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DISEASE MONITORING TO DETERMINE THE LEVEL OF SPREAD AND DEVELOPMENT OF THE PATHOGEN *PYRENOPHORA TRITICI-REPENTIS* IN KAZAKHSTAN

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Annotation

Tan spot, caused by the fungus *Pyrenophora tritici-repentis*, is economically important foliar disease in Kazakhstan. Monitoring of crops in the farms of the Almaty region was carried out to determine the spread and degree of development of tan spot, as well as the collection of infectious wheat material for further study of virulence. The aim of the study is disease monitoring and to

identify the genotypic potential of resistance to tan spot of cultivated wheat cultivars. As a result of the research, 18 (52.9%) cultivars and lines (Karasai, Matai, Bogarnaya-56, Taza, Kozha, Daulet, Asiada, BARU, Kazakhtanskii yantar, Satti, Kazkhastanskaya 10, Almaly, Zhetisu, Naz, Bezostaya 1, Brazilskaya elita, Brazilskaya ozimaya and Bezostaya 100) resistant to tan spot were identified. As a result of the selection and genetic study of promising wheat lines and cultivars, it is shown that it is recommended to use selected promising wheat lines and cultivars in Almaty region, which showed resistance to diseases, as a promising material in breeding for disease resistance. In the future, these 18 cultivars will be studied at subsequent stages of the breeding process in order to create new high-yielding varieties of winter wheat.

Key words: wheat; tan spot; pathogen; resistance; monitoring; differentiator varieties; *Pyrenophora tritici-repentis.*

Introduction

World grain production has been increasing in recent years, but the loss of wheat in the world from diseases accounts for 10% of the potential harvest [1]. According to FAO, annual global crop losses from diseases and pests of agricultural crops increased from 52.2 million tons of conventional grain units in 1986-1990 to 75 million tons in 2005-2015. A similar trend of increasing their harmfulness is observed in Kazakhstan.

One of the main reasons for the high losses of grain harvest in Kazakhstan is the intensive development of fungal diseases of wheat. Wheat crop losses in the republic from diseases in recent years have reached 25-30% of the southeast of Kazakhstan is occupied by rust fungi (yellow, stem and brown rust) [2-7], as well as diseases of leaf spots (Tan spot and Septoria) [8-12]. It is known that under the influence of abiotic and biotic factors in nature, there are constant changes in the racial composition of pathogens. Annual monitoring of the most dangerous diseases and analysis of the structure of pathogen populations allows us to assess the dynamics of their variability and identify isolates with a new virulence spectrum.

Tan spot (TS) of wheat, the causative agent *Pyrenophora tritici-repentis* (Died.) (PTR), is one of the most harmful diseases of soft and durum wheat in many agricultural regions of the world, including Kazakhstan. The reasons for the development of the disease in the region are minimal tillage with the preservation of stubble, wheat monoculture, and the cultivation of varieties resistant to the pathogen [2]. Tan spot can cause significant yield losses of up to 50%. Integrated disease control strategies, such as the cultivation of resistant varieties, combined with desirable crop rotations and management practices, are the most effective, environmentally friendly, and cost-effective means to control wheat blight [13].

When *P. tritici-repentis* infects susceptible wheat germplasm, necrotic or chlorotic symptoms are induced due to the interaction of host-

selective toxins (HST) produced by different races [14-16] which function as virulence factors [17]. Today, three host specific toxins, Ptr ToxA, Ptr ToxB and Ptr ToxC, have been identified and characterized in the 8 known races. Ptr ToxA induces necrosis on sensitive wheat cultivars [18-20]. It is produced by races 1, 2, 7 and 8 [16], so by approximately 80% of isolates Ptr ToxB is responsible of chlorosis symptoms in sensitive wheat genotypes, and it was identified in isolates of races 5 (Orolaza et al. 1995), 6, 7 and 8 [16]. While Ptr ToxC causes extensive chlorosis, it was found to be produce by races 1, 3, 6 and 8 [16].

Thus, due to the intensification of wheat production, the transition to minimizing tillage, the susceptibility of wheat varieties and the widespread use of fungicides, diseases such as yellow and brown rust, tan spot are becoming widespread, economically significant throughout the world, including in Kazakhstan. The presence and activation of intense foci of the above-mentioned diseases requires their annual monitoring, selection of new sources of resistance and their introduction into production.

