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ҚАЗАҚСТАН РЕСПУБЛИКАСЫ
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ВЕСТНИК

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NAS RK is pleased to announce that Bulletin of NAS RK scientific journal has been accepted for indexing in the Emerging Sources Citation Index, a new edition of Web of Science. Content in this index is under consideration by Clarivate Analytics to be accepted in the Science Citation Index Expanded, the Social Sciences Citation Index, and the Arts & Humanities Citation Index. The quality and depth of content Web of Science offers to researchers, authors, publishers, and institutions sets it apart from other research databases. The inclusion of Bulletin of NAS RK in the Emerging Sources Citation Index demonstrates our dedication to providing the most relevant and influential multidiscipline content to our community.

Қазақстан Республикасы Ұлттық ғылым академиясы "ҚР ҰҒА Хабаршысы" ғылыми журналының Web of Science-тің жаңаланған нұсқасы Emerging Sources Citation Index-те индекстелуге қабылданғанын хабарлайды. Бұл индекстелу барысында Clarivate Analytics компаниясы журналды одан әрі the Science Citation Index Expanded, the Social Sciences Citation Index және the Arts & Humanities Citation Index-ке қабылдау мәселесін қарастыруда. Web of Science зерттеушілер, авторлар, баспашылар мен мекемелерге контент тереңдігі мен сапасын ұсынады. ҚР ҰҒА Хабаршысының Emerging Sources Citation Index-ке енуі біздің қоғамдастық үшін ең өзекті және беделді мультидисциплинарлы контентке адалдығымызды білдіреді.

НАН РК сообщает, что научный журнал «Вестник НАН РК» был принят для индексирования в Emerging Sources Citation Index, обновленной версии Web of Science. Содержание в этом индексировании находится в стадии рассмотрения компанией Clarivate Analytics для дальнейшего принятия журнала в the Science Citation Index Expanded, the Social Sciences Citation Index и the Arts & Humanities Citation Index. Web of Science предлагает качество и глубину контента для исследователей, авторов, издателей и учреждений. Включение Вестника НАН РК в Emerging Sources Citation Index демонстрирует нашу приверженность к наиболее актуальному и влиятельному мультидисциплинарному контенту для нашего сообщества.

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CLASSIFICATION OF WHEAT YELLOW RUST POPULATIONS IN THE CONDITIONS OF KAZAKHSTAN (*Puccinia striiformis* West. f. sp. tritici Erikss. et Henn.)

Abstract. One of the most dangerous fungal diseases of cereals is the wheat yellow rust that causes *Pucciniastriiformis* West. f. sp. triticiErikss. et Henn. The yellow rust significantly reduces the yield and lowers grain quality. The occurrence of disease in autumn and its wintering during the vegetation period in favorable climatic conditions in the autumn wheat field leads to a 100 percent loss of crop. An important element in the integrated protection of wheat crops from rust disease is a variety. Success in selection of disease resistance depends on the population structure of pathogens, which differ from soil-climatic zones and biotic, abiotic factors. The article presents the results of yellow rust study in the South and South-Eastern Kazakhstan. The determined pathotypes are classified into three groups: high, middle and low (minimal) virulence. High virulence patterns of HeinesKolben, Lee Chinese 166, Heines VII and Reichersberg 4 were virulent to classifiers up to 100 percent.

Key words: wheat, resistance, pathotype, classifier varieties, yellow rust, epiphytotia, virulence.

Introduction. The use of genetically uniform, inefficient resistance genes in production will increase natural selection in agro-economic system and will result in new patterns, leading to the mutation of pathogenic populations and incidence of new virulent pathotypes [1]. The virulent gene, which is able to defeat the resistant gene will appear and spread widely. Finally, the resistant variety is defeated by the new race of pathotypes. With emergence of a new pathotype (race), a variety of monogenic resistance demonstrates complete non resistance against pathotypes. As a result, the disease can develop to the level of epiphytotic in the sowing field [2, 3]. The loss of endangered varieties from emergence of new races was shown in many studies. According to G.J. Green, T. Johnson, D.J. Samborski [4], the growth of new races in the first resistant varieties is different in each region. This is also due to the specification of variety and its prolonged use in production. In Mexico, Colombia and Kenya, the varieties lose their durability after 2-5 years due to the favorable condition of fungus rust disease development. The new resistant variety filters pathogenic population by involving virulent race. Therefore, selection of wheat rust resistance is one of the main factors that control the parasitic population changes in race structures.

