew using traditional phytopathological methods and modern genomic technologies [9,14,15]. Comprehensive studies have also been conducted in various regions of the country to determine the population structure of the pathogens *Pyrenophora teres* and *Blumeria graminis*, the racial composition and the effectiveness of resistance genes to these diseases. Recently, the demand for feed, raw materials for the food and brewing industries has been growing in the agriculture of the Republic of Kazakhstan, so it is necessary to continue research aimed at identifying barley varieties that are resistant to diseases common in the country and capable of producing high-quality products. Taking this into account, this research paper described 216 varieties of winter and spring barley for resistance to fungal diseases.

Of the winter barley accessions used in the overall study, only 19 accessions (25.3% of the breeding material used in the experiment) showed resistance to spotting, dark brown spot, rhynchospora and powdery mildew, and only 40 (28.4%) of the spring barley accessions were resistant to two and three of the four diseases taken into account. 48 barley varieties produced by the Karabalyk Agricultural Experimental Station were tested in 2015-2016 against the artificial background of spotting and powdery mildew diseases, of which only 6 samples showed complex resistance to these diseases during the growing season [9]. In addition, in those years, out of 116 barley varieties introduced to Kazakhstan from abroad, 45 or 38.8% of the samples showed resistance to spotting and 43 (37.1%) to powdery mildew [16]. This means that international breeding centers have significantly more barley samples that effectively protect against fungal diseases than domestic barley breeding.

The correlation analysis conducted in this work showed that in most cases there is a positive correlation between the degree of development of all diseases identified in barley. These results are consistent with the indicators of wheat crop resistance to fungal diseases. That is, in 2018-2019, in the conditions of Kazakhstan, the wheat variety *Puccinia graminis f.sp. tritici* and *P. triticiana* also showed a positive correlation between resistance to pathogens [17,18].

In Kostanay and Zhambyl regions of the country, in 2013-2014, about 700 selection materials of the spring barley crop were evaluated, including 96 lines of Kazakhstan for resistance to black-brown spots. As a result, based on the associative mapping approach, 7 QTL barley associated with black brown spot resistance were identified, of which 4 QTL are responsible for germination resistance and 3 QTLs are responsible for resistance at the adult plant stage [14]. This suggests that there are domestic varieties of barley that can genetically protect themselves from dark brown spot. But to determine the genetic resistance of barley varieties to the diseases described in this article using phytopathological methods, additional research is needed.

Also, the majority of barley varieties that exhibit resistance to fungal diseases in field conditions are unstable to individual races or pathotypes of pathogens in the germination phase [9]. Since the grain regions of Kazakhstan contain pathotypes of *Pyrenophora teres* and *Blumeria graminis* with very high virulence, many varieties and samples of barley are affected when favorable conditions for their development arise. Barley resistance to diseases is generally controlled by polygenic (horizontal resistance) and oligogenic (vertical resistance) systems. Therefore, in the future, it is necessary to test barley cultivars selected for disease resistance in the field in the seedling phase and determine their ability to protect against highly virulent races and pathotypes of fungal pathogens.

Conclusions

In accordance with the objective of the scientific work, the resistance of new and collection varieties-samples of barley to the main fungal diseases was assessed. The selected samples are the most valuable first material for barley breeding, but for their effective use in breeding programs aimed at fungal diseases common in Kazakhstan, additional research is still required. These include studying the resistance of barley varieties to particularly dangerous pathogens, conducting genetic screening using molecular markers, and identifying traits of economic value.

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References

1. Repko N.V., Podolyak K.V., Smirnova Ye.V., Ostrozhnaya YU.V. Statisticheskiye issledovaniya mirovogo proizvodstva zerna yachmenya. // Nauchnyy zhurnal KubGAU. – 2015. – 106(02). – C.1-9.

2. Rysbekova A.M., Sultanova N. Zh Infection of winter and spring barley by root rot in south-east Kazakhstan. https://journal.kaznaru.edu.kz/index.php/research/issue/view/3/8

3. Ploshchadi yachmenya v Kazakhstane uvelichili na 187 tys. ga [Elektron.resurs]. - URL: https://eldala.kz/novosti/zerno/9728-ploshchadi-yachmenya-v-kazahstane-uvelichili-na-187-tys-ga(дата обращения 13 июня 2022 г).

4. Koyshibayev M. Bolezni zernovykh kul'tur. – Almaty: Bastau, 2002. – 368 c.

5. Dreiseitl A., Kosman E. Virulence phenotypes of Blumeria graminis f. sp. hordei in South Africa. // Eur. J. Plant Pathol. – 2013. – Vol.136. – P.113–121.