The research strategy is based on an integrated approach, including selection and phytopathological research methods: the levels of danger of the pathogen of the most dangerous pathogen (tan spot) in various regions of Kazakhstan were determined. The aim of the study is disease monitoring and to identify the genotypic potential of resistance to tan spot of cultivated wheat cultivars.

Materials and methods

The objects of research are commercial cultivars and promising lines of winter and spring wheat, cultivated or being candidates for new cultivars. To determine the area of distribution and severity of tan spot, affected samples of wheat leaves were randomly collected in the southeastern and northern regions of growing winter and spring wheat in Kazakhstan - Almaty, Akmola. An analysis of the phytosanitary state of wheat crops was carried out during the heading period of the milky-wax ripeness of the grain in the growing season 2020-2021.

Monitoring of wheat crops includes analysis of 50-100 stems of each variety. To determine the intensity of the development of tan spot disease, a scale was used according to the method of Saari E.E. and Prescott L.M. [21]. This indicator was estimated by the area of the affected surface of organs covered with spots. The spread of the disease or the percentage of affected plants was determined by the method of Saari E.E. and Prescott L.M.

The spread (P) of the disease or the percentage of affected plants was determined by the formula [21]:

$$P = n \times 100 / N$$

where P – is the spread of the disease;
N – is the total number of plants in the sample;
n – the number of plants infected with the disease.

Whereas, R – the development of diseases is determined by the formula:

$$R=\sum ab/N$$

where, $\sum ab$ is the total sum of all scores;
N – is the total number of plants in the sample.

The assessment of wheat resistance to tan spot was determined by the benzimidazole method of L.A. Mikhailova [22]. Under laboratory conditions, samples of winter wheat were grown on plastic flowerpots filled with soil for 12-13 days. Then, leaf segments (2.0-3.0 cm long) were placed on moistened filter paper moistened with a solution of benzimidazole (0.004%) in cuvettes. After that, the material was infected with a suspension of *P. tritici-repentis* conidia grown on a vegetable medium. Cuvettes with inoculated leaf segments were covered with a film to create high air humidity and kept in the Flora chamber for 5-7 days at a temperature of 17-20ºC. After that, the analysis of the intensity of the manifestation of the disease on segments of the leaves was carried out according to a 5-point scale according to the method (Table 1) [23].

Table 1 – Scale for assessing the resistance of wheat samples and varieties to the causative agent of tan spot

Lesion size and appearance	Type of reaction, score (0–5 scale)	Phenotypic expression
No lesion present (indicates no infection or strong plant resistance)	0	HR (high resistance)
Small, dark brown to black singular spots (<0.5 mm diameter).	1	R (resistance)
Small dark brown to black spots (1–2 mm diameter) with very faint chlorotic borders.	2	MR (moderate resistance)
Small to medium (2–3 mm diameter) oval to diamond shaped lesion.	3	MS (moderate susceptibility)
Medium sized oval/ diamond shaped lesion (3–10 mm diameter).	4	S (sensitivity)
Medium to large oval/ diamond shaped lesion (10–20 mm diameter) with distinctive central eye spot being indistinguishable.	5	HS (high susceptibility)

Results

Phytosanitary assessment of wheat crops in the south-eastern region of Kazakhstan was carried out. The greatest attention is paid to winter wheat crops in the Almaty region. Monitoring of the spread and severity

of wheat leaf spot diseases, in particular, *P. tritici-repentis*, included phytopathological surveys of wheat crops in the Karasai, Talgar and Zhambyl regions. The assessment was carried out in the heading phase of winter wheat. The growing seasons were favorable for pathogen infection and disease development.The average maximum of air temperature for mid-May in 2021 reached 17.1C and 19.5°C, respectively. For April to June 2021, mean daily temperature was 12.1°C, 22.8C and 23.0°C, respectively. For April to June 2021 the monthly rainfalls and relative humidity (RH) were 54 mm, 99 and 20 mm, and 37%, respectively (www.pogodaiklimat.ru/monitor.php); conditions highly conducive for tan spot infection and development.

In order to identify the prevalence and extent of tan spot (*P. tritici-repentis)* damage, monitoring was carried out in the second decade of June 2021 in the south-eastern region of Kazakhstan. The points of the route survey were the sown areas of wheat in the rural district of Almalybak, Karasai district, Almaty region.

