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ASSESSMENT OF THE DISEASE RESISTANCE OF HYBRID PROGENIES AND SELECTION OF THE RESISTANT SPECIES

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ОЦЕНКА БОЛЕЗНЕУСТОЙЧИВОСТИ ГИБРИДНЫХ ПОТОМСТВ И ОТБОР УСТОЙЧИВЫХ ВИДОВ

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Abstract. The purpose of the study was to determine the degree of infection by various diseases and resistance of samples from different hybrid (F_2 and F_3) progenies. The selected disease resistant hybrid lines were recommended for the further investigations and hybridization programs as parental forms. F_2 hybrid combinations resistant to yellow rust disease were found to be: *TT 01404 Shefeg × Sonmez, TT 01407 Alman sortu × Murov-2, TT 01410 Shefeg-2 × Alman sortu, TT 01414 Doka × Alman sortu*; F_3 hybrids: *TT 01301 /1 Murov-2 × Bezostaya-1, TT 01302 /2 Murov-2 × Doka, TT 01321/1 Tereggi × Pervin, TT 01321/2 Tereggi × Pervin, TT 01327/2 Doka × Pervin,* etc. F_2 hybrid combinations resistant to brown rust disease were: *TT 01417 Sonmez × Shefeg-2, TT 01424 Pervin × Azeri, TT 01434 Yubilieinaya100/Tilek/1 × Murov-2, TT 01438 Murov × Shefeg-2*; F_3 hybrids: *TT 01302/2 Murov-2 × Doka, TT 01304/1 Murov-2 × Tanya, TT 01305/1 Murov-2 × Shefeg-2, TT 01305/3 Murov-2 × Shefeg-2, TT 01307 /1 Shefeg-2 × Doka*. F_2 hybrid lines resistant to powdery mildew disease were: *TT 01413 Doka × Sonmez, TT 01422 Pervin × Murov-2, TT 01428 Vassa × Mahmud 80, TT 01431 Yubilieinaya100/Tilek/1 × Mahmud 80, TT 01433 Yubilieinaya100/Tilek /1 × Yegane*; F_3 hybrids *TT 01310/1 Shefeq-2 × Vassa, TT 01316 /3 Murov × Bezostaya-1, TT 01317/2 Murov × Tanya, TT 01321/1 Tereggi × Pervin, TT 01334/1 Sonmez × Pervin*, etc.

Аннотация. Целью исследования было определение степени заражения различными заболеваниями и устойчивости образцов разных гибридных (F_2 и F_3) потомков. Отобранные устойчивые к болезням гибридные линии были рекомендованы для дальнейших исследований и программ гибридизации в качестве родительских форм. Было обнаружено, что гибридными комбинациями F_2, устойчивыми к болезни желтой ржавчины являются: *TT 01404 Шафаг × Сонмез, TT 01407 Немецкий сорт × Муров-2, TT 01410 Шафаг-2 × Немецкий сорт, TT 01414 Дока × Немецкий сорт*; F_3 hybrids: *TT 01301/1 Муров-2 × Безостая-1, TT 01302 /2 Муров-2 × Дока, TT 01321 /1 Тарагги × Парвин, TT 01321/2 Тарагги × Парвин, TT 01327 /2 Дока × Парвин* и др. Гибридные комбинации F_2, устойчивые к болезни бурой ржавчины: *TT 01417 Сонмез × Шафаг-2, TT 01424 Парвин × Азери, TT 01434 Юбилейная100/Тилек/1 × Муров-2, TT 01438 Муров × Шафаг-2*; F_3 гибриды: *TT 01302/2 Муров-2 × Дока, TT 01304/1 Муров-2 × Таня, TT 01305/1 Муров-2 × Шафаг-2, TT 01305/3 Муров-2 × Шафаг-2, TT 01307/1 Шафаг-2 × Дока*. Гибридные линии F_2, устойчивые к мучнистой росе: *TT 01413 Дока × Сонмез, TT 01422 Парвин × Муров-2, TT 01428 Васса × Махмуд 80, TT 01431 Юбилейная100/Тилек/1 × Махмуд 80, TT 01433 Юбилейная100/Тилек/1*

Т. 5. №7. 2019
DOI: 10.33619/2414-2948/44

× Егана. F_3 гибриды: *ТТ 01310/1 Шафаг-2 × Васса, ТТ 01316/3 Муров × Безостая-1, ТТ 01317 /2 Муров × Таня, ТТ 01321/1 Тарагги × Парвин, ТТ 01334/1 Сонмез × Парвин* и др.

Keywords: soft wheat, breeding, variety, hybrid, line, disease, yellow rust, leaf rust, resistance, infection.

Ключевые слова: мягкая пшеница, селекция, комбинация, гибрид, линия, болезнь, желтая ржавчина, бурая ржавчина, устойчивость, заражение.

