Improving Wheat Resistance to
Septoria Tritici Blotch

Septoria tritici blotch (STB) or speckled leaf blotch, caused by *Mycosphaerella graminicola* (anamorph *Septoria tritici*), is one of the most important foliar diseases of wheat worldwide. Losses to STB can reach 50% in disease-conducive climates. Infection by *M. graminicola* requires cool temperatures (15-25°C) with humid conditions. In the developing world, STB can be severe in North Africa, parts of South America, and Central and West Asia. The presence of wheat stubble, volunteer wheat, and susceptible grasses sustains the survival of the disease from year to year.

Typical symptoms start as angular lesions, where asexual fruiting structures called pycnidia produce pycnidiospores. Pycnidiospores are splash dispersed, providing a means for clonal propagation over short distances. The sexual stage is not easily detected everywhere but ascospores (the sexual spores) are a major source of inoculum. Sexual recombination in nature can occur many times per growing season. The fungus causes damage by producing toxic compounds that kill plant cells around the infection points.

Progress in Resistance and Challenges

Little progress was made in increasing the level of resistance to STB in wheat prior to 1990, for several reasons: a long latent period, environmental influences on symptom development, and difficulty in phenotypic scoring. Since then, with progress due to molecular studies and better knowledge of the fungus, up to 12 genes for resistance to STB in wheat have been identified and located on chromosome regions. Work with the target of incorporating these genes is still underway.

Strong resistance may exist in wheats when several genes are pyramided. However, with the high genetic variability of the pathogen it seems likely that most resistance genes will not last. Resistance to STB may be isolate-specific or quantitative.

Mycosphaerella graminicola infects both hexaploid and tetraploid wheats. In Mexico, isolates lack virulence on durum wheat. However, good screening conditions for STB in durum wheat exist in other countries like Tunisia.

Septoria tritici blotch on durum wheat in Tunisia

Resistance to *Septoria tritici* in bread wheat in Toluca

CIMMYT

Research at CIMMYT

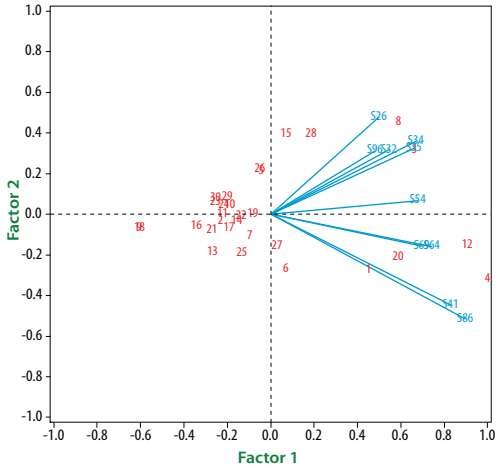
CIMMYT has been working for several decades on STB and over the years a range of resistant lines have been produced due to the excellent screening system established for bread wheat in Toluca Valley, Mexico (2,640 masl). Conditions in Toluca are particularly suitable due to abundant rain and cool temperatures. In Mexico, *M. graminicola* attacking bread wheat are used for artificial inoculation and have been found to be of both mating types.

In June, the breeding program receives fresh inoculum from the pathology group: a cocktail of five aggressive isolates from bread wheat produced in the pathology laboratory. The objective is to obtain stable, isolate-non-specific resistance. With support from SIDA (Sweden) and a collaboration with the University of Uppsala (SLU) specific studies were conducted on 30 bread wheat genotypes using 10 isolates selected from a larger Mexican collection based on their strong virulence to a set of wheat differentials and a CIMMYT Septoria tritici monitoring nursery (43-73 % leaf area covered by pycnidia). These isolates were used in field inoculations during 2006-2007 and in a detached leaf test in order to study possible interactions between isolate and genotype. Area under the disease progress curves (AUDPC) calculated from the disease severity scorings showed that evaluation of resistance in the field was superior to evaluation on detached leaves. Isolate and genotype interactions were visually observed in the field plots early in the epidemics, but the final effect was not strong. The ranking of genotypes in the field was similar over two years. Several genotypes harbored a strong resistance to STB, which may be due to the combination of several resistance genes. Isolate–non-specific intermediate resistance has also been observed, which indicates that durable resistance has been accumulated over years of testing.

Since Toluca is an excellent disease-prone environment, and phenotypic analysis is often a major limitation in support of molecular studies, mapping populations are being developed to further characterize field resistance to STB in bread wheat and identify new resistance genes. Toluca is also suitable for phenotyping a broad range of bread wheat materials for association mapping. Nurseries will be prepared to test resistant materials in several locations outside Mexico, including where differences in pathogen virulence on tetraploid or hexaploid wheats may exist.

Mean AUDPC for 30 wheat genotypes inoculated with 10 conidial isolates of *M. graminicola* in field tests in Toluca, and ranking of genotypes over 2006 and 2007

No.	Genotype	Mean AUDPC	Rank over 2 years
9	MURGA	135	1
18	CROC_1/AE.SQUARROSA(205)//BORL95/3/2*MILAN	135	2
16	BL 1496/MILAN/3/CROC_1/AE.SQUARROSA (205)//KAUZ	336	3
13	MILAN/S87230//BABAX	382	4
21	ALD/CEP75630//CEP75234/PT7219/3/BUC/BJY/4/CBRD/5/ TNMU/PF85487	389	5
23	KAUZ//TRAP#1/BOW	408	6
30	SW03-81497	410	7
2	OASIS/SKAUZ//4*BCN/3/PASTOR/4/KAUZ*2/YACO//KAUZ	421	8
11	FINSI/METSO	436	9
24	N894037	438	10
17	SRN/AE.SQUARROSA(358)//HXL7573/2*BAU/3/PASTOR	449	11
29	CHUANMAI 107	449	12
10	REH/HARE//2*BCN/3/CROC_1/AE.SQUARROSA (213)//PGO/4/HUITES	457	13
14	MINO	476	14
25	TINAMOU	485	15
22	CATBIRD	494	16
7	BUC/MN72253//PASTOR	518	17
19	CROC_1/AE.SQUARROSA(205)//KAUZ/3/2*PJN/BOW//OPATA	531	18
26	BH1146*3/ALD//BUC/3/DUCULA/4/DUCULA	572	19
5	KAUZ/PASTOR//PBW343	580	20
27	ALTAR 84/AE.SQ//OPATA/3/2*WH 542	607	21
6	OASIS/SKAUZ//4*BCN*2/3/PASTOR	634	22
15	PBW343*2/KUKUNA	678	23
28	CROC_1/AE.SQUARROSA(224)//KULIN/3/WESTONIA	763	24
1	MILAN/OTUS//ATTILA/3*BCN	920	25
20	CROC_1/AE.SQUARROSA(224)//OPATA/ 3/BJY/COC//PRL/ BOW/4/BJY/COC//PRL/BOW	1,028	26
8	ATTILA/3*BCN//BAV92/3/TILHI	1,073	27
3	HPO/TAN//VEE/3/2*PGO/4/MILAN/5/SSERI1	1,120	28
12	KAUZ//ALTAR4/AOS/3/MILAN/KAUZ/4/HUITES	1,271	29
4	SERI.1B*2/3/KAUZ*2/BOW//KAUZ	1,334	30



Biplot showing the field resistance of 30 bread wheats (red) against 10 *M. graminicola* isolates (blue)

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