According to phytopathologistsYahyaoui A, Wellinggs C.R., Torabi M., andKetata H. [5] the population structure of yellow rust has continuously change as in host-plant. The wheat varieties grown in Central and Western Asia were initially resistant to yellow rust populations. The use of varieties for several years in production has led to occurrence of virulent forms as well as decrease of gene resistance. In 1980, the emergence of a virulent race to Yr9 resistant gene, and its rapid spread led to yellow rust epiphytotics in wheat varieties in the regions from Western Asia to Pakistan.

As M.R.J. Kamali and F.Afshari state [6], *P. striiformis*, which has overcome certain known resistance genes, has been registered in many regions of the world. The Chamran variety, which was sown in Iran for half a million hectares in 2003, lost its resistance after the emergence of a new 166E134A + + pathotype. In Turkey, the planting of the Gerek 79 variety that is resistant to disease in the area of 1 million hectares has resulted in severe pathogenic damage and 26.5% of product losses. In 2003, Uzbekistan harvested 1,390,000 hectares of wheat, however it did not increase crop yields. The main reason for it was the planting of Polovchanka (376.5 thousand hectares), Koshka (322.9 thousand hectares), Knyazhna (53.2 thousand hectares) and Umanka (41.8 thousand hectares) varieties that were sent to be planted in the main production, however they were quickly infected and caused a favorable conditions for the pathogen development [7].

The purpose of the paper is to study population structure of wheat yellow rust (*Pucciniastriiformis* West. F.sp. triticiEriks. Et Henn.)

The tasks are to determine pathotype structure of *P. striiformis* population and to make classification of its virulence properties.

History: An in-depth study of raw material taken by selection, replacement of inefficient ones with efficient can help prevent progression of disease and prevent epiphytotic.

However, the problem of immunity can not be solved without deep study of systemic relationship between the two organism that affect each other. The relationship between pathogen and host-plant can be regarded as an evolutionary process that continuously develop. The ability of yellow rust to mutate leads to emergence of new pathotypes that get used to the host-plant in population structure.

Research Materials and Methods. The local population of wheat yellow rust *(Pucciniastriiformis West. f.sp. triticiErikss. et Henn.)* and single pathotypes (races) were used as epidemic material.

The main sources of epidemic material were obtained from the leaves of wheat, barley, triticale and wild grains that were get during the phytosanitary monitoring in the Southern, South-Eastern regions of Kazakhstan.

Identification of pathotypes in yellow rust population is based on the following main stages: collecting of samples; increasing of uredospores in the collected yellow rust samples; separation and multiplication of monopostic isolates; classification of isolates into pathotypes.

Identification of population structure of yellow rust was carried out in separate greenhouses. The following eight European variety classifiers as Heines VII, Spaldings Prolific, Carstens V, Compair, Nord Desprez, Heines Peko, Reichersberg 42, Hybrid 46 and Seven International classifiers like Suwon 92 x Omar, StrubesDickkopf, Moro, Vilmorin 23, HeinesKolben, Lee, Chinese 166 have been used [8,9]. The way of application of these varieties for studying yellow rust is shown in table 1.

