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Leaf Spot of Rye Caused by *Bipolaris sorokiniana* in Korea

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A leaf spot of rye (*Secale cereale* L.) was observed during the summer 1999 in Korea. A fungus associated with the disease was identified as *Bipolaris sorokiniana* (Sacc.) Shoem., based on the morphological characteristics of conidia and conidiophores. Pathogenicity of the fungus was proven by artificial inoculation on rye plants. This is the first record of leaf spot on rye caused by *B. sorokiniana* in Korea.

Keywords : leaf spot. *Bipolaris sorokiniana*, rye.

Rye (*Secale cereale* L.) is one of the important cereal crops in Korea. During a survey of rye diseases in the summer 1999, a severe leaf spot disease was observed in Yonchon area. A species of *Bipolaris* was consistently isolated from the plant. Leaf spot caused by *Helminthosporium* sp. on rye was reported in Korea (Park, 1961; Anonymous, 1998). However, the identification of the pathogen and the description of disease symptoms were not closely preformed.

The fungi *Helminthosporium* and related genera have been known to possess an wide host range, including rye, wheat and barley (Sivanesan, 1987). They cause spot blotch, common root rot, and kernel blight or black point on cereal crops (Sivanesan, 1987). *Bipolaris sorokiniana* (Sacc.) Shoem., *Drechslera japonica* (Atk.) Shoem., *D. siccans* (Drechsler) Shoem. and *D. tritici-repentis* (Died.) Shoem. have been reported on rye from many countries where the plant is growing (Sivanesan, 1987), but little is known of these pathogens from korea.

Leaf spot infection observed of the disease in the field was typically initiated on lower leaves and spread on the leaves in the middle and upper portions of the canopy. Symptoms on leaves and sheaths of rye appeared as circular to irregular spots with narrow yellowish to dark brown discoloration (Fig. 1A, B). Each spot was often surrounded by a chlorotic halo. These symptoms were similar to the description of leaf spot of rye previously published (Luttrell, 1963; Alcorn, 1983; Sivanesan, 1987). Severely infected plants blighted and then died under the humid environmental conditions favorable for the disease development.

A total of 8 isolates were obtained from the diseased leaves and sheath of the plants. Colonies grown on PDA (Potato Dextrose Agar) medium were gray to dark gray with partially black dots on the bottom (Fig. 1E). Colonies slowly grew, forming a velvety layer of grey to dark brown with concentric rings and margins waxy or irregular. Hypae were smooth to verruculose. Conidia of isolates were curved, in culture often straight, fusoid to broadly ellipsoidal, dark olivacous brown, smooth 3~11-septate, and 40-90 μm long 15-33 μm wide (Fig. 1F). Conidiophores were single or in small groups, straight to flexuous, smooth, septate, cylindrical, sometimes geniculate, pale or mid dark brown, up to 175 μm long, 5-8 μm thick. Conidiogenous nodes were smooth to verrculose. A telemorph state of the fungus was not found on many overwintered leaves examined.

All the isolates were confirmed as *B. sorokiniana* (Sacc.) Shoem., based on the morphological and cultural characteristics of the anamorph (Table 1). The morphological characteristics of *B. sorokiniana* examined were very similar to those reported by previous workers (Luttrell, 1963; Alcorn, 1983; Sivanesan, 1987; Alcorn, 1990). In particular, Luttrell (1963) suggested that aspects of basal cell germination are more important than the number and position of cells that germinate, establishing the differentiating criterion between *Bipolaris* and *Drechslera*. He reported that the germ tube from the basal cell in *Bipolaris* usually emerges immediately adjacent to the hilum, and grows in the direction of the long axis (semiaxially). The hilum was often displayed laterally due to the close proximity of the growing germ tube. In *Drechslera*, in contrast, the germ tube emerges more or less in a median position between the hilum and the septum, and grows at a wide angle (often perpendicularly) to the long axis of the conidium. Therefore, all the isolates were confirmed as *Bipolaris* sp., based on the aspects of basal cell germination (Fig. 1F).

