BULLETIN OF NATIONAL ACADEMY OF SCIENCES
OF THE REPUBLIC OF KAZAKHSTAN
ISSN 1991-3494
Volume 3, Number 373 (2018), 113 – 117

UDC 632.3/9:633.11(574)

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EFFECT OF BROWN RUST DESEASE ON PHOTOSYNTHETIC ACTIVITY OF SPRING WHEAT VARIETIES

Abstract. *Ruccinia recondita* Rob.ex Desm. f. sp. tritici is a brown-rust of wheat that represent a wide-spread, harmful biotrophic parasite, which destroys cereal crops and *Triticum aestivum* L. varieties [1]. Disease resistance in plants reflects the presence of physiologically active substances, incompatible interaction in host plant-pathogenic agent metabolism, existence of toxic substances in plant metabolism that weaken pathogenic agent and other adverse conditions for pathogens. The high susceptibility of the summer wheat varieties to brown-rust of wheat is clearly seen in response to the pathogen's penetration into the cell. In a resistant plant cell, the cells immediately produce necrosis in the place of pathogen penetration. The abundance of crop yields depends on the efficiency of photo-synthesis. The paper examines the amount of chlorophyll in the tissue of spring wheat varieties. Among the varieties under study, the following ones has demonstrated nonresistance to the disease: Almaken, Kazakhstanskaya 15, Lutescens 92, Kazakhstan early crop, MOVIR 409, D969th Stemrrsn, and Saratovskaya 29. The concentration of chlorophyll in these varieties was in the range of 0.1-41% that is significantly lower compared with its control varieties.

Keywords: brown rust, spring wheat, photosynthesis activity.

Introduction. *Ruccinia recondita* Rob.ex Desm. f. sp. tritici is a brown-rust of wheat, which rapidly spreads to several hundred meters by the air flow and represent a fungus disease excitant that cause epiphytotics in favorable conditions[1].

A comprehensive study of the selected material, the replacement of inefficient ones with the effective ones will reduce the incidence of the disease and prevent epiphytotics, and limit environmental pollution by chemicals [2-4]. Disease resistance in plants is connected with the presence of physiologically active substances, incompatible interaction in host plant-pathogenic agent metabolism, existence of toxic substances in plant metabolism that weaken pathogenic agent and other adverse conditions for pathogens. The high susceptibility of the summer wheat varieties to brown-rust of wheat is clearly seen in response to the pathogen's penetration into the cell. In a resistant plant cell, the cells immediately produce necrosis in the place of pathogen penetration. The abundance of crop yields depends on the efficiency of photo-synthesis. The process of photosynthesis slows down due to half-necrosis of cells. The crop infestation by the brown rust of wheat leads to the decrease of chlorophyll amount, and reflects the chlorosis. The effect of brown rust disease on photosynthesis depends on the resistance characteristics of the varieties [5].

Research Materials and Methods. The leaves of thespring wheat varieties deceased by the brown rust of wheat has been used as research material.

Research experiments on the photosynthesis pigment of spring wheat varieties damaged by *Puccinia recondita f. sp. tritici* fungushas been conducted at the Department of Biology of the Kazakh State Women's University under laboratory conditions.

Research methods: The research experiments on the spring wheat varieties damaged by *Puccinia recondita f. sp. tritici* funguswere conducted. The plant leaf alcohol extract has been obtained to determine the pigments. The obtained extracts were poured into the centrifuge test tubes and placed in the 6-7 thousand circuits for 7 minutes. The fluid from the centrifuge test tubes was brought into the same volume and the pigment amount of this extract was determined by spectrophotometric method. We determined the chlorophyll concentration in the Photometer-KFK-3 by putting the hydrophilic "a" and chlorophyll "b" in the following Vernon formula by spectrophotometric analysis.

$$C_{chlA} = 11{,}63*D_{665} - 2.39*D_{649};$$

$$C_{chlB} = 20.11*D_{649} - 5.18*D_{665};$$

$$C_{chl\ A+chl\ B} = 6.45*D_{665}+17.72*D_{649},$$

where C represent a, b chlorophyll and carotinoid concentrations mg / l, D-wavelengths 440.5; 665 nm,

The amount of carotenoids is calculated by the formula of Holm-Wettstein.

$$C_{car}=4{,}695D_{440.5}-0.268C_{(chl.a+chlb)}.$$

After determining the concentration of the pigment extract, the pigments in the tested material was calculated with taking into account the weight and extract amount of the investigated material (mass), by using the following formula:

$$A=C* V/P*1000,$$

where in the concentration of pigments obtained in C-mg/L is the obtained pigment concentration; V – pigment extract volume is shown in ml; the size of pigments in plant material is shown in A-mg/g; P – weight of plant material is shown in gram.