Table 1 – The way of application of International and European Varieties' Classification for studying yellow rust population

Decimal measure	Binary calculus	International Classifier Varieties (Resistant Genes)	European Classifier Varieties (Resistant Genes)
1 (=2^0)	1	Chinese 166(Yr1)	Hybrid 46 (Yr4+)
2 (=2^1)	10	Lee (Yr7, Yr22, Yr23)	Reichersberg 42 (Yr7+)
4 (=2^2)	100	HeinesKolben (Yr6)	HeinesPeko (Yr6+)
8 (=2^3)	1000	Vilmorin 23(Yr3V)	NordDesprez (Yr3N, Yr3a)
16 (=2^4)	10 000	Moro (Yr10, YrMor)	Compair (Yr8, Yr18)
32 (=2^5)	100 000	StrubesDickkopf (Yr2, YrSD)	Carstens V (YrCV)
64 (=2^6)	1 000 000	Suwon 92xOmar (YrSU, YrPa1-3)	SpaldingsProlific(YrSP, Yr6)
128 (=2^7)	10 000 000	–	Heines VII (Yr2, YrHVII)

Race numbering was based on the use of Hubbold's binary system [9]. The resistant species of varieties were shown as R-type (Resistance) 0, and the S-type (Susceptable) 1 and their decimal measurements. In definition of pathotype, first is shown the number in international collection, and second, the indication of letter E, followed by the number in European collection [10].

Research results. As a result of studying of yellow rust population collected from the Southern and South-Eastern regions of Kazakhstan, 46 pathotypes of pathogens were determined. Vulnerability of pathotypes for each classifier of colection was calculated. Chinese 166 varieties were exposed to 43 pato-types. That is, the typical virulence of pathotypes to this variety was 92%. The Moro variety was infected by only one pathotype (31E158), and the virulence of studied pathotypes to this variety was only 2%.

12 pathotypes (15E15 (31 / 1,5), 15E135, 15E159 (A-8 / 1,5), 15E191, 31E158, 47E143, 47E159, 15E159, 47E143, 15E199, 47E223, 71E191, 71E175, 79E143, 111E155) that showed 53,3-80,0% virulence to 15 International and European classifier varieties were determined to be the most dangerous yellow rust race.

Among the international classification of varieties Moro variety that has Yr10 and YrMor gene demonstrated high resistance to all determined isolates, not including the 31E158 pathotype. It has been found that the HeinesKolben variety among the European collection and the Yr6 Avocet variety transformed into a non resistant form due to the loss of effectiveness of Yr6 gene in the structure of their isogenic line. However, Spaldings Prolific variety that has Yr6 and YrSp genes demonstrated complete immunity for all pathogens except for the pathotype 47E223 (table 2).

Table 2 – Wheat yellow rust of high virulence

Racecode	Reactions of classifier varieties														
	International collection							European collection							
	Suwon 92xOmar	StrubesDickkopf	Moro	Vilmorin 23	HeinesKolben	Lee	Chinese 166	Heines VII	SpaldingsProlific	Carstens V	Compair	NordDesprez	HeinesPeko	Reichersberg 42	Hybrid 46
15E15 (31/1,5)	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*
15E135	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*R*	*R*	*S*	*S*	*S*
15E159 (a-8/1,5)	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*
15E191	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*S*
31E158	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*R*
47E143	*R*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*R*	*S*	*S*	*S*	*S*
47E159	*R*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*
47E223	*R*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*S*	*R*	*S*	*S*	*S*	*S*	*S*
71E175	*S*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*S*	*R*	*S*	*S*	*S*	*S*
71E191	*S*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*S*
79E143	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*R*	*S*	*S*	*S*	*S*
111E155	*S*	*S*	*R*	*S*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*R*	*S*	*S*
Averagevirulence, %	33,3	33,3	8,3	83,3	100,0	100,0	100,0	100,0	8,3	25,0	58,3	91,7	91,7	100,0	91,7

Note: «R» – tolerance reaction; «S» – the reaction of intolerance.

Most virulent pathotypes include 12 patterns, including 31 / 11.5 and A-8 / 1.5 races stored on collection models. These pathotypes showed virulence to Vilmorin 23, HeinesKolben, Lee, Chinese 166, Compair, Nord Desprez, Heines Peko, Reichersberg 42, Hybrid 46, and Moro and Spaldings Prolific. Only 31E158 pathotype showed virulence to Moro variety, while 47E223 pathotype was virulent to Spaldings Prolific variety. Studies pathotypes showed 100 percent virulence for HeinesKolben, Lee, Chinese 166, Heines VII and Reichersberg 42 varieties.