As a result of monitoring, the symptoms of the disease showed a different degree of damage in individual cultivars (Figure 1). In the course of the study, the collection of infectious material infected with pathogenic and phytopathological evaluation was carried out on wheat cultivars. Phytopathological screening was carried out during the period of earing and milky-wax ripeness of the grain.

Figure 1 – Tan spot (*P. tritici-repentis*) disease symptom on the leaves

Table 2 provides information on the distribution and degree of development of tan spot (*P. tritici-repentis*) in 24 cultivars of winter soft and durum wheat, as well as triticale, on the sown area 0,08–0,16–0,25 ha on wheat fields of Almalybak rural district. The following cultivars of winter soft wheat showed high susceptibility to the disease: cultivar Steklovidnaya 24 with 92% damage, cultivar Almaly and Farabi - 84% and 86%, respectively. The indicators of the degree of development of the disease of these cultivars were 8-11.9% and 9.6-12.2%. In addition, a high development of the disease was observed in winter wheat cultivars

Vavilov, Momyshuly and Dimash, where the value of this indicator was 6.7-6.2% and 4.9%, and the prevalence of the disease in these varieties manifested itself at the level of 82%, 72% and 74%, respectively. The cultivars Egemen and Aliya showed an average distribution of *P. tritici-repentis* with 50%-52% infestation, while the infection rate was 3.0%-3.2%.

Table 2 – Determination of the distribution area of tan spot (*P. tritici-repentis*) in the Almaty region, 2021

Rural district, Peasant farm	Name of cultivars	Predecessors	Distribution and development of tan spot, %		Hectare (ha)
			P	R	
Region: Almaty; district Karasay; coordinates: N 43°13'557" E 076°42'094" B792					
r/d Almalybak	Steklovidnaya 24	winter soft wheat	92	8	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'560" E 076°42'093" B792					
r/d Almalybak	Almaly	winter soft wheat	84	12,2	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'567" E 076°42'093" B792					
r/d Almalybak	Zhetisu	winter soft wheat	10	0,9	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'575" E 076°42'094" B792					
r/d Almalybak	Farabi	winter soft wheat	86	9,6	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'581" E 076°42'093" B792					
r/d Almalybak	Momyshuly	winter soft wheat	72	6,2	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'587" E 076°42'093" B792					
r/d Almalybak	Vavilov	winter soft wheat	82	6,7	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'591" E 076°42'095" B792					
r/d Almalybak	Dimash	winter soft wheat	74	4,9	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'597" E 076°42'092" B792					
r/d Almalybak	Aliya	winter soft wheat	52	3,2	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'602" E 076°42'092" B792					
r/d Almalybak	Egemen	winter soft wheat	50	3	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'606" E 076°42'093" B792					
r/d Almalybak	Kyzyl bidai	winter soft wheat	32	1,9	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'611" E 076°42'096" B792					
r/d Almalybak	Talimi	winter soft wheat	22	1,1	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'619" E 076°42'092" B792					
r/d Almalybak	Sapaly	winter soft wheat	28	1,9	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'620" E 076°42'093" B792					
r/d Almalybak	Mamyr	winter soft wheat	22	1,1	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'626" E 076°42'094" B792					
r/d Almalybak	Daulet	winter soft wheat	0	0	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'629" E 076°42'094" B792					

r/d Almalybak	Steklovidnaya 24	winter soft wheat	14	0,7	0,08
Region: Almaty; district Karasay; coordinates: N 43°13'633" E 076°42'095" B792					
r/d Almalybak	Karasai	winter soft wheat	0	0	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'636" E 076°42'095" B792					
r/d Almalybak	Matay	winter soft wheat	0	0	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'643" E 076°42'095» B792					
r/d Almalybak	Bogarnaya 56	winter soft wheat	0	0	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'648" E 076°42'095» B792					
r/d Almalybak	Taza	winter triticale	0	0	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'653" E 076°42'094» B792					
r/d Almalybak	Kozha	winter triticale	0	0	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'659" E 076°42'095» B792					
r/d Almalybak	Aziada	winter triticale	0	0	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'663" E 076°42'094» B792					
r/d Almalybak	BARU	winter triticale	0	0	0,25
Region: Almaty; district Karasay; coordinates: N 43°13'666" E 076°42'094» B792					
r/d Almalybak	Kazakhstanskii Yantar	winter durum wheat	0	0	0,16
Region: Almaty; district Karasay; coordinates: N 43°13'675" E 076°42'094» B792					
r/d Almalybak	Satti	winter durum wheat	0	0	0,16
Notes: P - spread of the disease, R - intensity of the development of the disease, r/d-rural district; p/f - peasant farming					

According to the infection of the disease in winter wheat varieties Kyzyl bidai and Sapaly showed average resistance (28-32%). The spread of the disease in these varieties was 1.9%. A similar lesion with tan spot was noted in cultivars Talimi and Mamyr with an average degree of damage of 1.1% and a distribution level of 22%. A resistant reaction to the disease was noted in the winter wheat cultivar Daulet, the infection index of this cultivarwas 0.7-1%, and the prevalence rate was 14%-20%.

