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Evaluation of synthetic hexaploid and indigenous wheat lines for resistance to Karnal bunt.

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The most important phase of any plant-breeding program is to assemble the genetic resources from which breeding populations can be developed. The most elaborate facilities and selection procedures will not compensate for an inadequate germ plasm base. Characterization of germ plasm obtained from different sources for desired breeding traits is particularly instrumental in providing the genetic diversity for breeding programs. The documented genetic base that exists in Indian wheat germ plasm for resistance to Karnal bunt of wheat is extremely narrow. Under the new set-up of IPR regimes, the scope for acquiring germ plasm with desired traits from alien sources are practically eliminated. Therefore, the need for exploration and evaluation of uncharacterized and locally available germ plasm for resistance to Karnal bunt is critical. Thousands of accessions belonging to local wheat strains, old NP series, and introductions from international sources have been preserved in a medium-term storage facility at the germ plasm repository at the Directorate of Wheat Research, Karnal. An attempt has been initiated to evaluate the uncharacterized wheat accessions for resistance to Karnal bunt.

In the crop year 2003–04, local wheat strains, some wheat lines belonging to old NP series, synthetic material developed at CIMMYT, Mexico, and fixed prebreeding lines developed at DWR, Karnal, were evaluated for resistance to Karnal bunt. The susceptible check WL 711 also was planted in the beginning, middle, and end of the test plot. Test materials were subjected to an artificial inoculation procedure described by Aujla et al. (1982). Percent coefficient of infection of each spike was worked out using the formula devised by Aujla et al. (1989), and genotypes were grouped further into response categories (resistant, moderately resistant, etc.). Out of 41 lines (NP series and local strains of the PI and IC series) evaluated, 22 and 6 lines were categorized as resistant or moderately resistant to Karnal bunt, respectively (Table 1). Out of 24 lines (14 CIMMYT synthetic hexaploids and 10 fixed prebreeding lines developed at DWR, Karnal), nine and seven lines were found resistant and moderately resistant, respectively (Table 2, p. 67). The remainder of the lines showed more than a 10.00 % coefficient of infection. The highest coefficient of infection of 42.50% was calculated on the susceptible check WL 711.

Table 1. Response of wheat genotypes (Old NP and local strains) to the Karnal bunt pathogen (*Tilletia indica*) under artificial inoculated conditions.

Lines categorized as resistant (up to 5% coefficient of infection)		
NP 830	VHC 6063	IC 321977
NP 836	IC 321865	IC 321980
NP 839	IC 321924	IC 321981
NP 850	IC 321927	IC 322013
NP 866	IC 321928	IC 322022
NP 884	IC 321932	IC 322026
PI 180967	IC 321939	
PI 180986	IC 321954	
Lines categorized as moderately resistant (5–10% coefficient of infection)		
NP 876	IC 321936	IC 322014
IC 321934	IC 322012	IC 322024

Using the ancestors of modern wheat to introgress genes that have the potential to improve resistance to biotic and abiotic stresses is an international effort. Synthetic hexaploids developed by scientists in Australia, the U.S., and at the International Maize and Wheat Improvement Centre in Mexico (CIMMYT) are the vehicles to introduce these ancient genes into our modern cultivars. Present-day hexaploid wheat originated with involvement of three different wild plant species. In the nature, *T. turgidum* crossed with goat grass, a close relative of modern wheat, and in doing so acquired some useful genes. But this crossing probably occurred only two or three times during the development of our present-day hexaploid wheats, which as a result possess some, but not many, of the 'good' genes from goat grass and durum wheat. Researchers are taking another look to see what else goat grass might have to offer and are finding a wide range of useful genes. To get these genes into our modern wheats, scientists are now 'remaking' wheats by going back to the original goat grass and crossing it with modern durum wheat to make crosses that do not happen in nature, popularly known as synthetic hexaploids. The present set of synthetic wheats was particularly evaluated for resistance to Karnal bunt and, fortunately, some of them did show promising resistance to Karnal bunt.

Karnal bunt had been rated as a minor disease in India before cultivation of Mexican wheats in this country (Joshi et al. 1983). This fact indicates the capability of our old wheat cultivars to resist Karnal bunt under natural conditions. Because of their smaller yield potential compared to Mexican genotypes, cultivation of these genotypes has been completely stopped by Indian farmers. Fortunately, a majority of these genotypes are maintained by Indian wheat scientists and are safely preserved in germ plasm repository of Directorate of Wheat Research. A few of them were found to be tested for their response to Karnal bunt and those found resistant are listed in Table 2.

