Evaluation of advanced bread wheat (*Triticum aestivum*) lines and synthetic hexaploid wheat derivatives (*T. turgidum*/*Aegilops squarrosa*/*T. aestivum*) for resistance to karnal bunt (*Tilletia indica*)

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NOTA CORTA

Evaluación de líneas avanzadas de trigo harinero (*Triticum aestivum*) y de líneas de trigos derivados de sintéticos hexaplodes (*T. turgidum*/*Aegilops squarrosa*/*T. aestivum*) para resistencia al carbón karnal (*Tilletia indica*)

Resumen. Ciento cuarenta y cuatro líneas avanzadas de trigo harinero y trigo derivados de sintéticos hexaplodes se evaluaron para resistencia al carbón karnal bajo inoculación artificial en campo en dos fechas de siembra, en el Valle del Yaqui, México. Las líneas que presentaron 5% de infección o menos, se evaluaron en la segunda fecha de siembra. El intervalo de infección en la primera fecha fue de 0 a 49.8%, con un promedio de 9.8%, mientras que el testigo susceptible tuvo 79.2%. De las 60 líneas con niveles de infección menores al 5% en la primera fecha, se evaluaron 59 en la segunda: El intervalo de infección fue de 0-40.9 con un promedio de 9.1. Treinta y nueve porciento de las líneas originalmente clasificadas como resistentes, también fueron resistentes en la segunda fecha, lo que indica la importancia de tener varias fechas de siembra para evitar escapes. El sintético CROC_1/AE.SQUARROSA (205) está presente en el pedigrí de las dos líneas que no presentaron ningún grano infectado; otros sintéticos así como las variedades resistentes HD 29 y 30 se encuentran en los pedigrís de algunas de las líneas que presentaron niveles de infección menores al 5%.
Palabras clave: Carbón parcial, *Neovossia indica*, inoculación.

Abstract. One hundred and forty four advanced bread wheat lines and synthetic hexaploid wheat derivatives were evaluated under field inoculation in two planting dates, for resistance to karnal bunt in the Yaqui Valley, Mexico. Lines with 5% infection or less, were evaluated on the second planting date. The range of infection for the first planting date was 0 to 49.8%, with a mean of 9.8%, while the susceptible check had 79.2% infection. Out of the 60 lines with less than 5% infection, 59 were evaluated in the second planting date: The range of infection was 0-40.9 with a mean of 9.1. Thirty nine percent of the lines originally classified as resistant were resistant in the second planting date, which emphasizes the importance of several planting dates in order to avoid escapes. The synthetic CROC_1/AE.SQUARROSA (205) is present in the pedigree of the two lines that did not show any infected grain; other synthetics as well as resistant cultivars HD 29 and 30 are in the pedigees of some of the lines that had infection levels lower than 5%.
Key words: Partial bunt, *Neovossia indica*, inoculation.

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Tilletia indica Mitra, is the causal agent of karnal bunt of wheat. Control of this pathogen is difficult because teliospores are resistant to physical and chemical factors [4]. Chemical control can be accomplished by applying fungicides during flowering [3]; however, this measure is not feasible when quarantines do not allow tolerance levels for seed production. Resistant wheat cultivars are the best mean to control this disease. The susceptibility of bread wheat has

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been documented [2] reaching infection levels above 50% under artificial inoculations; there also are reports of bread wheats which consistently have shown low infection levels [1]. Advanced lines and cultivars of durum wheat and triticale are reported to be resistant under artificially inoculated conditions [2]. Villareal *et al*. [5] reported that 49% of the synthetic hexaploids (SH) evaluated during three crop cycles under artificial inoculation, were immune to the disease; also, Villareal *et al*. [6] registered four SH as immune to the disease. The resistant reaction appears to be conferred by the genetic base of *Aegilops squarrosa* (syn. *Triticum tauschii*) and *T. turgidum*. The objective of our study was to evaluate new advanced bread wheat lines and synthetic hexaploid wheat derivatives for resistance to karnal bunt.

One hundred and forty four advanced bread wheat lines and synthetic hexaploid wheat derivatives were evaluated for resistance to karnal bunt during the crop cycle fall-winter 2004-2005 in the Yaqui valley, Sonora, Mexico. Planting dates were November 10 and 28, 2004, using approximately 10 g of seed on 1 m beds with two rows. A mist irrigation system was used 3 to 5 times a day for 15 min each time, to provide high relative humidity in the experimental area. Inoculations were carried out by injecting 1 mL of an allantoid sporidial suspension (10,000/mL) during the boot stage on 10 heads per line. Only lines that had 5% infection or less, were evaluated on the second planting date. Harvest was done manually, and the counting of healthy and infected grains was done by visually to determine the percentage of infection.

