Types of Rhizoctonia Foliar Blight on Soybean in Louisiana

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ABSTRACT

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Twenty locations in southern and central Louisiana were surveyed in 1987 and 1988 to determine the etiology of Rhizoctonia foliar blights of soybean (*Glycine max*). Web blight caused by *Rhizoctonia solani* anastomosis group 1, intraspecific group IB (AG-1 IB), was the major type in Louisiana in both years. Aerial blight caused by isolates of *R. solani* AG-1 IA, previously considered the only type in the state, was also found. No isolate of AG-1 IC was found. Isolates of AG-1 IA and AG-1 IB could be differentiated on the basis of cultural characteristics on water agar and potato-dextrose agar. Maximum production of microsclerotia in the field occurred from late July through August. Low numbers of microsclerotia produced by *R. solani* AG-1 IB were observed on plants at earlier and later soybean growth stages. *Thanatephorus cucumeris*, the teleomorph of the pathogen, was also observed during late July and August.

In the United States, Rhizoctonia foliar blight of soybean (*Glycine max* (L.) Merrill), caused by *Rhizoctonia solani* Kühn, anastomosis group 1 (AG-1), was first reported by Atkins and Lewis in 1954 in Louisiana (1). The disease is now important to soybean production in tropical regions of the world (5,6,14,15). In the United States, the disease occurs in Louisiana and other southern states (1,14).

Rhizoctonia foliar blight of soybean has been divided into two types on the basis of symptoms: aerial blight caused by *R. solani* AG-1 IA (= Sherwood's type 2 [13]) and web blight caused by *R. solani* AG-1 IB and IC (= Sherwood's types 1 and 3 [9,13]). Aerial blight is characterized by the production of sasakii-type sclerotia on diseased tissues. The pathogen spreads in the canopy by means of mycelial bridges between leaves (7). Web blight is characterized by the production of abundant microsclerotia on diseased tissues during the growing season. The microsclerotia function as the airborne propagules causing secondary infection (5,17). Foci of web blight have a large number of diseased leaves with small circular lesions caused by microsclerotia infection (18). The disease and its causal agent are easily identified.

Classification of different types of Rhizoctonia foliar blight of soybean in Louisiana has been inconsistent. Atkins and Lewis (1) first reported that the disease was caused by *R. microsclerotia* Matz (syn. *R. solani*), with abundant microsclerotia on diseased tissues. The pathogen fit Weber's (17) description of the causal agent of bean web blight. From results of a survey conducted in 1974 and 1975 in Louisiana, O'Neill et al (10) concluded that Rhizoctonia foliar blight was the aerial blight type characterized by the production of sasakii-type sclerotia on diseased tissues or in culture. Joye (7) reported the occurrence of web blight in 1985, but no effort was made to determine the prevalence or distribution of web blight type.

Because of the production of microsclerotia, web blight has a significant airborne phase, which is different from the leafborne nature of aerial blight. Therefore, different research approaches are required to study the two diseases. Furthermore, it is not clear which of the two intraspecific groups, AG-1 IB or AG-1 IC, is the primary causal agent of soybean web blight in Louisiana. It is necessary, therefore, to clarify the type and the causal agent(s) of Rhizoctonia foliar blights in Louisiana.

MATERIALS AND METHODS

Surveys were conducted during July and August in 1987 and 1988. Twenty locations were surveyed in southern Louisiana where soybean is a major crop and Rhizoctonia foliar blight is severe (Fig. 1). At each location, one to three commercial fields were sampled. Soybean cultivars planted in these areas included Davis, Hartz 7126, Asgrow 5980, and Forrest. In 1987, 20 disease foci in each field were sampled; in 1988, 10 disease foci per field were sampled, except for the fields at the Ben Hur Research Farm and the fields at the Burden Research Plantation, Baton Rouge, where 20 disease foci per field were sampled. Because web blight can be readily identified by the presence of microsclerotia on the diseased tissues, a disease in a focus was identified as web blight if microsclerotia were observed on the plants. If no microsclerotia were found on the diseased tissue, it was brought to the laboratory for isolation and identification of fungi.

