Host Range of *Peronosclerospora sorghi* in Thailand

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ABSTRACT

Bonman, J. M., Paisooksantivatana, Y., and Pitipornchai, P. 1983. Host range of *Peronosclerospora sorghi* in Thailand. Plant Disease 67:630-632.

Twenty-five native grass species and 20 introduced forage grasses were tested for susceptibility to *Peronosclerospora sorghi* in Thailand. *Sorghum nitidum*, a native species, was susceptible to systemic infection. The native grass *Themeda villosa* was partially susceptible because only its lower leaves became systemically infected. Also tested was *Zea diploperennis*, which was susceptible.

Sorghum downy mildew (SDM) has been an important disease of maize for more than 10 yr in Thailand (5). The means by which the pathogen *Peronosclerospora sorghi* (Weston & Uppal) C. G. Shaw survives the dry season is not known, although irrigated sweet corn and wild hosts have been suggested as possibilities. Two wild grasses, *Panicum cambogiense* and *Dichanthium caricosum*, have been reported as hosts of fungi morphologically similar to *Peronosclerospora sorghi* (1,12). Attempts to inoculate the fungus from *Panicum cambogiense* to maize, however, were unsuccessful (1). The fungus from *D. caricosum* could infect maize, but Watanavanich et al (12) were unable to observe infection of this grass by using inoculum taken from maize.

Wild sorghums are important in the SDM disease cycle in Venezuela (7), the United States (9,11,13,14), and Israel (6). An isolate of *P. sorghi* from the United States attacked maize and many species of sorghum including *Sorghum bicolor* L. (2). A fungus closely related to *P. sorghi, P. heteropogoni*, is an important maize pathogen in Rajasthan, India, and attacks and forms oospores in *Heteropogon contortus*, a common wild grass that can provide the primary inoculum for maize infection (4,10).

Because alternative hosts might be important in the SDM disease cycle in Thailand, the purpose of this study was to test native grasses and introduced forage grasses for susceptibility to the Thai SDM pathogen. *Zea diploperennis* is neither a native Thai species nor an introduced forage, but because it is of interest to tropical maize breeders, we also tested its susceptibility in a downy mildew (DM) field nursery.

MATERIALS AND METHODS

Collections. Native grasses in Thailand generally flower and set seed during the cool dry season from late October to March. Thus, our collections were made during this period in 1980–1981 and 1981–1982. Herbarium specimens of all the native species collected were deposited with the herbarium in the Botanical Section, Department of Agriculture at Bangkhen, Thailand.

Inoculations. Seeds of each accession were planted in autoclaved soil in 6-cm-diameter clay pots. For rhizomatous species that did not readily produce viable seed, rhizomes were collected and planted in 18-cm-diameter plastic pots.

Two methods of inoculation were used. In the first method, small clay pots with emerging seedlings were placed in plastic boxes measuring 25 × 17 × 8 cm that contained about 50 ml of water. Maize

Current address of first author: The International Rice Research Institute, Manila, Philippines.

Accepted for publication 16 November 1982.

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leaves systemically infected with *P. sorghi* were collected in the afternoon and draped over the top of the box with the adaxial leaf surfaces facing the seedlings. A lid was put on the boxes to hold the maize leaves in place. The boxes then were covered with plastic bags and placed in a 23 C incubator for 16 hr, during which the fungus sporulated and the conidia fell onto the seedlings and germinated. The second method was used mostly for the rhizomatous species planted in large pots. With this method, systemically infected maize leaves were placed in 1,000-ml beakers with their cut ends immersed in about 50 ml of water. To induce sporulation on the infected leaves, the beakers were covered with plastic bags and incubated in darkness at 23 C for 8 hr. The leaves then were removed and the conidia washed from the leaves into suspension. A hemacytometer was used to measure the conidial concentration and the concentration was adjusted to at least 100,000 conidia per milliliter. The suspension was sprayed onto seedlings with a hand sprayer and the plants incubated in plastic bags or under mist at 23 C for 4 hr. In both methods, susceptible maize was included as a check. After inoculation, the pots were placed out of doors.

Table 1. Susceptibility of grass species to *Peronosclerospora sorghi* in Thailand