The results of the research. In practice, the highest levels of pigment amount in different varieties of spring wheat damaged by brown rust of wheat was reflected in D939th Stemrrsn variety, where the amount of chlorophyll a is 0.290 mkg/g, chlorophyll b - 0.117 mkg/g, chlorophyll a + b - 0.409 mkg/g, carotenoid - 0.062 mkg/g; in Raxmon chlorophyll a - 0.282 mkg/g, chlorophyll b - 0.165 mkg/g, chlorophyll a + b - 0.447 mkg/g, the amount of carotenoid is equal to 0.065 mkg/g; in Arai chlorophyll a - 0.270 mkg/g, chlorophyll b - 0.117 mkg/g, chlorophyll a + b is equal to 0.387 mkg/g, carotenoid is 0.198 mkg/g; Lr-line 349 Thatcer chlorophyll a - 0.270 mkg/g, chlorophyll b - 0.069 mkg/g, chlorophyll a + b - 0.240 mkg/g, carotenoid b - 0.053 mkg/g; in Kazakhstanskaya 25 chlorophyll a - 0.225 mkg/g, chlorophyll b - 0.094 mkg/g, chlorophyll a + b - 0.499 mkg/g, carotenoid - 0.001 mkg/g; in Lr-line 341 Thatcer chlorophyll a- 0.192 mkg/g, chlorophyll b-0.078 mkg/g, chlorophyll a +b -0.270 mkg/g, carotenoids - 0,052 mkg/g, and in Alem chlorophyll a - 1.151 mkg/g, chlorophyll b - 0.061 mkg/g, chlorophyll a + b - 0.213 mkg/g, carotenoid was equal to 0.044 mkg/g, and the above-mentioned varieties showed a low level of 0.05-2% compared to the control variants. The analysis of all varieties demonstrated that the most high amount of chlorophyll was found in Alem variety that is 1.151 mkg/g. While the lowest level was shown in the Lr line 305 Thatcer varietyis, where chlorophyll a - 0.077 mkg/g, chlorophyll b - 0.025 mkg/g,, chlorophyll a + b - 0.10 mkg/g, carotenoid - 0.027 mkg/g; in SR-36 variety, chlorophyll a - 0.081 mkg/g, chlorophyll b - 0.037 mkg/g, chlorophyll a + a - 0.01 mkg/g, carotenoid - 0.174 mkg/g; in Samgau - chlorophyll a - 0.125 mkg/g, chlorophyll b - 0.044 mkg/g, chlorophyll a + b - 0.170 mkg/g, chlorophyll a+b 0.041; in Kazahkstanskaya early crop - chlorophyll a - 0.127 mkg/g, chlorophyll b - 0.050 mkg/g, chlorophyll a + b 0.178 mkg/g, carotenoid was 0.038 mkg/g. The decrease up to 3-36 percent can be observed in the comparison of the above-mentioned varieties with the control variants (table).

Among the varieties under study, the following ones have demonstrated nonresistance to the disease: Almaken, Kazakhstanskaya 15, Lutescens 92, Kazakhstan early crop, MOVIR 409, D969th Stemrrsn, and Saratovskaya 29. The concentration of chlorophyll in these varieties was in the range of 0.1-41% and significantly lower compared with its control varieties [6, 7]. A decrease in the number of chlorophyll in the plant leaf leads to a lower rate of photosynthesis. According to the literature, despite that the brown rust disease causes the decrease of chlorophyll, it does not lower the rate of photosynthesis [8-10]. Adult plant disease results in a rapid drop in the photosynthesis rate. These varieties have been damaged up to 40-70% in the area under spring crops during the ear stage.

