Synthetic Hexaploids x *Triticum aestivum* Advanced Derivatives Resistant to Karnal Bunt (*Tilletia indica* Mitra)

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Summary

Eighty-one advanced bread wheat lines derived from 12 crosses involving seven synthetic hexaploids (*Triticum turgidum x T. tauschii*) and seven high yielding *T. aestivum* cultivars were evaluated for Karnal bunt (*Tilletia indica* Mitra) resistance during two crop seasons at CIANO, Ciudad Obregon, Sonora, Mexico. Ten random tillers of each test entry at boot stage were injected with a suspension of sporidia in water (10,000 sporidia/ml of water). At maturity the inoculated spikes were threshed individually and evaluated for percent Karnal bunt infected grains. Based on the mean Karnal bunt score of each entry for two seasons, 17 lines showed less than 3% infection as compared to 82.1% of the susceptible *T. aestivum* check cultivar WL711. Most of the resistant cultivars were derivatives of Chen/*T. tauschii* (205)//Kauz cross. One entry from the cross Chen/T. tauschii (205)//Weaver remained immune (0% infection) after two years of test. Finally, these derivatives provide additional source of genetic variability for Karnal bunt resistance in bread wheat improvement.

Key words: synthetic hexaploids - *Triticum aestivum* - *T. turgidum* - *T. tauschii* - *Tilletia indica* - Karnal bunt - resistance

Introduction

Karnal bunt (KB) of wheat is caused by *Tilletia indica* Mitra (Syn. *Neovossia indica* (Mitra) Mundkur), a floral-infecting fungus that infects wheat and triticale seed. This organism was believed to have originated in the subcontinent of India-Pakistan and is indigenous to that area. The presence of the disease in Mexico was first reported in the early 1970s

(Duran, 1972). Outbreaks of the disease have since occurred in 1982, 1985 and 1989. Most current bread wheat (*Triticum aestivum* L.) cultivars are susceptible. The economic losses caused by KB in Northwestern Mexico are US$7.0 million per year (Brennan, et al. 1990) indicating that effective measures to control the disease could result in substantial savings.

Over the last decade, breeding for KB-resistant wheat germplasm has received high priority at CIMMYT. Considerable effort was made to identify and incorporate the germplasm with acceptable resistance to this disease. High levels of KB resistance has been found in a few bread and durum wheats, triticale and several accessions of *Triticum tauschii* (Coss) Schmal (*Aegilops squarrosa)* which can serve as sources of resistance (Gautam et al. 1977, Gill et al. 1981, Warham et al. 1986, Fuentes-Davila et al. 1992, Rajaram et al. 1991). Interspecific hybrids between *T. turgidum* and *T. tauschii* (synthetic hexaploids = SH)have shown highly resistant to immune (0% infection) response to KB, thus, offer new genetic variability for resistance to the disease (Villareal et al. 1994). Since 1989, crosses have been made between CIMMYT's elite but KB susceptible *T. aestivum* cultivars and best advanced SH wheat lines with good agronomic characteristics, cytogenetic stability and KB resistance. Advanced derivatives from these crosses are now available for further tests.

The objective of the study was to evaluate the KB resistance of SH x *T. aestivum* advanced derivatives using artificial inoculation in the field.

Materials and Methods

Eighty-one advanced bread wheat lines derived from 12 crosses involving seven SH and seven high yielding *T. aestivum* cultivars were included. The durum wheat, *T. tauschii* and the bread wheat backgrounds of the test materials are indicated in Table 1. Bread wheat cultivar WL711 from India was included as a susceptible check. Agronomic and disease evaluations were done at the Mexican Institute of Forestry, Agriculture and Livestock, Campo Agricola Experimental del Valle del Yaqui (CIANO) research station, Sonora Mexico (27°20'N, 105°55'W, elevation 39m above sea level) during 1992-93 and 1993-94 wheat seasons. Materials were grown on 90 cm wide beds as two-row plots of 2m long spaced at 20 cm between rows using a Completely Randomized Design with two replications. KB inoculation was performed using ten random tillers from each entry during the boot stage, stages 48-49 according to Zadoks et al. (1974), injecting 1 ml/tiller of the sporidial suspension (10,000 sporidia/ml of water) with a hypodermic needle. Tillers were tagged with color coding tape to indicate the date of inoculation. Overhead sprinklers with fine nozzles were used to achieve optimum relative humidity needed for successful disease infection. After inoculation, sprinklers were turned on 3-5 times daily for 8 minutes each time for 12 days. At maturity, the 10 inoculated spikes from each entry and the susceptible check, were harvested and hand threshed to determine the percentage of kernels infected with KB.