Tribe Species	No. systemically infected/no. inoculated
Andropogoneae	
Andropogon gayanus[a]	0/11
Apluda mutica	0/8
Bothriochloa glabra	0/39
Dichanthium annulatum	0/90
D. aristatum	0/6
D. caricosum	0/66
Eulalia trispicata	0/8
Heteropogon contortus	0/9
Schizachyrium brevifolium	0/5
Sorghum bicolor[a]	0/62
S. halepense[b]	0/105
S. nitidum	5/17
Themeda villosa	17/43[d]
T. triandra	0/9
Zea diploperennis[c]	39/39
Z. mays cv. CM109 (susceptible check)	92/92
Z. mays cv. Suwan 1 (resistant check)	5/92
Arundinelleae	
Arundinella setosa	0/25
Chlorideae	
Chloris barbata	0/19
C. gayana[a]	0/106
C. dolichostachya	0/31
Cynodon dactylon	0/38
Eragrosteae	
Dactyloctenium aegyptium	0/87
Eragrostis tenella	0/60
Paniceae	
Brachiaria mutica[a]	0/25
B. reptans	0/18
B. ruziziensis[a]	0/30
Cenchus ciliaris[a]	0/34
C. echinatus	0/31
C. setigerus	0/19
Cyrtococcum accrescens	0/20
Digitaria adscendens	0/24
D. decumbens[a]	0/29
Eriochloa procera	0/25
Panicum antidotale[a]	0/21
P. coloratum[a]	0/11
P. maximum cv. *common*[a]	0/26
P. maximum cv. *gatton*[a]	0/70
P. maximum cv. *guinea* OR 304[a]	0/16
P. maximum var. *trichoglume*[a]	0/17
P. notatum	0/31
P. repens	0/10
Paspalum plicatulum[a]	0/56
Pennisetum pedicellatum[b]	0/10
P. polystachyon[b]	0/5
P. purpureum[a]	0/20
P. clandestinum[a]	0/12
P. setosum[a]	0/56
Melinis minutiflora[a]	0/33
Setaria anceps[a]	0/22
S. pallide-fusca	0/10

[a] Introduced forages.
[b] Introduced species but now found in the wild.
[c] Introduced for experimental purposes.
[d] Only the first few leaves showed systemic symptoms and sporulation; leaves produced later were healthy.

Observations. After inoculation, the plants were examined periodically for symptoms of systemic infection as evidenced by chlorosis extending upward from the leaf base within the whorl and sporulation of *P. sorghi* on the chlorotic tissue. After about 2 wk, the plants in small pots were transplanted to 18-cm-diameter pots and observed weekly for symptoms of systemic infection until at least 8 wk after inoculation.

Field Nursery. *Z. diploperennis* seed was sown in two 6.5-m rows in a DM field plot similar to one described previously (3). Susceptible and resistant checks were included in the nursery, and 3 wk after emergence, the incidence of systematically infected plants was recorded.

RESULTS AND DISCUSSION

Among 45 native and introduced species of grasses tested, two native grasses in the tribe Andropogoneae, *Themeda villosa* (Poir.) A. Camus and *Sorghum nitidum* (Vahl.) Pers., were susceptible to systemic infection (Table 1). *T. villosa* appeared to be only partially susceptible because the first few leaves became systemically infected but leaves developing later were healthy. M. R. Bonde (*personal communication*) observed that *Andropogon gerardii* and *A. halli* also showed similar partial susceptibility when inoculated with a *P. sorghi* isolate from Thailand. *S. nitidum* is fully susceptible and plants showed symptoms through flowering. Oospores were not observed in infected *S. nitidum* tissue and naturally infected plants were not found.

S. nitidum is widely distributed in Asia and Australia and is closely allied with *S. versicolor* from Africa, *S. purpureo-sericeum* (an African species that may extend into India), and *S. leiocladum* and *S. australiense* from Australia (J. M. J. de Wet, *personal communication*). A member of this group, *S. versicolor* from Ethiopia, was susceptible to an American *P. sorghi* isolate in inoculation tests (2). *S. nitidum* and these closely related species are possible alternative hosts for the DM fungi in nature. Any possible role for *S. nitidum* and its relatives in the SDM cycle in Thailand and elsewhere, however, has yet to be ascertained. In our study, 15 native species and introduced forages from the tribe Andropogoneae were tested, and these represent only about 15% of the species in the Andropogoneae reported from Thailand. Because nearly all of the reported hosts of *P. sorghi* and other *Peronosclerospora* species are in the tribe Andropogoneae, future work should focus on the members of this group that have not yet been tested.

Z. diploperennis was highly susceptible to *P. sorghi* in the field plot, showing 100% systemic infection (Table 1). *Z. diploperennis* is tolerant or immune to some important maize viral diseases found in the tropics (8). Recurrent backcrossing might be used to incorporate this resistance into *Z. mays* lines or populations. To conduct such a program in an SDM endemic area, *Z. mays* stocks used as recurrent parents should be resistant to SDM because *Z. diploperennis* is highly susceptible. If neither parent carried resistance to SDM, the virus resistance transfer program might be jeopardized.

As a susceptible host species with weedy attributes of perennial habit and vigorous rhizomes, precautions should be exercised to guard against the escape of *Z. diploperennis* from research plots. In addition to possibly becoming a pernicious weed, it has the potential of serving as an alternative host for perpetuating the maize DM fungi and expanding their distribution. If safe management practices could be developed to prevent its establishment as a weed, *Z. diploperennis* might be useful in maintaining a perennial source of inoculum of SDM in disease nurseries used in screening for resistance.

ACKNOWLEDGMENTS

We thank CIMMYT for providing seeds of *Zea diploperennis*. We also thank Dale Smeltzer and Ken Fischer for reviewing the manuscript.

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