Table 8. Some new D-genome synthetic hexaploids *T. turgidum*/*Ae. tauschii* and bread wheat (BW)/SH derivatives with *Fusarium graminearum* head blight resistance under artificial inoculation in Toluca, Mexico. Data are means over two summer cycles.

Pedigree	% Damage Type I	% Damage Type II	DON (ppm)	Test weight losses (%)
Synthetic hexaploids (new set).				
Croc 1/*Ae. tauschii* (662) [1]		13.7		
Ceta/*Ae. tauschii* (172)		12.7		
Cpi/Gediz/3/Goo//Jo/Cra/4/*Ae. tauschii* (305)		10.3		
Ceta/*Ae. tauschii* (306)		14.7		
Ceta/*Ae. tauschii* (371)		13.0		
Ceta/*Ae. tauschii* (445)		13.4		
Ceta/*Ae. tauschii* (533)		15.9		
Cpi/Gediz/3/Goo//Jo/Cra/4/*Ae. tauschii* (1018)		14.9 [2]		
Ceta/*Ae. tauschii* (1031)		14.9 [2]		
Ae. tauschii (1026)/Doy 1		13.7 [2]		
BW/SH advanced derivatives.				
Turaco/5/Chir3/4/Siren//Altar 84/*Ae. tauschii* (205)/3/3*Buc	13.21	9.29	0.58	5.27
Bcn//Doy1/*Ae. tauschii* (447)	9.96	10.2	1.00	2.64
Mayoor//TK SN 1081/*Ae. tauschii* (222)	3.63	9.88	1.20	6.06
Mayoor//TK SN 1081/*Ae. tauschii* (222)	2.07	11.93	1.20	6.50
Sumai # 3 (resistant check)	2.63	13.04	0.27	38.59
Frontana (moderately resistant check)	12.23	22.44	2.00	7.71

[1] *Aegilops tauschii* accession number in CIMMYT wheat wide crosses working collection.
[2] Percentage based upon 10 spike inoculations.

Also provided are the data for advanced derivatives from resistant synthetic/bread wheat combinations that show resistance for other types, i.e., Types I (penetration), III (toxin), and IV (test weight) (Table 8) over two summer cycles in Mexico.

The line 'Mayoor//TK SN 1081/*Ae. tauschii* (222)' in addition to being a good source for all four types of scab resistances, also possesses resistance to leaf, stem, and stripe rusts; Karnal bunt; *S. tritici*; and *H. sativum*. The line is free-threshing type and has a spring habit. F_1s of this line have been made with a bread wheat Flycatcher, which is susceptible for all the above attributes. The F_1 currently is being used to produce a doubled haploid-based mapping population in order to obtain molecular information.

Practical applications of a gene pyramiding strategy with D genome-based synthetic hexaploids for two major biotic stress resistances: wheat head scab and spot blotch.

A. Mujeeb-Kazi, R. Delgado, and S. Cano.

Among the primary gene pool species we have focused on initially to exploit the genetic diversity of the D-genome for wheat improvement are the diploid species accessions of *Ae. tauschii*. The procedure followed has been to cross durum wheats with *Ae. tauschii* accessions and the then double the F_1 hybrids (2n = 3x = 21, ABD) to obtain hexaploid wheats called synthetic hexaploids or SHs. Several such combinations have been produced over the last decade, and have been seed increased, and evaluated for biotic stresses. Two of these stresses are of major global importance for wheat production; head scab and spot blotch (*H. sativum* or *C. sativus*). In field evaluations done in Mexico over the past 10 years, we have observed that the best lines selected for spot blotch in Poza Rica also performed adequately for scab in Toluca. Consequently the best performers of the synthetic hexaploids for spot blotch were intercrossed in order to combine the diversity of different *Ae. tauschii* accessions, select superior F_2 segregates, and make these stable by the maize doubled protocol using the detached tiller approach. Results of these DH synthetic/synthetic F_2 resistant selections for spot blotch were reported in the *Annual Wheat Newsletter*, Vol. 45, 1999.

The above DH spot blotch germ plasm was tested in the summer of 1999 in Toluca for head scab, and a few lines were identified that possessed superior Type 11 (spread) resistance (Table 9). Because stripe rust also is prevalent at this site, the selected lines also were screened for the stress, and all lines reported (Table 9) possess good stripe rust resistance. The lines also possess leaf and stem rust resistance based upon screening in Obregon, another location in Mexico. The DH derivatives are considerably early to flower, reach physiological maturity earlier, and are significantly shorter than their tall synthetic parents.

Table 9. Double haploids from synthetic hexaploid/synthetic hexaploid F_2 *Helminthosporium sativum*-resistant selections that also possess scab resistance (Type II) in Toluca, Mexico. For the two-digit scoring system for *H. sativum* resistance, the first digit = height of infection (5 = up to mid-plant and 9 = up to flag leaf) and the second digit indicates disease severity on infected leaves (1 = low and 9 = total leaf destroyed).

Pedigree	Days to flowering	Days to physiological maturity	Plant height (cm)	*H. sativum* foliage score at 96 days	Grain finish	Scab Type II (%)
Gan/*Ae. tauschii* (236) *//Doy 1/*Ae. tauschii* (447)/3/Maize						
CASS97B00040S	68	96	115	2-2	1	15.8
Gan/*Ae. tauschii* (236)//Ceta/*Ae. tauschii* (895)/3/Maize						
CASS97B00041S	68	96	110	2-2	2	14.2
Scoop 1/*Ae. tauschii* (434)//Ceta/*Ae. tauschii* (895)/3/Maize						
CASS97B00046S	70	98	110	3-3	1	11.0
Doy 1/*Ae. tauschii* (447)//Ceta/*Ae. tauschii* (895)/3/Maize						
CASS97B00054S	70	98	115	3-3	2	15.7
68.111/Rgn-u//Ward/3/Fgo/4/Rabi/5/*Ae. tauschii* (629)/6/Ceta/*Ae. tauschii* (895)/7/Maize						
CASS97B00058S	70	98	115	3-3	1	13.0
Ciano 79	58	96	85	9-9	4	—
Frontana (Resistant)						6.0
Sumai (Resistant)						15.2
Flycatcher (Susceptible)						42.5

* *Ae. tauschii* accession number in CIMMYT wheat wide crosses working collection.

Such lines with pyramided *Ae. tauschii* accessional diversity are advantageous for incorporation in wheat breeding, because diverse genes may be incorporated simultaneously, thereby enhancing breeding efficiency. In addition, our approach also is fostering the use of those synthetics that possess multiple disease resistances. Such germ plasm is being identified readily, and we anticipate that it also will make a significant contribution in wheat improvement by providing rapid outputs either by individual usage of the synthetics or by the above-described pyramiding route option.

The contribution of the D genome to efficiency of doubled haploid production in wheat.

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Bread wheat haploids are being produced by us routinely via the wheat/maize crossing protocol for use in wheat cytogenetics, wide crosses, wheat breeding, and genetic analyses, with extension of the application into genetic engineering and molecular mapping. The mean frequency percentage data at this stage for embryo recovery, plantlet differentiation, and