The analysis of results showed that Kazakhstani wheat yellow rust pathotypes virulent to resistant gene of Yr1, Yr2, Yr3a, Yr3N, Yr3V, Yr4, Yr6, Yr7, Yr8, Yr18, Yr22, Yr23. But most of the local pathotypes failed to defeat Yr10, YrMor, YrSP genes (table 3).

Table 3 – Wheat yellow rust pathotypes with low and middle virulence

Pathotype (racecode)	Reactions of classifier varieties														
	International collection							European collection							
	Suwon 92xOmar	StrubesDickkopf	Moro	Vilmorin 23	HeinesKolben	Lee	Chinese 166	Heines VII	SpaldingsProlific	Carstens V	Compair	NordDesprez	HeinesPeko	Reichersberg 42	Hybrid 46
0E0	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*	*R*
1E136	*R*	*R*	*R*	*R*	*R*	*R*	*S*	*S*	*R*	*R*	*R*	*S*	*R*	*R*	*R*
2E156	*R*	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*R*	*R*
4E144	*R*	*R*	*R*	*R*	*S*	*R*	*R*	*S*	*R*	*R*	*S*	*R*	*R*	*R*	*R*
5E136	*R*	*R*	*R*	*R*	*S*	*R*	*S*	*S*	*R*	*R*	*R*	*R*	*S*	*R*	*R*
6E145	*R*	*R*	*R*	*R*	*S*	*S*	*R*	*S*	*R*	*R*	*S*	*R*	*R*	*R*	*S*
7E3	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*R*	*R*	*R*	*R*	*S*	*S*
7E8	*R*	*R*	*R*	*R*	*R*	*S*	*S*	*R*	*R*	*R*	*R*	*S*	*R*	*R*	*R*
7E21	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*R*	*S*	*R*	*S*	*R*	*S*
7E47	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*S*	*R*	*S*	*S*	*S*	*S*
7E63	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*S*
7E135	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*R*	*R*	*R*	*S*
7E148	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*R*	*S*	*R*	*R*
7E151	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*R*	*S*	*S*	*S*
7E153	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*R*	*R*	*S*
7E156	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*R*	*R*
7E158	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*R*
7E159	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*
7E190	*R*	*R*	*R*	*R*	*S*	*S*	*S*	*R*	*R*	*S*	*S*	*S*	*S*	*S*	*R*
11E23	*R*	*R*	*R*	*S*	*R*	*S*	*S*	*R*	*R*	*R*	*S*	*R*	*S*	*S*	*S*
11E135	*R*	*R*	*R*	*S*	*R*	*S*	*S*	*S*	*R*	*R*	*R*	*R*	*S*	*S*	*S*
13E7	*R*	*R*	*R*	*S*	*S*	*S*	*S*	*R*	*R*	*R*	*R*	*R*	*S*	*S*	*S*
13E23	*R*	*R*	*R*	*S*	*S*	*R*	*S*	*R*	*R*	*R*	*S*	*R*	*S*	*R*	*S*
Pathotype (racecode)	Reactions of classifier varieties														

As a result of classification of the local population of wheat yellow rusts, they were classified as pathotypes with low virulence (0E0, 7E3, 7E8, 11E23, 13E7, 13E23, 15E5, 15E7 (N / 1,5), 15E13).

Stem rust is the most common and dangerous disease of wheat. Despite comprehensive studies of stem rust, protection of wheat from this disease is still relevant. In order to determine resistance to stem rust under field and laboratory conditions, phenologic, phytopathological were conducted on 90 varieties of spring wheat varieties [11].