Morphological identification was conducted following the description of *R. solani* (12). Anastomosis tests were conducted following the procedure described by Parmeter et al (11). If an isolate anastomosed with a known isolate of *R. solani* AG-1, had cultural characteristics

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on potato-dextrose agar (PDA) fitting Sherwood's type 1 or 3 and produced microsclerotia on 2% water agar (WA) (3), it was identified as the web blight pathogen. If the isolate did not produce microsclerotia and had cultural characteristics fitting Sherwood's type 2, the causal agent was considered to be the aerial blight pathogen. The frequency of web blight and aerial blight in each field was calculated by dividing the number of disease foci of each type by the total number of disease foci observed.

To determine when microsclerotia developed during the season, two fields infested with web blight, each 1,600 m^2, were observed at approximately 15-day intervals. One field was located at the Ben Hur Research Farm and the other at the Burden Research Plantation. The cultivar Davis was planted on 30 May at Ben Hur and 6 June at Burden in 1987 and on 23 May at Ben Hur and 27 May at Burden in 1988. Thirty 1-m^2 plots were selected at random in each field. Appearance of microsclerotia in these plots was monitored at 15-day intervals. For each observation time, the percentage of plots with microsclerotia in each field was calculated by dividing the number of plots with microsclerotia by the total number of plots with diseased plants in the field. If no microsclerotia were observed in these two fields after late September, 20 diseased plants were collected from each of the two fields to determine if the diseased plants in the fields were infected by the web blight or aerial blight organism, using techniques described previously.

RESULTS

Of the 20 locations surveyed, eight were surveyed both years. All isolates identified in samples from these locations were *R. solani* AG-1. Morphology of isolates on PDA was similar to the description of Sherwood's type 1 and 2 (= AG-1 IB and IA) (13). No isolates fitting Sherwood's type 3 were observed. Iso-

Fig. 1. Dots indicate 20 locations in Louisiana surveyed during 1987 and 1988 for aerial blight and web blight of soybean. Shaded areas are parishes where Rhizoctonia foliar blight of soybean has been reported (7).