References.

Aujla SS, Grewal AS, Gill KS, and Sharma I. 1982. Artificial creation of Karnal bunt of wheat. Cereal Res Commun 10:171-6.

Aujla SS, Sharma I, and Singh SS. 1989. Rating scale for identifying wheat varieties resistant to *Neovossia indica*. Ind Phytopath 42:161-2.

Joshi LM, Singh DV, Srivastava KD, and Wilcoxson RD. 1983. Karnal bunt: A minor disease that is now a threat to wheat. Bot Rev 49:309-30.

Table 2. Response of synthetic hexaploids and fixed prebreeding lines to the Karnal bunt pathogen (*Tilletia indica*) under artificial inoculated conditions. An * indicates the fixed prebreeding lines developed at the DWR, Karnal, the other lines are CIMMYT synthetic hexaploids.

Pedigrees of wheat lines categorized as resistant (up to 5% coefficient of infection).

DVERD-2 / *Ae. tauschii* (214) / OPATA
YUMAI 13 / 2*KAUZ
BCN / CROC-1 / *Ae. tauschii* (662)
ALTAR 84 / *Ae. tauschii* (219) // 2* LOXIA /3/ KAUZ
*EVD 2-1 1012 / Kauz // WH 542
*FASAN / CROC_1 / *Ae. tauschii* // KAUZ
*HD 2329 / CHOIX // RAJ 3777
*PBW343 / FIOS-1
*AGA / 2*CMH74A.582 / CMH76A.912 / CMH79.681 / BOW // RAJ 3777

Pedigrees of wheat lines categorized as moderately resistant (5–10% coefficient of infection).

XIANG82.2661 / 2*KAUZ
BCN // SORA / *Ae. tauschii* (323)
OPATA // CROC-1 / *Ae. tauschii* (879)
ALTAR 84 / *Ae. tauschii* (219) // SERI
CHEN / *Ae. tauschii* (TAUS) // FCT /3/ STAR
*HD 2329 / CHOIX // RAJ 3777
*PBW 343 // HE1 / 5*CNO79 / BORLAUG 95

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An inheritance study of spot blotch (Bipolaris sorokiniana (Sace) Schoem) resistance in bread wheat.

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Abstract. We studied the inheritance of resistance to spot blotch on six *T. aestivum* cultivars. Artificial epiphytotic conditions in the field were developed in the material, which was evaluated in a six parameter model and consisted of P_1, P_2, F_1, F_2, BC_1, and BC_2 generations. A total of 66 entries were evaluated from the six generation material. Disease scoring was recorded on the flag and penultimate leaf using double-digital rating. The resistance showed its dominance over susceptibility in all the F_1 material. The F_2 segregation ratio of the pathogen in 60% of the crosses involving 'resistant / resistant' and 'resistant / susceptible' cultivars was 15 resistant :1 susceptible. We showed that resistance is conditioned by two dominant genes with duplicate gene interaction. On the other hand, the segregation ratio of 9 resistant :7 susceptible in 40% of the crosses indicated complementary gene action. The BC_1 and BC_2 segregation pattern of 3 resistant : 1 susceptible further supplement the finding of the F_2 results. The genes controlling resistance and susceptibility in these parents are different.

Introduction. India, a major wheat-producing country, occupies second place after China in terms of area and production on global level. Three wheat species, *T. aestivum, T. turgidum* subsp. *durum,* and *T. turgidum* subsp. *dicoccum* are successfully cultivated in different parts of the country. Among the biotic stresses, rusts, smut, and foliar blight are the major diseases damaging the wheat crop at different stages with various intensity. Foliar blight is considered as a complex, because a number of pathogens causing blight, blotch, and spot are associated with wheat in India (Misra 1973; Joshi et al. 1978). *Drechslera sorokiniana* (Syn. *Helminthosporium sativum*; perfect stage *Cochliobolus sativus*) appears to be the major pathogen, along with *D. tritici repentis* and *D. tetramera* and *Alternaria triticina* and *A. alternata* (Joshi