Host Range of *Kabatiella zeae*, Causal Agent of Eyespot of Maize

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ABSTRACT

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Sixty-three collections of the Poaceae were tested for susceptibility to *Kabatiella zeae* in growth chamber, greenhouse, and field environments. Although eight species became infected in the growth chamber, only four taxa, *Zea diploperennis, Z. mays* ssp. *luxurians, Z. mays* ssp. *mexicana*, and *Z. perennis* consistently showed typical symptoms in all three environments. These four taxa were considered to be new hosts of *K. zeae*.

Additional key words: Aureobasidium zeae, teosinte, *Zea mays*.

The origin of the fungus that causes eyespot disease of maize (*Zea mays* L.) is unknown. According to Arny et al (1), Cassini (2), and Chez and Hudon (3), the organism could have been present earlier on maize or other plants, particularly grasses, in amounts which escaped detection. Narita and Hiratsuka (6), who described the fungus in 1959, found that *Kabatiella zeae* Narita & Y. Hiratsuka did not infect any of the 13 grass and two *Trifolium* spp. they tested. They, and later Cassini (2), concluded that *K. zeae* was specific to maize.

The purpose of this study was to determine if *K. zeae* could attack other grasses in addition to maize. The inclusion of the rediscovered perennial wild maize and of the newly described diploid perennial wild maize (5), or teosintes, in this host range study are of special interest. A brief report of our findings has been given (8).

MATERIALS AND METHODS

Binomials used for the grasses follow Hitchcock (4), Pohl (7), and Iltis et al (5).

Eight tribes of the Poaceae were represented in this study, with a total of 37 spp. and 63 collections. The numbers of collections for each tribe and species in the Poaceae that were tested for susceptibility to *K. zeae* are as follows, with numbers shown in parentheses: Agrostideae: *Agrostis alba* L. (1), *A. tenuis* Sibth. (2), *Phleum pratense* L. (3); Andropogoneae: *Sorghum bicolor* (L.) Moench. (8), *S. sudanense* (Piper) Stapf. (2), *S. bicolor* × *S. sudanense* (1); Aveneae: *Avena sativa* L. (1); Festuceae: *Bromus inermis* Leyss. (2), *B. tectorum* L. (1), *Dactylis glomerata* L. (2), *Festuca arundinacea* Schreb. (1), *F. elatior* L. (1), *F. rubra* L. (2), Poa pratensis L. (1), *P. trivialis* L. (1), *Puccinellia airoides* (Nutt.) Wats. & Coult. (2), *Uniola paniculata* L. (1); Hordeae: *Agropyron repens* (L.) Beauv. (1), *A. smithii* Rydb. (1), *Elymus junceus* Fisch. (1), *Hordeum vulgare* L. (1), *Lolium perenne* L. (3), *Secale cereale* L. (1); Paniceae: *Cenchrus longispinus* (Hack.) Fern. (1), *Digitaria sanguinalis* (L.) Scop. (2), *Echinochloa crusgalli* var. *frumentacea* (L.) Beauv. (2), *E. muricata* (Beauv.) Fern. (1), *Panicum capillare* L. (1), *P. dichotomiflorum* Michx. (1), *P. miliaceum* L. (1), *Setaria faberi* Herrm. (1), *S. italica* (L.) Beauv. (1), *S. lutescens* (Weigel) Hubb. (2), *S. viridis* (L.) Beauv. (5); Phalarideae: *Phalaris arundinacea* L. (1); Tripsaceae: *Zea diploperennis* Iltis, Doebley & Guzman (1), *Z. mays* ssp. *luxurians* (Durieu) Iltis (1), *Z. mays* ssp. *mexicana* (Schrad.) Iltis (1), *Z. perennis* (Hitch.) Reeves & Mangelsdorf (1). Plants of the susceptible maize inbred line W64A were used as checks in all experiments.