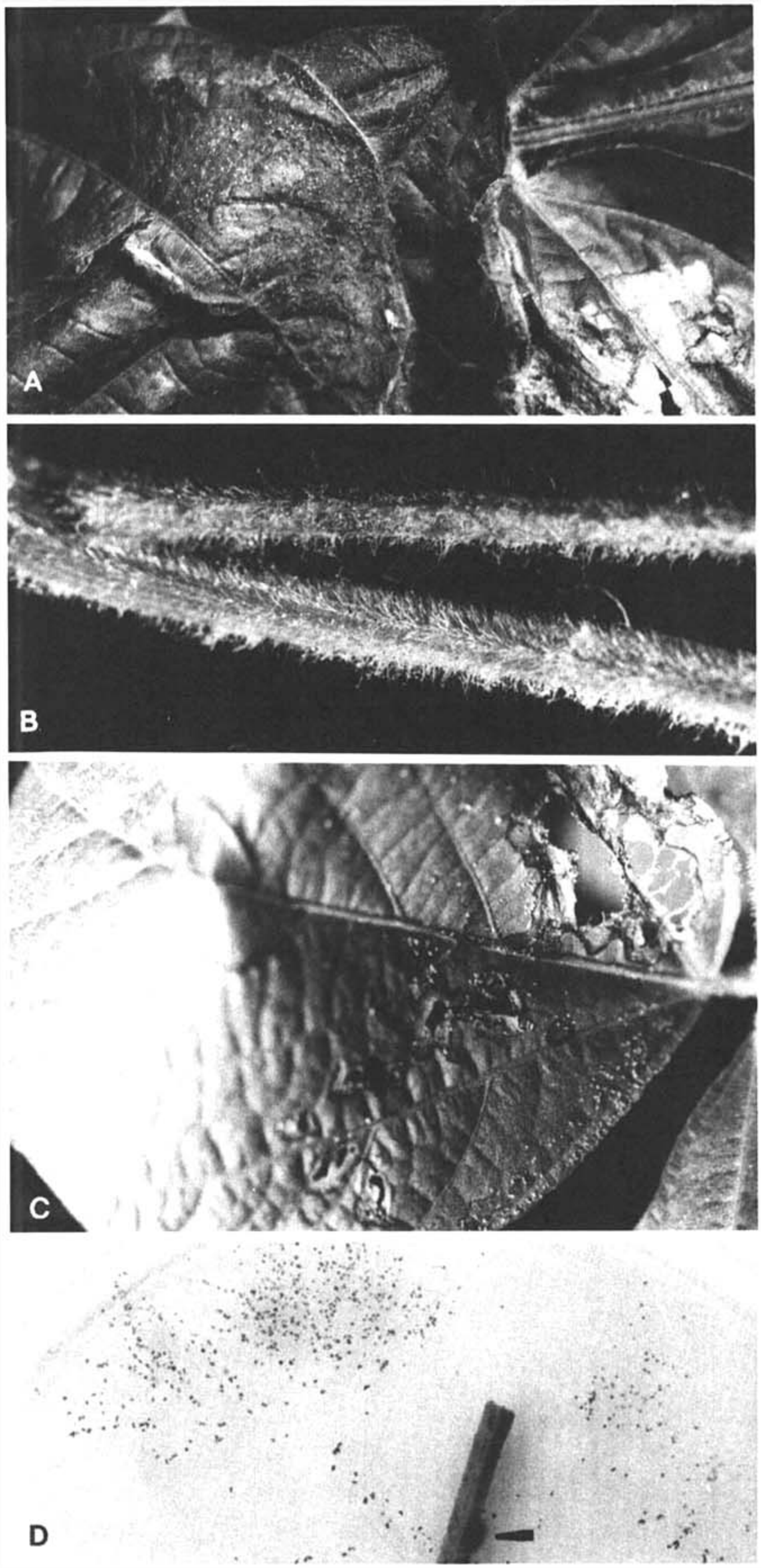

Fig. 2. Symptoms of web blight on soybean: **(A)** Microsclerotia on leaf showing blight symptom, **(B)** microsclerotia on petiole, **(C)** microsclerotia and shothole symptom on leaf, and **(D)** production of microsclerotia on water agar with sasakii-type sclerotium (arrow) formed on diseased tissue.

lates from tissues with microsclerotia produced abundant microsclerotia and a few sasakii-type sclerotia on WA (Fig. 2D). Subculture from hyphal tips of AG-1 IB isolates produced reduced numbers of microsclerotia and a few sasakii-type sclerotia on WA. On PDA, isolates of *R. solani* AG-1 IB did not produce microsclerotia. Isolates of AG-1 IA produced only typical sasakii-type sclerotia on PDA and WA.

Plants in 12 of the 24 fields surveyed in 1987 were infected with the web blight pathogen, plants in two fields were infected with the aerial blight organism, and plants in 10 fields were infected with both pathogens (Table 1). In 1988, plants in 16 of the 30 fields surveyed were infected with web blight, plants in four fields were infected with isolates of *R. solani* AG-1 IA, and plants in 10 fields were infected with both types of blight. Of the 54 fields surveyed, 52, 11, and 37% contained plants infected by isolates of *R. solani* AG-1 IB only, *R. solani* AG-1 IA only, or both, respectively. Rhizoctonia web blight of soybean was more frequently observed than Rhizoctonia aerial blight in Louisiana during 1987 and 1988.

Symptoms of web blight in the surveyed fields were similar to those previously described by Atkins and Lewis (1). Abundant sandlike microsclerotia were seen on soybean leaflets (Fig. 2A) and petioles (Fig. 2B), especially on the tissues that were severely water-soaked or blighted (Fig. 2A). Leaf spots were usually observed on the severely infected plants with microsclerotia. Lesions usually resulted in a shothole effect (Fig. 2C) when weather was unfavorable for disease development. On some plants infected with the web blight pathogen, sasakii-type sclerotia also formed.

