Epidemiology and Control of Bacterial Leaf Blight of Corn

Donald R. Sumner and N. W. Schaad

Assistant Professors, Department of Plant Pathology, University of Georgia, Coastal Plain Station, Tifton, GA 31794, and Georgia Station, Experiment, GA 30212, respectively.

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ABSTRACT

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Bacterial leaf blight, which is caused by *Pseudomonas avenae*, was widespread in corn in southern Georgia from 1973 through 1976. The survival of the bacterium was determined by means of a basal salts agar medium containing D-sorbitol and neutral red (SNR agar). The bacterium did not survive in infected leaves on dead plants 2 mo after maturity, but did survive for 2 wk in infected green leaves buried in soil. *Pseudomonas avenae* was pathogenic to many other cultivars of gramineous species in greenhouse tests, but it was not isolated from plants other than corn in nature. Most cultivars of corn were resistant to the bacterium, but several were highly susceptible. The apparent infection rate (r) in a susceptible cultivar was 0.18 to 0.21 plants/day, compared with 0.13 to 0.16 plants/day in several resistant cultivars, during the 3- to 4-wk period before tasseling. Lesions were relatively small on leaves of resistant plants, and streaking and leaf shredding rarely occurred. The disease did not become epidemic in any of the cultivars after tasseling. The bacterium caused leaf blight but not stalk rot, shank rot, or ear rot. The in vitro dry matter digestibility of blighted plants at tasseling was not different from that of green plants.

Additional key words: maize, ecology.

Bacterial leaf blight (BLB) of corn (*Zea mays* L.), which is caused by *Pseudomonas avenae* (11), was first reported in Georgia in 1944 (3). The disease was investigated in the southeastern United States in the 1940's (4), but was considered to be of minor importance on corn, and most cultivars of open-pollinated dent corn were resistant. The bacterium was reported to cause both leaf blight and stalk rot in corn (4), and foliage diseases in numerous grasses (4, 7, 9). Bacterial leaf blight was widespread in southern Georgia in 1972 and 1973 and recently was reported in Florida (1). Our previous study on the effect of temperature on infection in a phytotron showed that disease development is correlated with plant growth (12). The present study was undertaken to elucidate some of the factors influencing the epidemiology of BLB, and to determine what measures are needed to control the disease.

MATERIALS AND METHODS

Bacterial Strains.—Four strains of *Pseudomonas avenae* were used. Strain C-9 was isolated from blighted corn collected near Climax, Georgia, in 1973; strain C-11 (072-1872) was obtained from J. Miller, Florida Department of Agriculture, Gainesville, FL 32601, in 1973; C-13 (ATCC 19860) was obtained from the American Type Culture Collection in 1973; and C-71 was isolated from blighted corn (Pioneer 3030) collected near Climax, Georgia, in 1975. These cultures were maintained on slants of yeast extract-dextrose-calcium carbonate (YDC) agar (15) at 3 C.

Selective medium.—Sorbitol neutral red (SNR) agar was prepared by adding the following compounds to 950 ml distilled water: K_2HPO_4, 3.0 g; NaH_2PO_4, 1.0 g; KNO_3, 1.0 g; $MgSO_4 \cdot 7H_2O$, 0.3 g; neutral red (69% active material, Matheson Coleman & Bell, Norwood, OH 45212), 10 ml of 0.2% aqueous solution; and agar, 15.0 g. The preparation was autoclaved at 121 C for 15 min. Twenty-five mg cycloheximide and 50 ml of a 10% Millipore®-filtered (0.2-μm maximum pore size) aqueous solution of D-sorbitol was added to the autoclaved medium.

Growth of *P. avenae* on SNR was compared with that on King's medium B (6), 523 (5), YDC, and nutrient agar (Difco® Laboratories, Detroit, MI 48232) plus 10% glucose (NAG). *Pseudomonas avenae* strains C-9, C-11, C-13, and C-71 were grown in 523 broth (5) and tested as described by Schaad and White (13).

Occurrence and pathogenicity.—The occurrence of bacterial leaf blight of corn in Georgia was studied from 1973 to 1976. The disease was observed on corn in five to 20 fields in southwest Georgia each year. In addition, numerous corn plant samples collected by county extension agents and agronomists were examined each year.