6. Avrova A., Knogge W. Rhynchosporium commune: A persistent threat to barley cultivation. // Mol. Plant Pathol. – 2012. – Vol.13. – P. 986–997.

7. Akhavan A., Turkington T.K., Askarian H., Tekauz A., Xi K., Tucker J.R., Kutcher H.R., Strelkov S.E. Virulence of Pyrenophora teres populations in western Canada. // Can. J. Plant Pathol. – 2016. – Vol. 38. – P. 183–196.

8. Acharya K., Dutta A.K., Pradhan P. ‘Bipolaris sorokiniana’ (Sacc.) Shoem.: The most destructive wheat fungal pathogen in the warmer areas. // Aust. J. Crop Sci. – 2011. – Vol.5. – P. 1064.

9. Gupta P., Chand R., Vasistha N., Pandey S., Kumar U., Mishra V., Joshi A. Spot blotch disease of wheat: The current status of research on genetics and breeding. // Plant Pathol. – 2018. – Vol.67. – P. 508–531. https://doi.org/10.1111/ppa.12781

10. Rsaliyev A.S., Chudinov V.A., Amirkhanova N.T. Ustoychivost' selektsionnykh materialov yachmenya Karabalykskoy sel'skokhozyaystvennoy opytnoy stantsii k setchatoy pyatnistosti i muchnistoy rose // Doklady NAN RK. – 2016. - №4. – C.79-87.

11. Loskutov I.G., Kovaleva O.N., Blinova Ye.V. Metodicheskiye ukazaniya po izucheniyu mirovoy kollektsii yachmenya i ovsa // SPb.: VIR. – 2012. – 63 c.

12. Zadoks J.C., Chang T.T., Konzak C.F. A decimal code for the growth stages of cereals. // Weed Res. – 1974. – Vol.14. – P. 415–421.

13. Afanasenko O.S. Metodicheskoye ukazaniya po diagnostike i metodam polevoy otsenki ustoy-chivosti yachmenya k vozbuditelyam pyatnistostey list'yev. L.: VIZR. – 1987. – 20 c.

14. Saari E.E., Prescott J.M. A scale for appraising the foliar intensity of wheat disease //Plant disease reporter. – 1975. – Vol. 59. – № 5. – P. 377-380.

15. Turuspekov Y., Ormanbekova D., Rsaliev A., Abugalieva S. Genome-wide association study on stem rust resistance in Kazakh spring barley lines // BMC Plant Biology. – 2016. – Vol.16. – P.13-21.

16. Rsalïev A.S., Ämirxanova N.T. Teñbil daq jane aq untaq awrwlarına arpanıñ tözimdilik közderin tabw // Izdenister, nätïjeler. – 2016. - №3. – C.199-205.

17. Genievskaya Y., Turuspekov Y., Rsaliyev A., Abugalieva S. Genome-wide association mapping for resistance to leaf, stem, and yellow rusts of bread wheat in conditions of South Kazakhstan // Peer J. – 2020. – Vol. 8. DOI 10.7717/peerj.9820.

18. Genievskaya Y., Abugalieva S., Rsaliyev A., Yskakova G., Turuspekov Y. QTL Mapping for Seedling and Adult Plant Resistance to Leaf and Stem Rusts in Pamyati Azieva × Paragon Mapping Population of Bread Wheat // Agronomy. – 2020. – Vol. 10. – P. 1-18.

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ОЦЕНКА КОММЕРЧЕСКИХ И КОЛЛЕКЦИОННЫХ СОРТООБРАЗЦОВ ЯЧМЕНЯ НА УСТОЙЧИВОСТЬ К ОСНОВНЫМ ГРИБНЫМ ЗАБОЛЕВАНИЯМ В ПОЛЕВЫХ УСЛОВИЯХ

Аннотация

Ячмень-важная зернофуражная культура. Значительное количество его также используется для производства круп и пива. По посевным площадям (около миллиона гектаров) и сбору зерна ячмень занимает четвертое место в мире. Объемы посевов ячменя в Республике Казахстан достигают 2 миллионов гектаров. В 2021-2023 годах на опытном поле Казахского научно-исследовательского института земледелия и растениеводства проведена полевая оценка устойчивости 216 сортообразцов озимого и ярового ячменя отечественного происхождения к наиболее распространенным грибным заболеваниям в Казахстане. За три года полевых исследований удалось получить объективные данные о реакции на заражение возбудителем. По результатам фитопатологической оценки среди сортообразцов ячменя выбраны источники устойчивости (восприимчивости) к возбудителям грибных заболеваний, высокоустойчивые (повреждаемость 0%) не выявлены, выявлено 59 сортообразцов озимого и ярового ячменя, устойчивых к грибным заболеваниям.