To prove the pathogenicity of the fungus, single conidium was trasferred from the leaf tissue sample to a V-8 juice agar medium. Two weeks later, conidia were harvested by adding about 2 ml of sterile distilled water to the plate and then scraping the culture with a rubber spatula. The conidia

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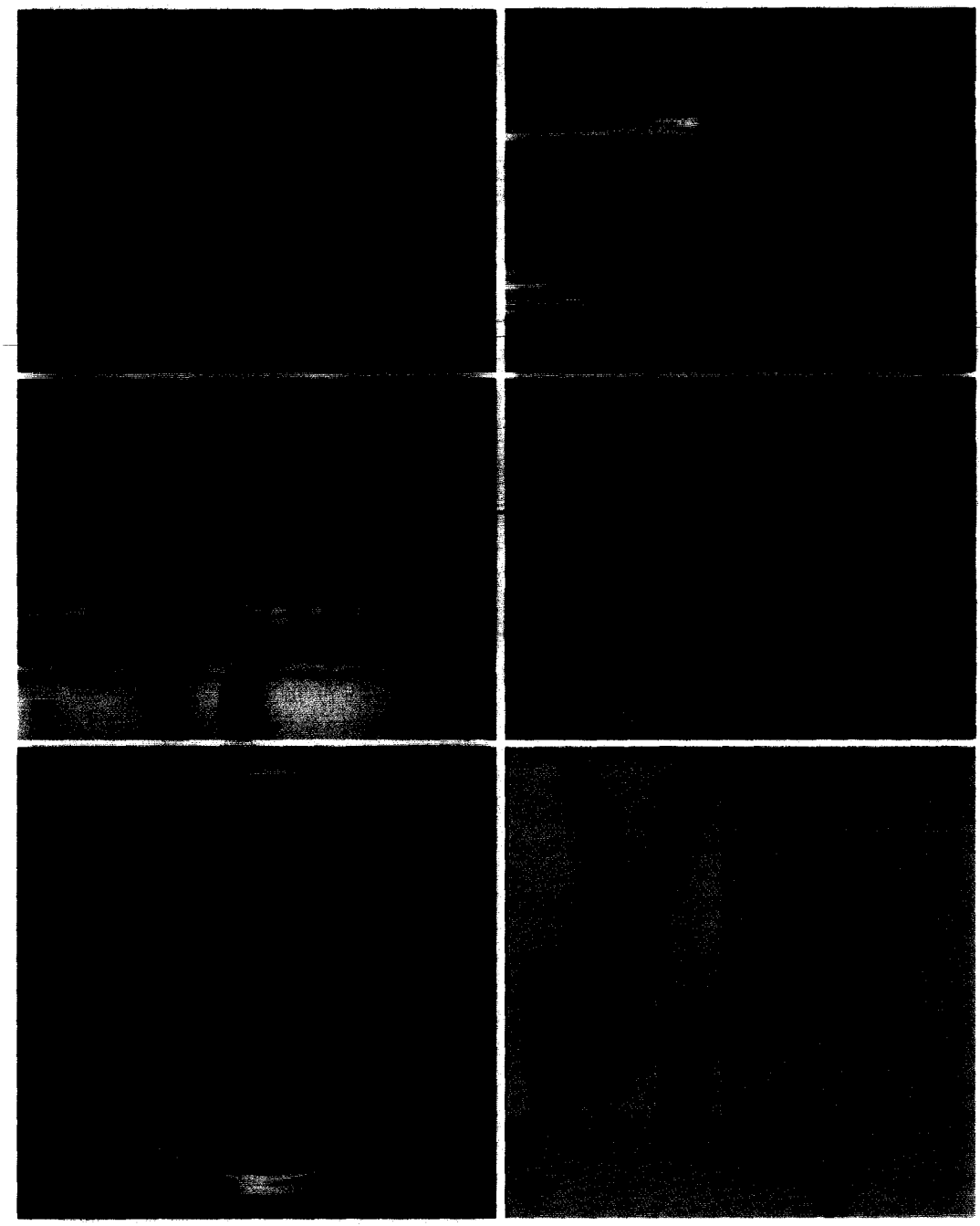