Introduction

The exchange of hybrid samples among countries, their exploration in different ecological areas, different climatic and soil conditions, detection and creation of productive, quality, complex resistant varieties, as well as the use of these materials in selection processes and hybridization programs as an initial material have led to efficient results in the world practice. Disease resistance is one of the main biological indices of wheat. Cereals differ in the level of incidences of infectious diseases and it should be noted that cereals are exposed to various causatives of diseases. The most common and negatively affecting plant productivity are: yellow rust (*Puccinia striiformis* West), brown rust (*Puccinia recondita* Rab), powdery mildew (*Blumeria graminis f. sp.* Tritici*)*, stem rust (*Puccinia graminis f. sp. Tritici Pers*), septoria leaf blotch (*Septoria tritici blotch*), bunt fungus (*Tilletia caries* (DC.)), loose smut (*Ustilago tritici* (Pers.) Jens.), etc. [1].

Yellow rust, brown rust and powdery mildew are widely spread and economically harmful diseases of autumn bread wheat (*Triticum aestivum* L.) and durum wheat (*Triticum durum* Desf.) in Azerbaijan. Naumov N. A. [2] showed that both diseases damage plant leaves, ears, awns and grains. Usually low tier leaves are affected first and then fungus infects upper leaves disturbing normal development and growth of wheat leading to the reduced productivity. According to N. I. Vavilov, et. al. [3], the only correct way to fight rust disease is to create new resistant varieties by selective breeding. Geshele E. E. [4] noted that the selection of resistant varieties should continue permanently in order to replace the disease-affected varieties with new ones. According to P. P. Lukyanenko, hybridization between rust resistant and severely infected wheat varieties led to positive results in the North Caucasus [5].

High levels of yellow rust disease were found to cause 15–30% decline in productivity [6]. Based on the results of numerous investigations, the resistance of wheat varieties to diseases depends on many factors such as the amount of precipitation, air temperature, relative humidity, nutritional elements, sowing time, plant density in the field, etc. [7].

Materials and methods

The research was performed in the Terter Regional Experimental Station of the Research Institute of Crop Husbandry under irrigated conditions. The objects of the study were the second (F_2) and third hybrid (F_3) progenies of autumn bread wheat. The main materials of the study were hybrid combinations created by intraspecies hybridization (*according to the plan, hybridization was carried out in the earing phase, during 2012–2013 years (P-20; F_0-62) and 2013-2014 (P-18; F_0-39)*) using the limited pollination method (*Tvel method*). Selection was performed on 39 samples of the first generation (F_1) and 56 samples of the second-generation hybrid lines obtained as a result of the intraspecies hybridization of bread wheat studied in the hybrid nursery during 2014-2015. To include in the re-selection program 32 samples of the second (F_2) and 38 samples of the third (F_3) hybrid combinations were retained. However, it should be noted that to continue research in 2015-

T. 5. №7. 2019
DOI: 10.33619/2414-2948/44

2016, the third generation (F_3) hybrid materials were grouped according to their height, which resulted in a total of 81 samples of the third generation (F_3) hybrids.

Rust disease report is based on the accepted international scale (*modified scale of Kob recommended by CIMMYT and ICARDA*) [8–9], the assessment of the powdery mildew infection level is based on the 9-point scale applied by CIMMYT (*by N. Simlakovich, 1966*) [10–11], resistance to septoria leaf blotch on the international 9 point scale (*G. V. Pizhikova, et.al., 1989*) [12], and resistance to bunt fungus on the international 5 point scale accepted by VIR [13].

Results and discussion

For obtaining hybrid combinations using intraspecies hybridization, which have suitable properties meeting requirements, it is important to select samples with important biological indices and study their disease resistance for including them in the breeding programs in the future. Observations were performed on hybrid combinations having more pronounced symptoms of the diseases (in the early spring during, earing, leaf-tube formation, flowering, milk-ripening, wax-ripening) and the degree of the infection was recorded. According to the obtained results, septoria leaf blotch, powdery mildew, yellow rust and brown rust were detected in the examined materials. However, there were no symptoms of bunt fungus, loose smut as well as stem rust diseases.

The degree of the infection varied in hybrid samples. Thus, during 2015–2016 years, 12.5% (4 samples) of the second generation (F_2) bread wheat hybrid samples (total 32) were resistant (R); 56.25% (18 samples) — medium resistant (MR); 9.37% (3 samples) — sensitive (S); 21.88% (7 samples) — medium sensitive (MS) to the yellow rust disease. The degree of the resistance to the brown rust disease was as follows: 12.5% (4 samples) — resistant (R); 18.75% (6 samples) — sensitive (S); 68.75% (22 samples) — medium sensitive (Table, Figure 1–2).

Table.

THE DEGREE OF THE INFECTION WITH YELLOW AND BROWN RUST DISEASES OF THE HYBRID LINES

Years	*Samples*	*The number of materials*	*Yellow rust, %*				*Brown rust, %*			
			Resistant, R	*Medium resistant, MR*	*Sensitive, S*	*Medium sensitive, MS*	*Resistant, R*	*Medium resistant, MR*	*Sensitive, S*	*Medium sensitive, MS*
2015–2016	F_2	32	12.5	56.25	9.37	21.88	12.5	—	18.75	68.75
2015–2016	F_3	81	—	25.93	28.39	45.68	23.46	—	39.51	37.03

Note. R — resistant, MR — medium resistant, S — sensitive, MS — medium sensitive.