Conclusion. About 80 percent of the isolates that were identified during experiment showed high virulence and 20 percent showed lower virulence to the classifier varieties. The studied wheat yellow rust were classified into high, middle and lower virulence groups.Pathotypes with high and middle virulence to the classifier varieties showed virulence to Moro (Yr10, YrMor) variety and Spaldings Prolific (Yr6,

YrSp) variety. The average virulence rate was 2 percent for Suwon 92xOmar (YrSU, YrPa1-3) variety, 23 percent for StrubesDickkopf (Yr2, SD) variety and 11 percent for Carstens V (YrCV) variety. HeinesKolben, Lee, Chinese 166, Heines VII and Reichersberg 42 varieties have demonstrated the loss of gene efficacy for 12 pathotype with high virulence.

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ҚАЗАҚСТАН ЖАҒДАЙЫНДА БИДАЙ САРЫ ТАТЫ (*Puccinia striiformis* West. f. sp. tritici Erikss. et Henn.) ПОПУЛЯЦИЯ ҚҰРАМЫН ЖІКТЕУ

Аннотация. Астық дақылдарының өте кең таралаған, ең зиянды ауруларының бірі *Puccinia striiformis* West. f. sp. tritici Erikss. et Henn. қоздырғышы шақыратын сары тат саңырауқұлақ ауруы. Сары тат егін түсімін айтарлықтай төмендетіп, дән сапасын кемітеді. Аурудың күз мезгілі кезінде пайда болып, вегетациялық кезенде қолайлы климат жағдайда күздік бидай егістігінде қыстап шығуы, 100 пайызға дейін егін шығынының болуына әкеледі. Бидай егістігін тат ауруынан интеграцияланған қорғауда маңызды элемент сорт болып табылды. Ауруға төзімділік селекциясында жетістіктерге жетуде топырақ-климаттық аймақтар және биотикалық, абиотикалық факторлар әсерінен әртүрлі болатын патогеннің популяциялық құрамына байланысты. Мақалада оңтүстік және оңтүстік-шығыс Қазақстан жағдайында сары таттың популяционного құрамын зерттеу нәтижелері көрсетілген. Анықталған патотиптер үш топқа жіктелінген: вируленттілігі жоғары, орташаа және төмен (минималды) вируленттілер. Вируленттілігі жоғары патотиптер Heines Kolben, Lee Chinese 166, Heines VII және Reichersberg 4 жіктегіш сорттарға 100 пайыз (%) вирулентті болды.

Түйін сөздер: бидай, төзімділік, патотип, жіктегіш сорттар, сары тат, эпифитотия, вируленттілік.

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ДИФФЕРЕНЦИАЦИЯ ПОПУЛЯЦИОННОГО СОСТАВА ЖЕЛТОЙ РЖАВЧИНЫ ПШЕНИЦЫ (*Puccinia striiformis* West. f. sp. tritici Erikss. et Henn.) В УСЛОВИЯХ КАЗАХСТАНА

Аннотация. Одним из наиболее вредоносных заболеваний зерновых культур является желтая ржавчина, вызываемая грибом *Pucciniastriiformis*West. f. sp. triticiErikss. etHenn. Она существенно снижает урожай и качество семян. При появлении в осенний период, успешной перезимовке и развитии во время вегетационного сезона можно ожидать 100 % потерю урожая. Важнейшим элементом интегрированной защиты пшеницы от ржавчинных болезней являются устойчивые сорта. Для успешной селекции растений на устойчивость к болезням большое значение имеет знание структуры популяций патогенов, которая заметно различается в разных почвенно-климатических зонах и подвержена изменению во времени и пространстве под воздействием биотических, абиотических и антропогенных факторов. В статье представлены результаты изучения популяционного состава желтой ржавчины пшеницы в условиях южного и юго-востока Казахстана. Выявленные патотипы разделены на три группы высоковирулентные, средне и мало (минимально) вирулентные. Высоковирулентные патотипы проявили 100% вирулентность к сортам дифференциаторам Heines Kolben, Lee Chinese 166, Heines VII и Reichersberg 42.

Ключевые слова: пшеница, устойчивость, патотип, сорта дифференциатор, желтая ржавчина, эпифитотия, вирулентность.

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