Isolations routinely were made from corn by surface-disinfesting small pieces of tissue for 10 to 25 sec in 0.5% NaOCl and rinsing them a few seconds in tap or sterile water. Tissues then were crushed in drops of sterile, deionized water in sterile petri plates, and after 10 to 15 min at room temperature (20 to 25 C) the suspension was streaked on YDC, SNR, potato-dextrose agar, King's B, or NAG. Cells from colonies resembling *P. avenae* (11)

were streaked on YDC and SNR agar, grown in nutrient broth, and tested for pathogenicity on corn. Greenhouse-grown corn plants (cultivars Pioneer 3030, Pioneer 3369A, Funk's G 4761, Gold Cup, and Golden Security) were inoculated when they were 3 to 9 wk old and in the five- to nine-leaf stage. Nutrient broth (Difco®) cultures were adjusted to $OD_{625\ nm} = 0.1$ with a Spectronic® 20 colorimeter, and diluted with sterile deionized water to 10^7 to 10^8 cells/ml (11). The suspension was sprayed into the leaf whorls with a DeVilbiss® atomizer or injected into the stalks with a 0.89-mm (20-gauge) needle and a syringe. Symptoms were more severe when plants were injected, and this method was used routinely for pathogenicity tests. In initial experiments some plants were placed in a humidity chamber for 1 to 4 days at 20 to 32 C at 95 to 100% RH. However, since inoculated plants developed typical symptoms of BLB without being placed in a humidity chamber, in later experiments plants were left in the greenhouse after inoculation.

The natural occurrence of BLB on corn and other susceptible crops (commonly grown in rotation with corn) was studied in field plots of Dothan loamy sand at Tifton. In March, 1974, plants of six cultivars of corn were artificially inoculated with *P. avenae* strain C-9. One ml of a bacterial suspension containing 10^9 cells was dropped into the whorls of three to six plants in each of four replications. In July the mature corn residue was shredded into pieces (approximately 10×10 mm) with a mechanical rotary-chopper. The field was sprayed with dinoseb (2-*sec.* butyl-4, 6-dinitrophenol) to kill weeds, and fertilizer was broadcast. On 1 August 1974 six cultivars of pearl millet [*Pennisetum glaucum* (L.) R. Br.] were hand-planted into the plots and millet plants were checked for lesions until October. Isolations were made from numerous lesions on YDC and SNR agars to determine if *P. avenae* was naturally infecting the millet. In October the plots were disk-harrowed approximately 10 cm deep to destroy weeds, and fertilizer was broadcast on the soil surface. The plot area then was hand-planted to the following small grains: wheat, *Triticum vulgare* Vill, 'Arthur 71' and 'Holley'; oats, *Avena sativa* L., 'Elan' and 'Coker 227'; barley, *Hordeum vulgare* L. 'Volbar', 'Barsoy', and 'Florida 102'; rye, *Secale cereale* L. 'Athens Albruzzi' and 'Weser'; and Triticale 72S. Isolations were made from numerous lesions on the small grains during the winter. In April, 1975, the area was fertilized, disk-harrowed, and plowed approximately 15 cm deep. On 2 May 1975 McNair 508 corn was planted, and the plants were observed periodically for development of BLB symptoms.

Both wheat and rye in fields at the Coastal Plain Station were inoculated in January and February, 1975. Two to four replications of rows 3 to 7 m long were atomized with bacterial suspensions of isolates C-9 and C-13. Isolations were made from numerous lesions observed on both inoculated and noninoculated plants.

Chemical control and disease severity.—In 1975 epidemiology of BLB was studied in field plots of Pioneer 3030 and 3369A corn. A latin-square design with three treatments was used. Treatments were: (i) a noninoculated control (ii) an inoculated control (C-9); and (iii) inoculated but sprayed with hexachlorophene [2, 2′-methylene bis (3, 4, 6-trichlorophenol)]. Each plot included approximately 900 plants in a 9.1×9.1 m block

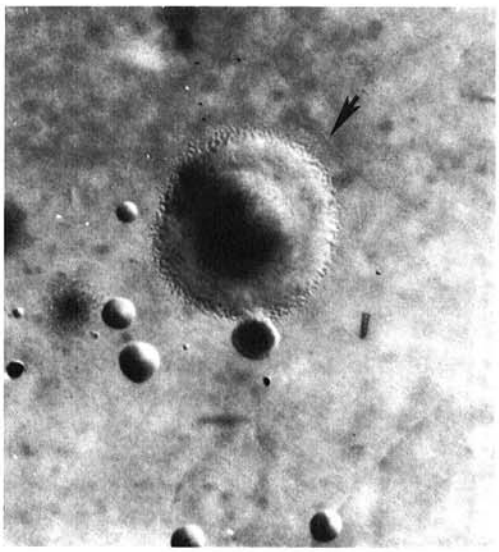

Fig. 1. Distinctive, umbonate, rough, spreading colony of *Pseudomonas avenae* with an entire margin (arrow) obtained when infested soil was diluted 1:10 and plated on sorbitol-neutral red agar. The smaller, smooth colonies were unidentified saprophytes.