The range of infection for the first planting date was 0 to 49.8%, with a mean of 9.8%; eleven lines did not have infected grain. Thirty lines were within the category of 0.1-2.5% infection, 19 in 2.6-5.0%, 30 in 5.1-10.0%, 45 in 10.1-30%, and 9 had more than 30% infection, while the susceptible check had 79.2% infection. Out of the 60 lines with less than 5% infection, 59 were evaluated in the second planting date: The range of infection was 0-40.9 with a mean of 9.1; three lines did not have infected grain, 12 were within the 0.1-2.5% infection category, 8 in 2.6-5.0%, 19 in 5.1-10.0%, 15 in 10.1-30%, and two had more than 30% infected grain (Figure 1). Thirty nine percent of lines originally classified as resistant were resistant in the second planting date [1], which emphasizes the importance of several planting dates in order to avoid escapes. The pedigrees and selection history of lines that did not have infected grain in both dates are CROC_1/AE.SQUARROSA (205)//BORL95/3/OASIS/

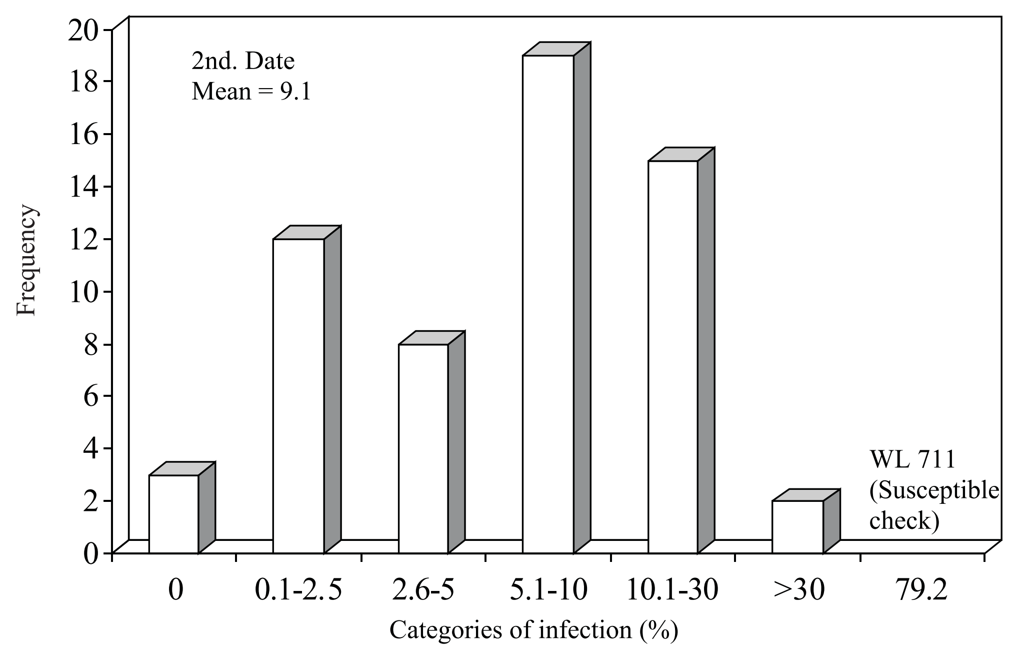

Figure 1. Results of artificial field inoculation in the second planting date with Karnal bunt (*Tilletia indica*) of 59 advanced bread wheat (*Triticum aestivum*) lines and synthetic hexaploid wheat derivatives (*T. turgidum*/*Aegilops squarrosa*//*T. aestivum*) in the Yaqui Valley, Sonora, Mexico, during the crop cycle 2004-2005. The level of infection of WL711 is the mean of the three highest infection scores.

Table 1. Bread wheat (*Triticum aestivum*) lines and synthetic hexaploid wheat derivatives (*T. turgidum*/*Aegilops squarrosa*//*T. aestivum*) with infection levels below 5% after artificial field inoculation with Karnal bunt (*Tilletia indica*) in two planting dates, during the crop cycle fall-winter 2004-2005 in the Yaqui Valley, Sonora, Mexico