Effect of brown rust wheat disease in summer wheat varieties on pigment composition (Case 2: I - inoculated, II - control)

I-variant						II-variant				
#	Name of varieties	Chl a	Chl в	Chl a+в	Carotenoid	#	Chl a	Chl b	Chl a+в	Carotenoid
1/1	Aray a 25	0,270± 0,0005	0,117± 0,0007	0,387± 0,0006	0,198± 0,0004	2/1	0,318± 0,0008	0,198± 0,0006	0,401± 0,0005	0,201± 0,0003
1/2	Almaken	0,157± 0,0007	0,066± 0,0006	0,224± 0,001	0,056± 0,0005	2/2	0,166± 0,0006	0,057± 0,0008	0,266± 0,0005	0,032± 0,0004
1/3	Kazakhstanskay	0,225± 0,0004	0,094± 0,0001	0,499± 0,0005	0,001± 0,0005	2/3	0,289± 0,0006	0,125± 0,0007	0,414± 0,0009	0,062± 0,0005
1/4	Kazakhstanskaya rannespelaya	0,127± 0,0005	0,050± 0,0008	0,178± 0,0006	0,038± 0,0005	2/4	0,202± 0,0004	0,091± 0,0004	0,294± 0,0004	0,052± 0,0005
1/5	Alem	1,151± 0,0001	0,061± 0,0005	0,213± 0,0007	0,044± 0,0001	2/5	0,286± 0,0004	0,111± 0,0007	0,379± 0,0007	0,068± 0,0006
1/6	Kazakhstanskay 15	0,210± 0,0009	0,084± 0,0005	0,294± 0,0008	0,053± 0,0008	2/6	0,233± 0,0008	0,059± 0,0007	0,327± 0,0007	0,059± 0,0007
1/7	Kazakhstanskay 17	0,143± 0,0003	0,043± 0,0006	0,187± 0,0006	0,044± 0,0002	2/7	0,006± 0,0007	0,138± 0,0006	0,445± 0,0004	0,056± 0,0004
1/8	Lyutestsens 90	0,162± 0,0005	0,062± 0,0009	0,224± 0,0006	0,060± 0,0006	2/8	0,274± 0,0007	0,119± 0,0007	0,394± 0,0005	0,050± 0,0005
1/9	Lyutestsens 92	0,172± 0,0005	0,070± 0,0005	0,243± 0,0006	0,193± 0,0002	2/9	0,205± 0,0005	0,176± 0,0004	0,282± 0,0005	0,197± 0,0004
1/10	Raksanom	0,282± 0,0006	0,165± 0,0004	0,447± 0,0004	0,065± 0,0003	2/10	0,379± 0,0005	0,159± 0,0005	0,538± 0,0006	0,052± 0,0006
1/11	Samgau	0,125± 0,0004	0,044± 0,0006	0,170± 0,0005	0,041± 0,0005	2/11	0,266± 0,0005	0,109± 0,0006	0,375± 0,0004	0,052± 0,0007
1/12	Lr-линия 305 Thatcer	0,077± 0,0008	0,025± 0,0003	0,103± 0,0005	0,027± 0,0005	2/12	0,293± 0,0006	0,128± 0,0004	0,421± 0,0004	0,055± 0,0007
1/13	Lr-линия 349 Thatcer	0,270± 0,0007	0,069± 0,0002	0,240± 0,0003	0,053± 0,0007	2/13	0,298± 0,0005	0,103± 0,0007	0,345± 0,0004	0,089± 0,0005
1/14	Lr-линия 341 Thatcer	0,192± 0,0005	0,078± 0,0005	0,270± 0,0006	0,052± 0,0004	2/14	0,233± 0,0007	0,096± 0,0004	0,306± 0,0005	0,079± 0,0005
1/15	MOVIR 409	0,111± 0,0002	0,045± 0,0005	0,107± 0,0005	0,191± 0,0006	2/15	0,231± 0,0008	0,121± 0,0004	0,168± 0,0005	0,222± 0,0004
1/16	Д11705th Stemrrsn	0,158± 0,0005	0,073± 0,0004	0,231± 0,0007	0,042± 0,0006	2/16	0,201± 0,0007	0,182± 0,0005	0,298± 0,0006	0,086± 0,0005
1/17	SR-36	0,081± 0,0006	0,037± 0,0006	0,011± 0,0008	0,174± 0,0005	2/17	0,189± 0,0005	0,102± 0,0005	0,322± 0,0005	0,183± 0,0004
1/18	Д939th Stemrrsn	0,290± 0,0003	0,117± 0,0003	0,409± 0,0005	0,062± 0,0004	2/18	0,387± 0,0007	0,168± 0,0007	0,455± 0,0007	0,079± 0,0004
1/19	Д969th Stemrrsn	0,170± 0,0008	0,068± 0,0004	0,239± 0,0007	0,386± 0,0007	2/19	0,268± 0,0007	0,101± 0,0007	0,299± 0,0001	0,045± 0,0007
1/20	Saratovskaya 29	0,143± 0,0002	0,058± 0,0005	0,202± 0,0004	0,041± 0,0004	2/20	0,201± 0,0006	0,125± 0,0005	0,301± 0,0005	0,098± 0,0006