Thus, the area of distribution, development and harmfulness of tan spot pathogens *Pyrenophora tritici-repentis* in the Almaty region in 2021 was significant and reached 72-92% on the most widely cultivated varieties Almaly, Steklovidnaya 24, Zhetisu, Farabi and Momyshuly. It was found that of the 24 wheat varieties studied, most showed susceptibility to pyrenophorosis. This indicates the high harmfulness of the pathogen *P. tritici-repentis*, which is dangerous from the point of view of food security. Eight cultivars have been identified (Karasai, Matai, Bogarnaya-56, Taza, Kozha, Asiada, BARU, Daulet), which are determined to be resistant to the disease.Cultivars of winter durum wheat Kazakhtanskii yantar and Satti also showed high resistance to tan spot. It is recommended to use these tan spot resistant wheat cultivars in wheat production.

In 2021, according to the results of monitoring conducted in Karasai, Talgar and Zhambyl districts of Almaty region in the second decade of June, the spread of tan spot and the degree of damage to this disease were studied. Studies of winter wheat varieties were carried out on wheat production crops. As a result of observation, the symptoms of the pathogen manifested to varying degrees depending on the area of cultivation of the crop. During the study, a phytopathological assessment of the disease was carried out by collecting infectious material from wheat samples infected with the pathogen *P. tritici-repentis*. Monitoring of diseases was carried out during earing and milk-wax ripeness of grain (Table 3). In Almalybak rural district of Karasai district, the Kazkhastanskaya 10 variety sown on 40 hectares and the Almaly variety sown on an area of 20 hectares showed high resistance to tan spot.

Table 3 – Determination of the distribution area and severity of tan spot *P. tritici-repentis* in the Almaty region (Karasai, Talgar and Zhambyl regions), 2021

Rural district, Peasant farm	Name of cultivars	Predecessors	Distribution and development of tan spot, %		Hectare (ha)
			P	R	
Region: Almaty; district Karasay; coordinates: N 43°14'333" E 076°41'657" B783					
r/d Almalybak	Kazakhstanskaya 10	Barley	0	0	40
Region: Almaty; district Karasay; coordinates: N 43°14'291" E 076°41'521" B786					
r/d Almalybak	Almaly	Soybean	0	0	20
Region: Almaty; district Karasay; coordinates: N 43°14'168" E 076°41'376" B786					
r/d Almalybak	Zhetisu	Barley	86	6,80	30
Region: Almaty; district Talgar; coordinates: N 43°22'690" E 077°06'304"					
r/d Panfilov	Kazakhstanskaya 10	Barley	0	0	60
Region: Almaty; district Talgar; coordinates: N 43°24'326" E 077°09'854"					
r/d Panfilov	Bogarnaya 56	Soybean	0	0	55
Region: Almaty; district Talgar; coordinates: N 43°23'890" E 077°09'577"					
r/d Karabulak	Zhetisu	Barley	24	1,2	80
Region: Almaty; district Talgar; coordinates: N 43°24'802" E 077°12'875"					
r/d Koishybek	Naz	Oats	0	0	30
Region: Almaty; district Talgar; coordinates: N 43°22'324" E 077°05'653"					
r/d Kyzyltu	Steklovidnaya 24	Barley	0	0	60
Region: Almaty; district Talgar; coordinates: N 43°24'718" E 077°22'115"					
r/d Esik	Bezostaya 1	Wheat	0	0	50
Region: Almaty; district Zhambyl; coordinates: N 43°13'239" E 076°28'702"					
r/d Sayunshy	Kazakhstanskaya10	Oats	50	3	30
Region: Almaty; district Zhambyl; coordinates: N 43°13'418" E 076°23'571"					
r/d Kargaly	Naz	Oats	98	10	40