On plants with aerial blight, leaf blight and defoliation were the major symptoms. Distinct leaf spots were not observed on leaves of plants with aerial blight. The disease was usually restricted to development within the canopy. Numerous sasakii-type sclerotia were produced on diseased plants.

Microsclerotia were not observed on diseased tissues before mid-June (growth stage V_5) (4). During both seasons, the maximum microsclerotia production occurred during August (Fig. 3). The production of microsclerotia appeared to be closely associated with the occurrence of the teleomorph, *Thanatephorus cucumeris* (Frank) Donk. Hymenia and microsclerotia were seen on foliage of severely infected plants during August. The percentage of plots in which diseased plants were found with microsclerotia declined by the end of August, and microsclerotia were not seen in the field after mid-September (Fig. 3). Sasakii-type sclerotia were sometimes formed later in the season on plants from which microsclerotia had been observed during August. Isolates from these diseased plants produced microsclerotia of *R. solani* on WA, indicating that these tissues were infected by the web blight pathogen.

DISCUSSION

Our survey during 1987 and 1988 showed that both Rhizoctonia aerial blight and web blight occurred in Louisiana, which differed from results of previous works (1,10). Previous works reported either only web blight (1) or only aerial blight (10) in Louisiana.

O'Neill et al (10) reported only aerial blight caused by *R. solani* AG-1 sasakii-type (= *R. solani* AG-1 IA) affected Louisiana soybean in the mid-1970s. However, the frequency of strains of *R. solani* in Louisiana may have changed during the last 10 years. The web blight pathogen infects pods of plants (6,7), and the incidence of diseased seeds as high as 5% was reported (6). The seedborne

Table 1. Percentage of disease foci with aerial blight and web blight of soybean caused by *Rhizoctonia solani* at different locations in Louisiana during 1987 and 1988[a]

Location	Field no.	Aerial blight (%)	Web blight (%)
1987			
Burden	1	50	50
	2	55	45
	3	0	100
Ben Hur	1	15	85
	2	15	85
Perkins Road Farm	1	70	30
Sunshine	1	80	20
	2	100	0
	3	80	20
Lake Arthur	1	0	100
	2	0	100
	3	0	100
Cameron	1	0	100
	2	0	100
Gueydan	1	0	100
Spencer	1	100	0
Crowley	1	0	100
	2	0	100
Lakeland	1	10	90
	2	0	100
	3	0	100
Morrow	1	40	60
	2	0	100
Waxia	1	5	95
1988			
Ben Hur	1	0	100
	2	0	100
Burden	1	20	80
	2	25	75
Lake Arthur	1	0	100
	2	0	100
Cameron	1	0	100
	2	0	100
Wright	1	100	0
Crowley	1	100	0
	2	50	50
	3	0	100
East Crowley	1	30	70
Burnside	1	0	100
	2	100	0
	3	0	100
Gonzales	1	40	60
	2	0	100
St. Gabriel	1	0	100
	2	0	100
	3	0	100
Sunshine	1	0	100
	2	40	60
Maringouin	1	30	70
Morrow	1	0	100
	2	60	40
Willow Glen	1	100	0
Sherburne	1	0	100
	2	20	80
Lakeland	1	40	60

[a] Percentage of disease foci of each type was calculated by dividing number of disease foci of each type by total number of disease foci observed in each field ($n = 20$ for 1987, $n = 10$ for 1988 except for Burden and Ben Hur, where $n = 20$).