Results and Discussion

The range and mean KB infection scores of the 12 SH x *T. aestivum* crosses screened during the 1992-93 crop cycles are presented in Table 1. KB screening of the test materials had infections ranging from 0% to 39%. The overall mean KB infection of the advanced derivatives was 11.8% compared to 77.4% of the susceptible *T. aestivum* check cultivar WL711. Nearly 10% of the test materials showed 0% infection or immune response to *Tilletia indica*. Moreover, 18.5% of the entries scored less than 3% infection. These were considered resistant since their reaction fell below the 3% threshold known to be of practical significance in breeding.

Thirty two entries with KB scores of 0% to 5.09% infection during the 1992-93 screening were re-tested in 1993-94 for confirmation. Fifty-six % of the test entries showed less than 3% KB infection as compared to 86.8% on WL711. The mean scores of the highly resistant entries after two cycles of testing is summarized in Table 2. Most of the resistant cultivars were derivatives of Chen/*T. tauschii* (205)//Kauz cross. One entry from the cross Chen/*T. tauschii* (205)//Weaver remained immune (0% infection) after two years of tests. Information on flowering days, days to physiological maturity, plant height and 1000-grain weight were also recorded (Table 2). The highly resistant materials were generally semidwarfs, intermediate in maturity and possessed large grains. Finally, these advanced derivatives provide additional source of genetic variability for KB resistance. Studies are underway to evaluate the yield potential of these cultivars for utilization in the wheat breeding program.

Table 1. Germplasm description of the synthetic hexaploids x *Triticum aestivum* advanced bread wheat derivatives screened for Karnal bunt at CIANO during the 1992-93 wheat cycle.

Cross	No. of lines	% KB infection	
		Range	Mean
Altar 84/*T. tauschii* (191)//Opata	9	1.19-19.09	8.67
Altar 84/*T. tauschii* (221)//Yaco	3	0-1.25	0.57
Altar 84/*T. tauschii* (221)//Papago	1	1.45	1.45
Altar 84/*T. tauschii* 224//Papago	4	6.71-36.53	25.3
Chen/*T. tauschii* (205)//Kauz	28	0-39.30	12.36
Chen/*T. tauschii* (205)/Weaver	4	0-5.09	1.92
Chen/*T. tauschii* (205)//Flycatcher	2	7.58-9.70	8.64
Chen/*T. tauschii* (210)//Yaco	2	15.49-28.12	21.8
Chen/*T. tauschii* (213)//Esmeralda	2	15.77-22.75	19.26
Chen/*T. tauschii* (213)//Papago	6	0-39.44	9.72
Chen/*T. tauschii* (224)//Yaco	14	1.40-36.94	15.54
Chen/*T. tauschii* (224)//Opata	6	2.24-37.88	16.93
WL711 (Susceptible check)	1	-	77.4

Table 2. Highly resistant advanced bread wheat derivatives of synthetic hexaploids x *Triticum aestivum* to Karnal bunt during the 1992-93 and 1993-94 field screenings at CIANO.

Cross and pedigree	% KB infection	Flow. days	Physiol. mat.	Plt. ht. (cm)	1000-grain wt. (g)
Chen/*T. tauschii* (205)//Weaver CIGM90.250-4Y-3B-4Y-0B	0	80	132	89	52.0
Chen/*T. tauschii* (205)//Weaver CIGM90.250-4Y-3B-3Y-0B	0.13	78	127	91	53.5
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-3B-5Y-0B	0.29	91	137	94	50.0
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-1B-2Y-0B	0.61	91	133	94	47.1
Altar 84/*T. tauschii* (221)//Yaco CIGM90.642-1Y-3B-8Y-0B	0.82	93	135	99	52.5
Chen/*T. tauschii* (205)//Kauz CIGM90.248-1Y-2B-1Y-0B	0.95	91	134	86	49
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-1B-9Y-0B	0.97	91	134	97	44.6
Altar 84/*T. tauschii* (221)//Yaco CIGM90.462-1Y-3B-2Y-0B	1.24	91	134	97	48.0
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-3B-2Y-0B	1.30	88	130	85	46.7
Altar 84/*T. tauschii* (191)//Opata CIGM 90.483-4Y-2B-3Y-0B	1.40	83	126	96	47.2
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-2B-2Y-0B	1.44	85	133	89	43.2
Chen/*T. tauschii* (213)//Papago CIGM90.412-5Y-3B-6Y-0B	1.75	85	133	102	50.9
Chen/*T. tauschii* (205)//Kauz CIGM90.248-1Y-4B-3Y-0B	1.75	83	123	82	38.2
Chen/*T. tauschii* (205)//Kauz CIGM90.248-1Y-4B-6Y-0B	1.82	84	128	90	39.3
Chen/*T. tauschii* (205)//Kauz CIGM90.248-1Y-4B-5Y-0B	1.92	86	131	91	43.6
Chen/*T. tauschii* (205)//Kauz CIGM90.261-3Y-1B-5Y-0B	2.19	87	135	94	46.9
Chen/*T. tauschii* (205)//Weaver CIGM90.250-4Y-3B-2Y-0B	2.73	82	131	89	50.9
WL711 (Susceptible check)	82.10	-	-	-	-

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