Region: Almaty; district Zhambyl; coordinates: N 43°10'833" E 076°20'042"					
r/d Yzynagash	Steklovidnaya 24	Soybean	50	0	50
Region: Almaty; district Zhambyl; coordinates: N 43°13'282" E 076°21'046"					
r/d Yzynagash	Brazilskaya elita	Soybean	0	0	20
Region: Almaty; district Zhambyl; coordinates: N 43°13'314" E 076°21'101"					
r/d Yzynagash	Brazilskaya ozimaya	Soybean	14	1	20
Region: Almaty; district Zhambyl; coordinates: N 43°13'349" E 076°21'238"					
r/d Yzynagash	Bezostaya 1	Soybean	0	0	20
Region: Almaty; district Zhambyl; coordinates: N 43°08'264" E 076°05'377"					
r/d Karakystak	Bezostaya 100	Wheat	0	0	320
Notes: P - spread of the disease, R - intensity of the development of the disease, r/d- rural district; p/f – peasant farming					

It was shown that the variety Zhetisu, sown on an area of 30 hectares, demonstrated susceptibility to tan spot, while the damage rate was 6.8%, and the distribution rate reached 86%. In the Panfilov rural district of the Talgar district, the cultivars Kazkhastanskaya 10 (55 ha) and Bogarnaya 56 (60 ha) did not develop and spread the disease. In the Karabulak rural district, the cultivar Zhetysu, sown on an area of 80 hectares, was affected by the disease by 1.2% with a prevalence of 24%. Monitoring of wheat tan spot in the rural districts of Koishybek, Kyzyltu, Esik on winter wheat cultivars Naz (30 ha), Steklovidnaya 24 (60 ha) and Bezostaya 1 (50 ha), revealed high resistance to the pathogen.

Monitoring in the Kargaly rural district of the Zhambyl district of the Almaty region showed that the winter wheat cultivar Naz, sown on an area of 40 hectares, was affected by the disease by 10%, and the spread rate was 98%. In the rural district of Sayunshy, the cultivar Kazkhastanskaya 10 sown on an area of 30 hectares showed susceptibility to tan spot, the infection rate was 3%, and the prevalence rate was 50%. In Zhambyl region, Uzynagash rural district, variety Steklovidnaya 24, sown on an area of 50 hectares and variety Bezostaya 1, sown on an area of 20 hectares, proved to be resistant to tan spot cultivar. In the same area, symptoms of tan spot were found in the Brazilskaya Elita cultivar, the prevalence of the disease was 14%, and the level of development was 1.0%. Studies in the rural district of Karakastek showed that the wheat cultivat Bezostaya 1, cultivated on an area of 320 hectares, was not affected by the tan spot pathogen.

Thus, as a result of determining the distribution area and severity of tan spot *P. tritici-repentis* in the Almaty region (Karasai, Talgar and Zhambyl regions), in 2021, it was found that the manifestation of tan spot was at an average and high level. It is shown that this disease represents a great danger and harmfulness in this region. Most of the commercial cultivars were characterized by high distribution (from 50% to 98%) and development (from 3% to 10%). In

varieties Zhetisu, Kazkhastanskaya 10 and Naz, the largest area of distribution and harmfulness of tan spot *P. tritici-repentis* was found in 2021. In Karasai, Talgar and Zhambyl districts, the most resistant to the pathogen were the cultivars Kazkhastanskaya 10, Almaly, Bogarnaya 56, Naz, Bezostaya 1, Brazilskaya elita, Brazilskaya ozimaya and Bezostaya 100, which found the absence of the disease and the smallest distribution area, and the harmfulness of *P. tritici-repentis*.

Discussion

Research on monitoring the spread and severity of wheat diseases is ultimately aimed at increasing the efficiency of breeding for immunity, creating new varieties that are resistant to diseases. In this regard, studies have been carried out to identify breeding material that combines disease resistance and productivity. The area of distribution, development and harmfulness of tan spot pathogens *P. tritici-repentis* in the Almaty region in 2021 was significant and reached 72-92% on the most widely cultivated varieties Almaly, Steklovidnaya 24, Zhetisu, Farabi and Momyshuly. It was found that of the 24 studied wheat cultivars, most of them showed susceptibility to tan spot. It is shown that this disease represents a great danger and harmfulness in this region. In Karasai, Talgar and Zhambyl districts, the varieties Kazkhastanskaya 10, Almaly, Naz, Steklovidnaya 24, Bezostaya 1, Brazilskaya elita, Brazilian winter and Bezostaya 1 were the most resistant to the pathogen, which found the absence of the disease and the smallest distribution area, and the harmfulness of tan spot.