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All grass seeds were coated with Captan 50-W (captan), *N*-trichloromethylthio-4-cyclohexane-1,2-dicarboximide, before planting. In 1977 and 1978, collections were tested in a greenhouse at 21 ± 5 C and in a growth chamber with 26 C day/21 C night temperature and a 16-hr photoperiod. In 1978, a field trial also was conducted at Arlington Experiment Station. The *Zea* spp. were first received in 1979 and for that reason were tested separately.

In the greenhouse, five to 50 seeds of each collection were planted in 13-cm-diameter pots containing a soil:sand:peatmoss (2:1:1, v/v) mixture. A maximum of four plants per pot was left after thinning. A similar procedure was employed for plants tested in the growth chamber, except that vermiculite was used instead of the soil mixture. One-month-old plants were inoculated by spraying with a conidial suspension (5×10^6 conidia/ml) of *Kabatiella zeae* isolate 73A3. *Kabatiella zeae* medium (9) was used for the production of conidia. After inoculation, plants were incubated in a mist chamber for 24 hr, and then returned to the benches.

In the field, a 1-m row (~1 m between rows) of each grass collection was planted alternately with inbred W64A. The 1-mo-old maize plants were inoculated as in the previous experiments, thus serving as spreader rows. Ground maize debris, obtained from *K. zeae*-infected plants grown in 1977, were placed in the whorls of the maize plants and on the ground between the rows.

Two weeks after inoculation, plants were examined for the presence and type of symptom as described by Arny et al (1). Field-grown plants continued under observation for an additional 2 wk. Reisolation of the fungus and sporulation on detached lesion-bearing leaves were determined for the growth chamber- and field-grown plants that showed symptoms.

For the reisolation, lesions were washed under running tap water, then rubbed with a cotton ball soaked in a 70% alcohol solution, and finally immersed in a 0.525% sodium hypochlorite solution (10% Clorox) for 1 min. Lesioned areas were cut into one-to-two mm wide strips, plated on potato dextrose agar (PDA), and the plates were incubated at 24 C for 10 days. The ability to sporulate in vivo was determined by placing lesion-containing pieces of leaf tissue, in a vertical position, in water-agar plates (20 g agar/L), and incubating the open plates in a dew chamber (15 C air/21 C water pan temperature) for 48 hr. The lesions were then mounted in water and observed with phase-contrast optics for the presence of conidia.

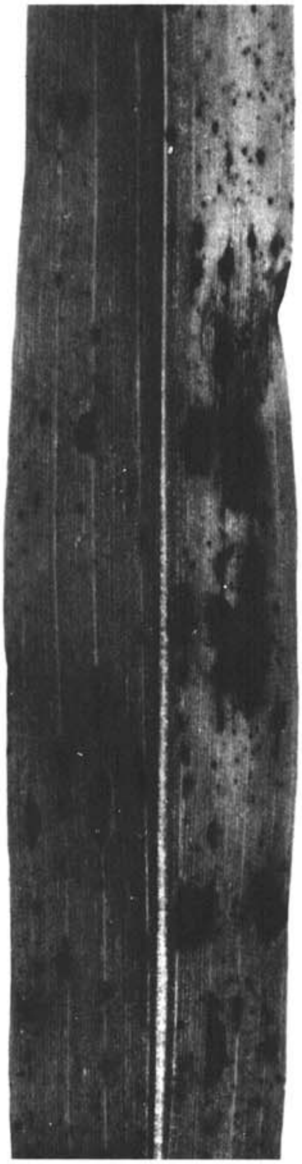

Fig. 1. Atypical symptoms shown by *Sorghum sudanense* 'Sart' inoculated with *Kabatiella zeae* isolate 73A3 and maintained in a growth chamber (26 C day/21 C night, 16-hr photoperiod).

