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Pathogenicity Eight *Fusarium* Originating in Four

Introduction

The expression of wheat (*Triticum aestivum* L.) host plant resistance to head blight caused by *Fusarium graminearum* Schw. varies widely, depending on environmental conditions (e.g., rainfall, temperature) and the inoculum used (age, concentration, incremental substrate, and isolate composition). It is important to have good control of these factors to avoid variation in the expression of resistance.

However, controlling the inoculum applied is more complicated than it might seem at first glance. At present, a mixture of highly virulent pathogen isolates is commonly used as inoculum in screening wheat for head blight resistance in the belief that there are no vertical races in *F. graminearum*, as noted in the literature. There are, nonetheless, significant differences in pathogenicity among isolates that can greatly influence measurement of resistance levels (Mesterhazy, 1997).

The authors of this study frequently observed differences in the response of varieties to the mixture of isolates used. This made them suspect the existence of significant cultivar x isolate interaction. They therefore initiated a preliminary study aimed at determining the cause of the observed differential in varietal response. The objective of the study was to evaluate the pathogenicity and virulence of *F. graminearum* isolates from different regions of Mexico on four resistant wheat cultivars.

Materials and Methods

During the 1998 crop cycle in Atizapan, Toluca, Mexico, a trial was carried out in which four resistant (Sumai#3, Frontana, Catbird, and Sha4/Chilero) and one susceptible (Flycatcher) wheat cultivars were inoculated with eight different *F. graminearum* isolates. The four resistant cultivars chosen were of different genetic backgrounds.

The origins of the test isolates were Tepatitlan (isolates 3, 4, 5, 6), Jesus Maria (2), and El Tigre (1) in the State of Jalisco; and Patzcuaro (8, 9) in the State of Michoacan (Fig. 1). Isolate 0 was the uninoculated check. The trial was planted with three replications; the main plot was the cultivar and the sub-plot, the isolate.

Figure 1. Geographical areas affected by fusarium head blight in Mexico.

The inoculum was increased in Mung bean medium, and its concentration adjusted to 50,000 spores/ml after five growing days. Twenty wheat spikes per plot were inoculated at flowering using the cotton method (Gilchrist et al., 1997) (Fig. 2); after inoculation, the spikes (including 20 non-inoculated ones from the check) were covered with glassine bags.

Figure 2. The cotton method of inoculation used in this study.

Except for four days, there was rain throughout the whole cropping cycle, including during inoculation and the infection period. Supplementary moisture in the form of mist irrigation was provided on the four rainless days.

The different treatments were evaluated 30 days after inoculation. Results were analyzed using categorical data analysis.

and Virulence of *graminearum* Isolates Regions of Mexico

Results

Very high infection levels were achieved as a result of the high moisture conditions maintained throughout the trial.

Results of the analyses of variance showed highly significant differences at 0.001% between isolates, varieties, and cultivar x isolate interactions (Table 1).

Table 1. Analysis of variance of blighted spikelets of five wheat cultivars inoculated with eight individual *Fusarium graminearum* isolates, Atizapan, Toluca, Mexico, 1998.

Source	DF	Chi Square	Prob
Intercept	1	10071.99	***
Cultivar	4	609.29	***
Isolate	8	4984.76	***
Cultivar x Isolate	32	675.45	***

Table 2 shows the absolute ratio of infected/healthy grains for every wheat cultivar with each isolate. The uninoculated, protected check showed a very low level of natural infection.

Isolate 1 from El Tigre was the only isolate that was highly virulent on all cultivars, including Frontana and Sumai#3, which are universal resistant checks. The reason for this high level of virulence may be that severe head blight epidemics occur in the El Tigre region every year. Other isolates, such as numbers 4 and 5, produced moderate damage on Sumai#3. Number 6 was the least virulent isolate, even on the susceptible check Flycatcher.

Tables 3 and 4 show that *F. graminearum* populations can vary widely and produce differential reactions in important sources of resistance such as Frontana and Sumai#3.

Table 2. Absolute ratios of infected/healthy grains on four resistant and one susceptible wheat cultivars inoculated with eight different *Fusarium graminearum* isolates from four regions of Mexico. Atizapan, Toluca, 1998.

	ISOLATES								
Cultivar	0	1	2	3	4	5	6	7	8
Sha4/Chil	0.024	0.413	0.118	0.133	0.119	0.172	0.089	0.135	0.108
Catbird	0.020	0.276	0.164	0.104	0.118	0.096	0.096	0.080	0.054
Sumai#3	0.012	0.385	0.109	0.112	0.188	0.165	0.046	0.117	0.122
Frontana	0.005	0.335	0.089	0.119	0.091	0.101	0.148	0.103	0.111
Flycatcher	0.014	0.458	0.265	0.216	0.250	0.240	0.165	0.247	0.247

Conclusions

- *Fusarium graminearum* isolates produced different responses in different cultivars. Further testing is necessary to corroborate these results.
- Breeding programs, especially new ones, should be careful when choosing which isolates to use in selecting wheat germplasm for fusarium head blight resistance.
- This is especially true in situations where the resistance base of the test varieties is not very strong or where conditions are highly favorable to disease development.

These results are in partial agreement with the information reported by Xu and Fan (1982) and Wang et al. (1985), who found that *F. graminearum* strains from different districts in China showed the same significant differences in virulence; however, they did not find significant differences in individual cultivar x isolate interactions, as did this study in Mexico.

Table 3. Analysis of contrast among the eight *Fusarium graminearum* isolates.

	Isolates							
	1	2	3	4	5	6	7	8
0	***	***	***	***	***	***	***	***
1		***	***	***	***	***	***	***
2			NS	NS	NS	***	*	NS
3				**	**	***	NS	NS
4					NS	***	**	NS
5						***	**	NS
6							***	***
7								*

Table 4. Analysis of contrast among the five test wheat cultivars.

Cultivars	1	2	3	4	5
1		***	NS	***	***
2			***	NS	***
3				***	***
4					***

References

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