Conclusions

As a result of the research, 18 (52.9%) cultivars and lines resistant to tan spot were identified. As a result of the selection and genetic study of promising wheat lines and cultivars, it is shown that it is recommended to use selected 18 promising wheat lines and cultivars in Almaty region, which showed resistance to diseases, as a promising material in breeding for disease resistance. In the future, these cultivars will be studied at subsequent stages of the breeding process in order to create new high-yielding varieties of winter wheat.

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ҚАЗАҚСТАНДА *PYRENOPHORA TRITICI-REPENTIS* ҚОЗДЫРҒЫШЫНЫҢ ТАРАЛУЫ ЖӘНЕ ДАМУЫ ДЕҢГЕЙІН АНЫҚТАУ ҮШІН АУРУЛАР МОНИТОРИНГІ

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Түйін

Пиренофороз – *Pyrenophora tritici-repentis* саңырауқұлағы қоздыратын Қазақстандағы экономикалық маңызды жапырақ дақты ауруы болып табылады. Пиренофороздың таралуы мен залалдану дәрежесін анықтау, сондай-ақ вируленттілігін одан әрі зерттеу мақсатында инфекциялық бидай материалын жинау мақсатында Алматы облысының шаруашылықтарында мониторинг жүргізілді. Зерттеудің мақсаты – ауруды бақылау және пиренофорозға төзімді бидай сорттарын идентификациялау. Зерттеу нәтижесінде пиренофорозға төзімді 18 (52,9%) сорт пен перспективті

линиялар (Карасай, Матай, Богарная-56, Таза, Кожа, Даулет, Азиада, BARU, Казахтанский янтарь, Сатти, Казахстанская 10, Алмалы, Жетису, Наз, Безостая 1, Бразильская элита, Бразильская озимая и Безостая 100) анықталды. Генетика-селекциялық зерттеу нәтижесінде пиренофорозға төзімді селекцияда перспективті материал ретінде Алматы облысындағы іріктелген линиялар мен бидай сорттарын пайдалану ұсынылады. Болашақта осы іріктеліп алынған 18 үлгілер бидайдың жаңа жоғары өнімді сорттарын жасау мақсатында селекциялық процестің кейінгі кезеңдерінде зерттелетін болады.

Кілт сөздер: бидай; пиренофороз; патоген; төзімділік; мониторинг; дифференциатор-сорттар; *Pyrenophora tritici-repentis.*

МОНИТОРИНГ БОЛЕЗНЕЙ ДЛЯ ОПРЕДЕЛЕНИЯ УРОВНЯ РАСПРОСТРАНЕНИЯ И РАЗВИТИЕ ВОЗБУДИТЕЛЯ *PYRENOPHORA TRITICI-REPENTIS* В КАЗАХСТАНЕ

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Аннотация

Пиренофороз или желтая пятнистость вызываемое грибком *Pyrenophora tritici-repentis*, является экономически важным лиственным заболеванием в Казахстане. Мониторинг посевов в хозяйствах Алматинской области был проведен для определения распространения и степени развития пиренофороза, а также для сбора инфекционного материала пшеницы для дальнейшего изучения вирулентности. Целью исследования является мониторинг болезни и идентификация устойчивых сортов пшеницы к пиренофорозу. В результате исследований идентифицировано 18 (52,9%) сортов и линий (Карасай, Матай, Богарная-56, Таза, Кожа, Даулет, Азиада, BARU, Казахтанский янтарь, Сатти, Казахстанская 10, Алмалы, Жетису, Наз, Безостая 1, Бразильская элита, Бразильская озимая и Безостая 100), устойчивые к пиренофорозу. В результате генетико-селекционного изучения рекомендуется использовать в качестве перспективного материала в селекции на устойчивость к пиренофорозу выделенные перспективные линии и сорта пшеницы в Алматинской области. В дальнейшем эти отобранные 18 образцов будут изучаться на последующих этапах селекционного процесса с целью создания новых высокоурожайных сортов озимой пшеницы.

Ключевые слова: пшеница; пиренофороз; патоген; устойчивость; мониторинг; сорта-дифференциаторы; *Pyrenophora tritici-repentis.*