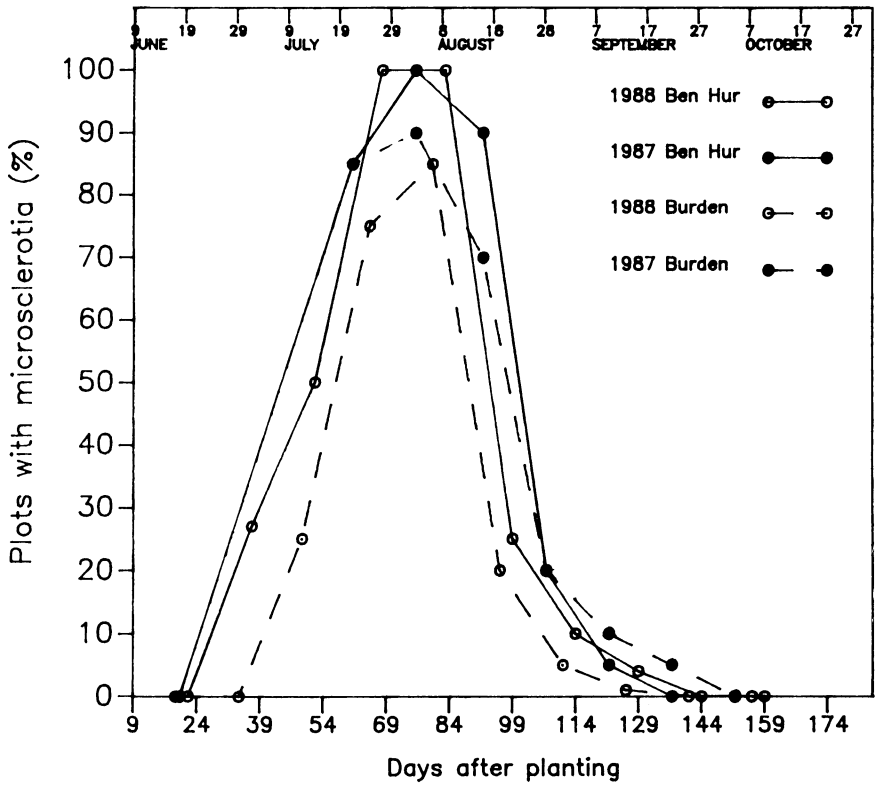

Fig. 3. Frequency of plots (30 per field) with microsclerotia during the 1987 and 1988 growing seasons at Ben Hur Research Farm and Burden Research Plantation, Baton Rouge, Louisiana. Frequency was calculated by dividing the number of plots with microsclerotia by the total number of plots with diseased plants in a field.

nature may also be responsible for the increase in web blight. Web blight also has a soilborne phase (5), and this could help the pathogen survive in new fields after its introduction. During the growing season, the airborne nature of microsclerotia (6,17) may provide a means for the pathogen to quickly spread and increase in a field.

Other possible reasons for differences in findings among studies may be that changes in the cultivation practices of soybean, such as cultivar selection, row spacing, and plant density, have encouraged the expression of web blight. Also, differences in observations may simply represent differences in sampling times. In our study, there was a narrow period for the maximum production of microsclerotia in the growing season. The frequency of microsclerotia occurrence was low early and late in the season (Fig. 3). The optimum time to observe microsclerotia in Louisiana is at the end of July and in August, when soybeans are in growth stage V_{12}–R_2 (4) and the disease quickly develops in association with frequent rainfall (1). Finally, our results and those of Exner (3) have indicated that the web blight pathogen produced microsclerotia on WA but not on PDA.

The sexual stage of *R. solani* has not been reported on soybean in Louisiana since 1954 (1). Our observations indicated that the occurrence of the sexual stage of *R. solani* on soybean is not rare in Louisiana. Sampling time appears to be the key to detecting the presence of the sexual stage. Infection by basidiospores has been reported in web blight of bean (2,5), but the importance of basidiospores to the epidemics of soybean web blight has not been established.

Our study was based on the assumption that in *R. solani* AG-1 there are three intraspecific groups: IA, IB, and IC (9). Cultures of isolates of the organisms in this study showed only AG-1 IA and AG-1 IB (Sherwood's type 2 and 1). The two intraspecific groups are classified primarily according to the pathogenicity of causal agents, the disease signs, and the cultural characterization of isolates on PDA. Recent work on DNA hybridization among anastomosis groups of *R. solani* has indicated the possibility of genetic differences between AG-1 IA and AG-1 IB (8,16). The initiation and development of microsclerotia are of a lateral type different from the loose sasakii-type sclerotia, which indicates that microsclerotia may be related to the sexual stage of the fungi (19). Further work to understand the relationship between the two causal agents of Rhizoctonia foliar blights of soybean is needed.

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