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ЖАЗҒЫ БИДАЙ СОРТТАРЫНЫҢ ФОТОСИНТЕЗДІК БЕЛСЕНДІЛІГІНЕ ҚОҢЫР ТАТПЕН ЗАЛАЛДАНУЫНЫҢ ӘСЕРІ

Аннотация. Қоңыр тат қоздырғышы (Puccinia recondita f. sp. tritici P.triticiana Erikss.) – астық дақылдарын және *Triticum aestivum* L. жұмсақ бидайды зақымдайтын өте кең таралған, зиянды биотропты паразиттердің бірі болып табылады.

Төзімді сорттарды қалыптастырып өндіріске енгізу бидайды таттан қорғаудың ең тиімді шарасы ретінде қабылданған. Өсімдіктің індетке төзімділігі оның ұлпасында қоздырғышқа қажетті қорек элементтерінің болмауы, не болмаса физиологиялық белсенді заттардың болмауы, қожайын-өсімдік пен патогеннің зат алмасуымен сәйкес келмеуі, патогеннің өсімдік метаболизмінің токсинді өнімдерімен ауырлауы, және басқа да патогенге қолайсыз факторлардың болуына байланысты. Тақта жоғары сезімдалдылық редакциясы патогенді енгізу барысында және өсімдіктерді қоректенудің биотрофты типімен сипатталатын облигатты паразиттермен зақымдау барысында ерекше анық байқалады. Іріктеу жетістіктеріне қарамастан жазғы бидай сорттарының фотосиндездік белсенділігіне қоңыр таттың әсері әлі күнге дейін айтарлықтай анық емес.

Осы мәселеге қатысты мақалада қоңыр татпен зақымданған жазғы бидай сорттарының ұлпаларындағы хлорофилл мөлшерінің азаюы қарастырылған. Жүргізілген эксперимент нәтижесінде зақымданған Алмакен 15, Казахстандық 15, Лютесценс 92, ерте пісетін Қазақстандық сорт, МОВИР 409, Саратов 29 сорттарындағы хлорофиллдің мөлшері бақылаудағы нұсқамен салыстырғанда 0,1 ден 41 % азайғаны байқалды.

Түйін сөздер: қоңыр тат, жаздық бидай, фотосинтез белсенділігі.

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ВЛИЯНИЕ ЗАБОЛЕВАНИИ БУРОВОЙ РЖАВЧИНЫ НА ФОТОСИНТЕТИЧЕСКУЮ ДЕЯТЕЛЬНОСТЬ ЯРОВЫХ ПШЕНИЦ

Аннотация. Возбудитель бурой ржавчины Puccinia triticina Erikss. –специализированный биотрофный паразит, являющий одним из наиболее распространенных и вредоносных заболеваний зерновых злаков и поражающий мягкую пшеницу Triticum aestivum L.

Среди мер защиты пшеницы от ржавчины наиболее эффективным признано создание и внедрение в производство устойчивых сортов. Устойчивость растения к болезни может быть связана с отсутствием в его тканях необходимых для возбудителя элементов питания или физиологически активных веществ, несоответствием обмена веществ растения-хозяина обмену веществ патогена, угнетением патогена токсичными продуктами метаболизма растения, другими неблагоприятными для патогена факторами. Реакция сверхчувствительности к ржавчине наиболее ярко проявляется при внедрении патогена и при заражении растений облигатными паразитами, которые характеризуются биотрофным типом питания. Несмотря на селекционные достижения, мало известно влияние бурой ржавчины на фотосинтетическую активность сортов яровой пшеницы.

В связи с данной проблемой в статье исследовано уменьшение содержания хлорофилла в тканях сортов яровой пшеницы, пораженного бурой ржавчиной. В результате проведенного эксперимента выявлено уменьшение хлорофилла от 0,1 до 41% у пораженных сортов Алмакен, Казахстанская 15, Лютесценс 92, Казахстанская раннеспелая, МОВИР 409, Саратовская 29 по сравнению с контрольным вариантом.

Ключевые слова: бурая ржавчина, яровая пшеница, фотосинтезная активность.

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