RESULTS

In the growth chamber, the *Zea* spp. developed typical eyespot lesions, although those in *Zea diploperennis* were smaller than those of the checks. The fungus sporulated upon and was reisolated from inoculated material in all five taxa; symptoms appeared on leaf and sheaths of all except *Z. diploperennis* (leaves only). Atypical symptoms (Fig. 1), varying from punctiform spots to 7-mm-diameter necrotic lesions, were evident on *Echinochloa crusgalli* var. *frumentacea, Setaria viridis, Sorghum bicolor* 'Atlas', 'Early Sumac', 'Rox Orange', and 'Sart', and *S. sundanense* 'Piper' and 'Sweet Sudan'. *K. zeae* was reisolated from all these taxa and it sporulated on all except cultivar Sweet Sudan. Symptoms appeared on leaves and sheaths of *Setaria viridis* and *Sorghum bicolor* 'Atlas' and 'Sart', but only on leaves of the other taxa that developed atypical symptoms.

In the greenhouse only the *Zea* spp. showed typical eyespot symptoms. *Sorghum bicolor* 'Rox Orange', 'Early Sumac', and 'Sart' showed atypical symptoms consisting of punctiform spots. All other species tested were asymptomatic.

In the field, typical lesions were observed only in the *Zea* spp. Eleven grass collections were lost due to heavy rains. Of these, only *Sorghum bicolor* 'Early Sumac' and 'Rox Orange' had previously shown atypical symptoms in the growth chamber when inoculated with *Kabatiella zeae*. Reisolation was possible and sporulation was

TABLE 1. Taxa infected with *Kabatiella zeae* isolate 73A3 in greenhouse[a], growth chamber[b], and field environments

	Presence and type of symptom[c]		
Taxon	Greenhouse	Growth chamber	Field
Echinochloa crusgalli var. *frumentacea*	–	A	–
Setaria viridis	–	A	A
Sorghum bicolor			
'Atlas'	0[d]	A	A
'Early Sumac' and 'Rox Orange'	A	A	0
'Sart'	A	A	–
S. sudanense			
'Piper' and 'Sweet Sudan'	–	A	–
Zea diploperennis	T	T[e]	T
Z. mays[f]	T	T	T
Z. mays ssp. *luxurians*	T	T	T
Z. mays ssp. *mexicana*	T	T	T
Z. perennis	T	T	T

[a]21 ± 5 C.
[b]26 C day/21 C night, 16-hr photoperiod.
[c]T = typical lesions present, comparable to the check; A = atypical symptoms; and – = no lesions.
[d]0 = not tested.
[e]Lesions smaller than check.
[f]Inbred line W64A, used as check.

observed in *Setaria viridis*, *Sorghum bicolor* 'Atlas', and the *Zea* spp. In the first two grasses, conidia were obtained only in atypical lesions formed in senescent tissue. The presence and types of symptoms under greenhouse, growth chamber, and field conditions are summarized in Table 1.

DISCUSSION

The presence of typical eyespot symptoms under the three different environmental conditions used, and the reisolation and sporulation from leaves infected in the growth chamber and field, were the criteria used to determine that *Zea diploperennis*, *Z. mays* ssp. *luxurians*, *Z. mays* ssp. *mexicana*, and *Z. perennis* were new hosts to *K. zeae*.

Although four other species (eight collections) developed symptoms in at least one of the experiments, symptoms always were atypical, and these grasses were considered to be nonhosts. Furthermore, in the field, where natural conditions were better simulated through the use of spreader rows, the two collections with atypical symptoms, *Setaria viridis* and *Sorghum bicolor* 'Atlas', supported sporulation of *K. zeae* only on senescent host tissue. This made it difficult to determine whether *K. zeae* was a parasite or a saprophyte; however, we consider the latter to be the case.

The infection of the perennial wild maizes, or teosintes, by *K. zeae* is a further indication of the phylogenetic relationship between these and the cultivated maize. To our knowledge *K. zeae* has not been reported from Mexico, where these two grasses are endemic (5), which makes it impossible to suggest a role, if any, that these maize relatives might have had in the origin or epidemiology of the eyespot disease in cultivated maize.

The number of species found to be susceptible to *K. zeae* under highly favorable (growth chamber) conditions indicates that host range studies conducted under artificial conditions must be interpreted very cautiously, and should always be related to field results.

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