Pedigree* and selection history**
Lines that did not show any infected grain
*CROC_1/AE.SQUARROSA (205)//BORL95/3/OASIS/5*BORL95
**CMSS97M04968S-020Y-030M-020Y-040M-4Y-1M-0Y
CHIL/BUC//PASTOR/3/CROC_1/AE.SQUARROSA (205)//KAUZ
CMSS97M03874T-040Y-030M-020Y-030M-015Y-38M-3Y-3M-0Y
Lines with 0.1-2.5% infection
SW89.5193/3/KAUZ*2/BOW//KAUZ
CMSS97M01870S-040M-020Y-030M-015Y-4M-1Y-2M-0Y
KETUPA/PASTOR//HUITES
CMSS97M04207T-040Y-020Y-030M-020Y-040M-13Y-2M-0Y
ALTAR 84/AE.SQUARROSA (224)//2*YACO/3/KAUZ
CMSS97M05029S-020Y-030M-020Y-040M-5Y-1M-0Y
HD30/5/CNDO/R143//ENTE/MEXI75/3/AE.SQ/4/2*OCI
CMSS98Y00192S-020Y-030M-020Y-040M-6Y-2M-0Y
VEE/PJN//2*TUI/3/SKAUZ*2/SRMA
CMSS97M04479S-020Y-030M-020Y-040M-13Y-1M-0Y
KAUZ/MILAN/3/CROC_1/AE.SQUARROSA (205)//KAUZ
CMSS97M03766T-040Y-040M-020Y-030M-015Y-36M-2Y-2M-0Y
SW94.60002/4/KAUZ*2//DOVE/BUC/3/KAUZ/5/SW91-12331
CMSS98Y02345T-040M-0100M-040Y-040M-030Y-28M-1Y-0M
SW89.2089/CHIBIA
CMSS98M00051S-0100M-040Y-040M-030Y-2M-3Y-0M
URES/KAUZ//2*PASTOR
CMSS98Y01728M-040M-0100M-040Y-040M-030Y-12M-3Y-0M
SRN/AE.SQUARROSA (358)//HXL7573/2*BAU/3/PASTOR
CMSS98Y02467T-040M-0100M-040Y-040M-030Y-9M-2Y-0M
Lines with 2.6-5.0% infection
PJN/BOW//OPATA*2/3/CROC_1/AE.SQUARROSA (224)//OPATA
CMSS96Y03204F-050M-040Y-020M-050SY-020SY-16M-0Y
MO88/MILAN
CMSS92Y02929S-64Y-03M-03Y-010Y-2M-0Y-4AL-1AL-0B-0Y
MILAN/BAV92//PASTOR
CMSS98Y02082T-040M-4SY-0M-010Y-010M-1Y-1M-0Y
HD29/2*WEAVER/3/VEE/PJN//2*TUI/4/MILAN
CMSS97M03667T-040Y-020Y-030M-020Y-040M-26Y-2M-0Y
CHEN/AE.SQ//WEAVER/3/SSERI1
CMSS98Y00278S-020Y-030M-020Y-040M-8Y-2M-0Y
KAUZ*2/TRAP//KAUZ/3/PASTOR/4/SKAUZ*2/SRMA
CMSS97M04053T-040Y-040M-020Y-030M-015Y-24M-2Y-1M-0Y
SW90.1057//HD29/2*WEAVER/3/SW91-12331
CMSS98Y02244T-040M-0100M-040Y-040M-030Y-39M-3Y-0M
CHEN/AE.SQ//WEAVER/3/PASTOR
CMSS98Y00279S-0100M-040Y-040M-030Y-4M-2Y-0M

5*BORL95, CMSS97M04968S-020Y-030M-020Y-040M-4Y-1M-0Y, and CHIL/BUC//PASTOR/3/ CROC_1 /AE.SQUARROSA (205)//KAUZ, CMSS97M03874T-040Y-030M-020Y-030M-015Y-38M-3Y-3M-0Y (Table 1); ten lines were in the 0.1-2.5% infection category in both dates and eight in 2.6-5.0%. The synthetic CROC_1/AE.SQUARROSA (205) is present in the pedigree of the two lines that did not show any infected grain, and in one line in the 0.1-2.5% infection category; also, synthetics with *T. turgidum/Aegilops squarrosa* are present in three lines in the 0.1-2.5% and 2.6-5.0% infection categories, respectively. These results corroborate that resistance to karnal bunt is conferred by synthetics [5], as well as by indian sources [1] since HD 30 and HD 29 appear as parents in one and two lines in the 0.1-2.5% and 2.6-5.0% infection categories. It would be important to determine the genetic bases of resistance to karnal bunt in such germplasm, in order to achieve a more efficient breeding scheme. Villareal *et al*. [7] reported that resistance was dominant or partly dominant over susceptibility in crosses of four resistant synthetic hexaploid wheats and two susceptible *T. aestivum* cultivars. Some of the synthetic hexaploid wheats evaluated in this work might carry the same type of resistance since genotypes used as parents are the same, but perhaps different accessions of AE. SQUARROSA. If these lines could not be candidates for commercial release, they could be used as a source of resistance to karnal bunt. The availability of resistant cultivars could provide excellent management of the disease in the affected areas of north-western Mexico; this would imply less contamination to the environment by the limited use of agrochemicals, more flexibility of quarantine regulations related to seed and grain movement from the affected areas, and a more profitable crop for the farmers. Also, export markets for wheat produced in north-western Mexico could increase.

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