Fig. 1. Leaf spot symptoms on rye leaf naturally infected by *Bipolaris sorokiniana* in a commercial field (A, B); Symptoms on leaves induced by artificial inoculation with *B. sorokiniana* (C, D) and mycelial colony of *B. sorokiniana* grown on PDA after 7 days (E). Conidia and conidiophores of *B. sorokiniana* (F), Bar=20 μm.

per mililiter were counted with a hemacytometer. The concentration of suspension was ajusted to 10^5 conidia per mililiter. The conidial suspension was sprayed onto a healthy plant without wounding. Inoculated plants were maintained in a moist chamber at 100% relative humidity and 25±1°C for 24 hr in the dark. They were then trasferred to a growth chamber. A comparable plant was treated with sterilized water and maintained under the same conditions.

All of the three isolates tested were virulent on rye plants (cv. Jochunhomil). Characteristic spots were noticed on the leaves inoculated with conidial suspension 3 days after treatment. Leaf spot symptoms with necrosis which were induced on the plants after inoculation with the isolates were similar to those observed in the field (Fig. 1C, D). The

Table 1. Comparative morphology of *Bipolaris sorokiniana* and other related fungi on rye and present isolate

	Conidia				Conidiophores			
Source	Morphology	Color	Dimension (μm)	Septation	Morphology	Color	Length (μm)	Width (μm)
Present isolate	curved, in culture often straight, fusoid to broadly ellipsoidal, smooth	dark olivaceous brown	40-90×15-33	3-11-distoseptate	single or in small groups, straight to flexuous, smooth, septate, cylindrical, sometimes geniculate, conidiogenous nodes smooth to verrculose	pale or mid dark brown	up to 175	5-8
Bipolaris sorokiniana[v]	curved, in culture often straight, fusoid to broadly ellipsoidal, smooth	dark olivaceous brown	40-120×17-28	3-12 (commonly 6-10)-distoseptate	single or in small groups, straight to flexuous, smooth, septate, cylindrical, sometimes geniculate, conidiogenous nodes smooth to verrculose	pale or mid dark brown	up to 220	6-10
Drechslera japonica[w]	cylindrical, slightly tapering just above the middle in some cases, rounded at both ends, basal cell longer than wide and paler, scar dark brown, wall thick and dark brown	olivaceous brown to dark yellowish brown	45-210×12-25 (commonly 50-145×16-22)	3-9 (commonly 4-6)	single or in small groups, straight or slightly curved, erect, septate, base swollen, apex slightly tapering., conidiogenous nodes smooth	pale to dark brown	up to 400	11-18
Drechslera siccans[x]	straight, almost cylindrical, slightly tapering towards the apex and base, smooth	pale to mid brown	30-170 (commonly 60-100)×14-22	3-11-distoseptate	single or in small groups, straight, sometimes geniculate above, swollen at the base, with distinct large scars. conidiogenous nodes verrculose	mid brown	up to 400	7-11
Drechslera tritici-repentis[y]	single, straight to slightly curved, cylindrical, rounded at the apex, smooth, basal cell distinctly and conical, of the shape of a snake's head	subhyaline to yellowish brown	75-250×14-20 (commonly 70-120×14-17)	1-9	single or in small groups, cylindrical, septate, smooth, straight or flexuous, sometimes geniculate above, base often swollen tapering towards the apex,. conidiogenous nodes smooth to verrculose	mid to dark brown, pale yellow brown towards the apex	up to 400	6-12

[v]: Sivanesan and Holiday (1972), [w]: Ellis (1976), [x]: Ellis and Holiday (1972), [y]: Ellis and Waller (1972)

fungus was reisolated from lesions on the plants inoculated. On the other hand, there were no visible spots on the leaves sprayed with sterile water up to 7 days after treatment. There was no significant difference in pathogenicity among the isolates. This species has been recorded from nearly all over the world where rye plants are cultivated (Sivanesan, 1987), but not from Korea. This study was the first report of leaf spot of rye caused by *B. sorokiniana* in Korea. Ecology and host range of the fungus remain to be further examined.

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