UDK 633.11:632.9

ENHANCED FUSARIUM HEAD BLIGHT RESISTANCE IN BREAD WHEAT AND DURUM BY ALIEN INTROGRESSIONS

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Abstract

Fusarium head blight resistance has previously been detected in two accessions of *Ae. cylindrica (*2n=4x=28, CCDD genome*).* The resistance was introgressed initially into a semi-dwarf winter wheat, then subsequently into a number of Canadian hard red spring wheat cultivars plus one cultivar from USA. DON contents, determined on field plot-harvested samples are reported for selected lines from three populations. Of the total of 83 lines tested from the three populations, 18 lines showed DON contents of less than 1ppm. Another 48 lines had 1-5ppm DON in their seed, compared to check cultivars Sumai3 at 1.2ppm and Roblin at 11.0 ppm. It is anticipated that unique FHB resistance QTL will be identified in these populations.

Introduction

Fusarium head blight caused by Gibberella zea is a common disease of cereals in all temperate growing regions of the world.With the world's two best sources of resistance; the cultivars Sumai3 and Frontana, being only partially resistant, a search was initiated in the secondary and tertiary gene pools of the Triticeae, with which to enhance these levels of resistance(Fedak et. al.,1997; Fedak et. al.,2003, Cao et. al., 2003).We chose to work on accessions that were not being employed elsewhere. In this report we will present data on the field performance of lines of hexaploid wheat that were selected from progenies of crosses to wild wheat species.

Materials and Methods

A high level of FHB resistance was found in several accessions of *Aegilops cylindrica,* that were collected in natural habitats in southern

ISSN 0582-5075. Селекція і насінництво. 2008. Випуск 96.

Ukraine. These lines were crossed onto a semi-dwarf Odessa experimental line of winter wheat and following several cycles of selection and backcrossing, the FHB resistance was established in that background. These sources of resistance, designated as 1/74-91 and 5/20-91 were crossed onto Canadian cultivars AC Superb, AC Barrie, Domain, Teal Elsa, HY644 and Glenlea. Selections were made in the progeny of each cross, by initially inoculating hill plots in field plantings with a conidial spore suspension. After inoculation, the spikes of each plant were enclosed in plastic bags for 72 hours to maintain the relative humidity. FHB symptoms were scored on each plot at 21 days after flowering. After harvest, the grain samples were selected based on the absence of Fusarium damaged kernels.

Populations from three of the cross combinations (Table 1), were grown in single rows in an epiphytotic nursery in Ottawa in 2007 crop year. Corn spawn was applied as the source of inoculum. Plots were irrigated by means of overhead sprinklers twice per day to maintain a high level of humidity during disease development. After harvest, one gram aliquots of grain were removed from each sample and ground for analysis of DON content, by an ELISA technique (Sinha and Savard, 1997)

Results and Discussion

Results on DON analysis on 83 samples from three populations plus four check varieties are shown in Table . The parental cultivars used to produce the populations were AC Superb, a high yielding hard red spring wheat cultivar with good milling quality but poor FHB resistance; AC Barrie, a hard red spring wheat cultivar with high milling quality and fairly good FHB resistance; and Alsen, a hard red spring wheat cultivar released by North Dakota State University, for it’s high level of FHB resistance. The check cultivar Strongfield, is a durum cultivar, having a fair level of FHB resistance for that class of wheat.

Despite very good FHB symptoms development occurred (incidence and severity) in the FHB nursery in 2007; the DON levels across the board were low. In general, the distribution of lines with various DON levels was similar across the three populations. The population derived from Barrie, differed somewhat, by having no lines in the <1ppm category, but having more lines in the category with >5ppm DON. Otherwise the data show that 66 out of the 83 lines tested, from the three combinations had DON levels of 5ppm or less. This test needs to be repeated, using multiple-row plots and multiple replications. It is expected however that with a total of 36 lines from the three populations giving DON levels of 2ppm or less; lines with low DON levels and fairly good agronomic characters should be present in these populations and should be selected in the final tests.

Table 1. DON levels of *Ae. cylindrica*-derived lines in FHB nursery of 2007

Derivatives	Gener.	<1ppm	1-2 ppm	2-5ppm	>5ppm	DON levels # of lines
/ Superb	F7	11	8	10	4	33
/ AC Barrie	F6	--	4	14	9	27
/ Alsen	F4	7	6	6	4	23
Check						
Sumai 3		1.2				
Roblin					11.0	
Superb					10.7	
Strongfield					17.6	

The FHB resistance expressed in field plots would have been Type II. Single plant selections were made in field plots in all populations, grown in greenhouses over-winter and point-inoculated. Many of the lines tested had good resistance to Type I as well. In terms of agronomic performance, from a visual selection aspect, the population derived from Alsen, seemed to be more vigorous, with shorter plant types and better straw strength.

Aegilops cylindrical is a tetraploid with a genomic constitution of CCDD. Very few FHB-resistance QTL have been mapped in the D genome of hexaploid wheat thus far. In our studies, QTL analysis is proceeding in the population derived from AC Superb. Preliminary data indicate the presence of introgressions on chromosomes 1D and 3D. It is anticipated that unique FHB-resistance QTL will be identified. Population development has been started to pyramid the *Ae. cylindrica* resistance with other known QTL.

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Устойчивость к фузариозу колоса/гибберелёзу предварительно выявлена у 2-х образцов Ae.cylindrica (2n = 4 x = 28, ССДД геном). Первоначально эта устойчивость была интрогрессирована в полукарликовую озимую пшеницу, затем впоследствии в ряд канадских сортов твердой краснозерной яровой пшеницы и в один сорт из США. Данные по уровням содержания DON, определявшихся по образцам, собранным с полевой делянки, представлены для селекционных линий от 3-х популяций. Из всех 83 линий, которые испытывались, 18 линий демонстрировали DON-содержание менее 1 части на миллион. Другие 48 линий имели в своих семенах показатель DON 1-5 частей на млн. в сравнении с контрольными сортами Сумаи 3 при показателе 1.2 частей на млн. и Роблин – 11,0 частей на млн. Ожидают, что уникальную стойкость к болезням в локусах количественных признаков идентифицируют в этих популяциях.

Виявлено стійкість до фузаріозу колоса/гіберельозу спочатку у 2-х зразків Ae.cylindrica (2n = 4 x = 28, ССДД геном). Вперше ця стійкість була інтегрована у напівкарликову озиму пшеницю, потім у ряд канадських сортів твердої червонозерної ярої пшениці та у один сорт із США. Дані по рівню утримання DON, що визначались по зразках, зібраних з польових ділянок, представлені для селекційних ліній від 3-х популяцій.

Із усіх 83 ліній, які випробувались, 18 ліній продемонстрували DON-вміст менше 1 частини на мільйон. Інші 48 ліній мали у своєму насіння DON-показник 1-5 частин на мільйон в порівнянні з контрольними сортами Сумаі 3 при показнику 1.2 частини на мільйон і Роблін – 11,0 частин на мільйон. Чекають, що унікальну стійкість до хвороб у локусах кількісних ознак буде визначено у цих популяціях.