The degree of the resistance to yellow rust disease in the third generation (F_3) bread wheat hybrids (total 81) was as follows: 25.93% (21 samples) — medium resistant (MR); 28.39% (23 samples) — sensitive (S); 45.68% (37 samples) — medium sensitive (MS). But the degree of the resistance to brown rust disease was: 23.46% (19 samples) — resistant (R), 39.51% (32 samples) — sensitive (S); 37.03% (30 samples) — medium sensitive (MS) (Table, Figure 1–2).

Т. 5. №7. 2019
DOI: 10.33619/2414-2948/44

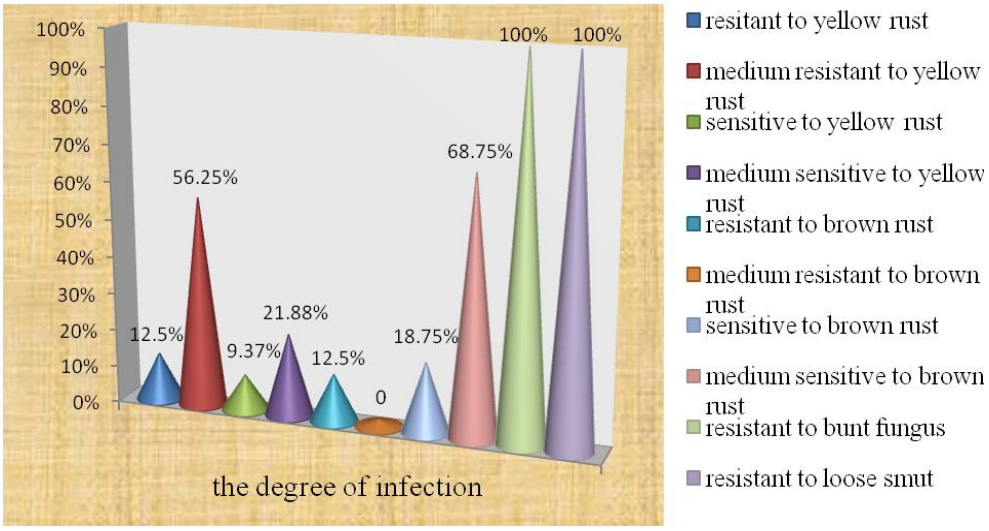

Figure 1. The degree of the infection in the second generation (F_2) hybrids.

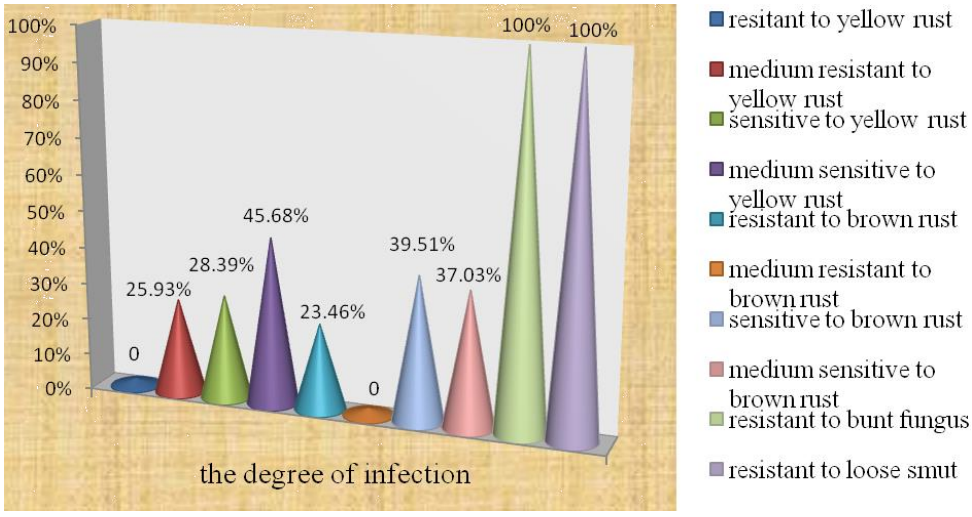

Figure 2. The degree of the infection in the third generation (F3) hybrids.

The hybrid materials studied in the field conditions were 100% resistant and medium resistant to bunt fungus and loose smut. The hybrid lines resistant and medium resistant to yellow rust, brown rust and powdery mildew diseases were selected.

It should be noted that in the future researches, it is advisable to use the selected disease-resistant (especially, yellow and brown rust diseases) hybrid samples as an initial material in the creation of resistant varieties. In addition to using various methods (applying fungicide, etc.), minimizing the effects of diseases on productivity, creating resistant varieties by proper using selection materials is also one of the key conditions.

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