Ключевые слова: *ячмень, сорт, образец, грибные заболевания, распространение, устойчивость.*

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ЕГІСТІК ЖАҒДАЙДА АРПАНЫҢ КОММЕРЦИЯЛЫҚ ЖӘНЕ КОЛЛЕКЦИЯЛЫҚ СОРТ-ҮЛГІЛЕРІНІҢ НЕГІЗГІ САҢЫРАУҚҰЛАК АУРУЛАРЫНА ТӨЗІМДІЛІГІН БАҒАЛАУ

Аңдатпа

Арпа-маңызы бар дәнді-малазықтық дақыл. Оның едәуір бөлігі жарма мен сыра өндіруге де жұмсалады. Дүние жүзінде арпа егіс көлемі (млн гектарға жуық) және өнімі бойынша төртінші орында. Қазақстан Республикасында арпа егісінің көлемі 2 миллион гектарға жетіп отыр. 2021-2023 жылдары Қазақ егіншілік және өсімдік шаруашылығы ғылыми-зерттеу институтының тәжірибе алқабында отандық күздік және жаздық арпаның 216 сорт-үлгілерінің Қазақстанда жиі кездесетін саңырауқұлақ ауруларына төзімділігі бойынша егістік бағалау жүргізілді. Үш жыл бойы егістік зерттеулердің нәтижесінде қоздырғышпен залалдану реакциясы туралы шынайы деректер алуға мүмкіндік болды. Фитопатологиялық бағалау нәтижелеріне сүйене отырып, арпа сорт-үлгілерінің арасында негізгі саңырауқұлақ ауруларына төзімділік көздері таңдалды. Зерттелген сорт-үлгілер саңырауқұлақ ауруларының қоздырғыштарына төзімділік (қабылдағыштық) дәрежесі бойынша топтарға бөлінді: жоғары төзімді (залалдану 0%) анықталмады, саңырауқұлақ ауруларына төзімді 59 күздік және жаздық арпа сорт-үлгілері анықталды.

Кілт сөздер: *арпа, сұрып, үлгі, саңырауқұлақ аурулары, таралуы, төзімділік*

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ОСОБЕННОСТИ ФОРМИРОВАНИЯ АССИМИЛЯЦИОННОЙ ПОВЕРХНОСТИ ГРЕЧИХИ ПОСЕВНОЙ В УСЛОВИЯХ АКМОЛИНСКОЙ ОБЛАСТИ

Аннотация

В статье приведены результаты исследования особенностей формирования площади листовой поверхности гречихи посевной (Fagopyrum esculentum Moench) в процессе онтогенеза. Наблюдения за развитием растений осуществлялось на протяжении всего периода вегетации. Бурный рост ассимиляционной поверхности растений гречихи отмечен в течении вегетативного периода растений. Наблюдался плавный переход от нарастания зеленой массы к цветению и формированию плодов. Выявлены биотипы гречихи, обладающие относительной скороспелостью, которая заключается в дружности созревания плодов во второй период вегетации. На продолжительность вегетативного и генеративного периодов сильное влияние оказывали условия внешней среды - сумма положительных температур и количество выпавших осадков. В условиях короткого безморозного периода Акмолинской области при создании новых сортов особую ценность приобретают биотипы, созревающие до наступления осенних заморозков. Для более качественной оценки продуктивности ассимиляционного процесса и нарастания площади листьев использованы различные методы измерений. Наиболее информативным и доступным при проведении исследований оказался метод линейных измерений.

Генеративный период у гречихи как правило более продолжителен и характеризуется большим количеством процессов, идущих параллельно с созреванием растений: формирование листьев, побегов, зерна и нарастанием общей биомассы. Поэтому трудно зафиксировать четкое наступление или окончание различных фаз развития растений. Кроме этого, из-за внутрисортовой изменчивости у каждой сортолинии можно выделить различные биотипы с отдельными отклонениями периодов онтогенеза в ту или иную сторону.

Изучение площади ассимиляционной поверхности листьев в процессе вегетации позволило отобрать биотипы культуры различающиеся по темпу прохождения фаз развития, установить зависимость между площадью листьев и зерновой продуктивностью. Выделены