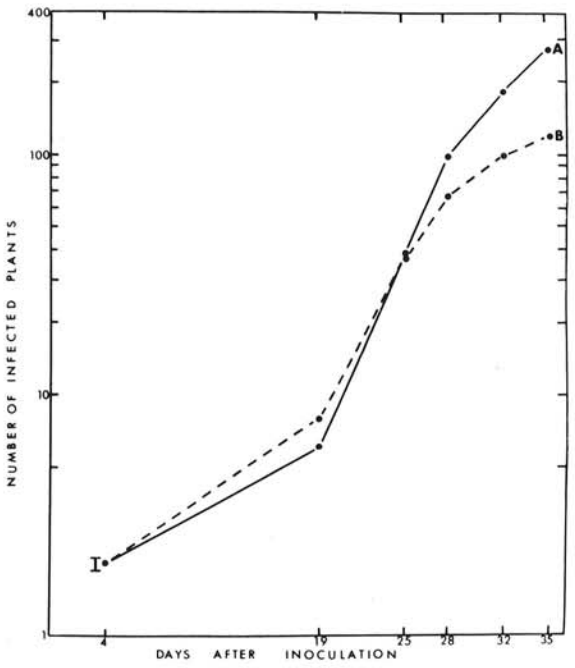

Fig. 2. Progress of an epidemic of bacterial leaf blight from plants inoculated (I) 37 days before tasseling in field plots of two cultivars, (A) Pioneer 3030 (susceptible) and (B) Pioneer 3369A (resistant). Apparent infection rate (r) was 0.17 plants/day in Pioneer 3030 and 0.14 plants/day in Pioneer 3369A. LSD ($P \leqslant 0.05$) = 111 plants at any given sampling date, and was only significant 35 days after inoculation.

surrounded by a fallow area 3.1 m wide. Two wk after planting, 1 ml of inoculum containing approximately 10^8 viable cells was placed in the whorl of one plant in the center of each plot in the latter two treatments. Hexaclorophene (105 g/ha) was applied to the sprayed plots with a low-volume mist sprayer 11 days after inoculations, and weekly thereafter until 1 wk after tasseling (six applications). The number of plants with symptoms of BLB were counted weekly in each plot after inoculation, and semi-weekly during the 2 wk before tasseling. The apparent infection rate (r) was calculated according to van der Plank's formula (14).

Infection rates also were studied in Pioneer 3030 in another field on the Coastal Plain Station where natural infection with BLB occurred for three successive years in a corn-winter rye rotation. Dry matter digestibility was determined by Warren G. Monson, by means of the two-stage in vitro method (8), on 10 green plants and 10 severely blighted (six or more leaves severely streaked or shredded) plants obtained from the same field just before tasseling.

Resistance.—Cultivars of corn and other crops were evaluated for resistance to BLB in greenhouse and field tests. In field experiments in 1974 and 1975 four plots each of 6 and 33 cultivars, respectively, were planted in a randomized complete block design. One ml of inoculum (containing approximately 10^8 cells) was dropped into the whorls of each of 5 to 10 plants of each cultivar when they were in the three- to six-leaf stage (5-15 cm tall). Controls either were noninoculated or 1 ml of sterile water was dropped into the whorls. The progress of the disease was recorded periodically by estimating the severity of infection on both inoculated and noninoculated plants until maturity.

Survival of the pathogen.—The survival of *P. avenae* was studied in both naturally and artificially inoculated corn leaves in soil and as free bacteria in soil. Percentage recovery of the bacterium from soil was determined by adding an appropriate dilution of the bacterium to freshly collected field soil and assaying two 1 g samples (13). Naturally infected leaves showing symptoms of BLB were collected from susceptible cultivars 8 August 1975 in a field at Tifton where some plants had been inoculated with isolate C-9 in May. The plants were approximately 6 wk past midsilk and were still green. Leaves were cut into 5 × 5 cm sections, and divided randomly into two samples; one was tested at the Coastal Plain Station at Tifton and the other at the Georgia Station at Experiment. Two holes, 30 × 30 cm, were dug 10 cm deep at each location. Cheesecloth or plastic cloth with 1-2 mm openings was placed in each hole and covered with 1 cm of soil and 1 to 2 cm of the sample. The sample then was covered with 1 cm of soil, and another layer of cloth, and the holes refilled with soil. Leaf samples were collected and assayed for *P. avenae* at weekly intervals for 1 mo. Two samples of 0.1 to 1.0 g (oven-dry wt) were collected at each sampling from each site and ground for 10 to 15 sec at 20 to 25 C in a micro-blender with 10 ml of sterile, deionized water. Then the suspensions were diluted 1:1, 1:3, and 1:10 and 0.1 ml was spread on each of three petri plates of SNR agar with a glass rod. Colonies that resembled *P. avenae* were purified by streaking on SNR and YDC agars and tested for pathogenicity on corn in the greenhouse.

The experiment was repeated in October 1975 with leaves from plants grown in a greenhouse and inoculated with isolate C-9. The leaves were dried in a forced-air oven at 30 C for 46 hr, buried between two layers of cloth, and sampled as previously described.

TABLE 1. Comparative plate counts on four standard media and the selective SNR medium for broth cultures of four strains of *Pseudomonas Avenae*

Medium[z]	Colonies per plate at 10^{-8} dilution[y] for strain: C-9	C-11	C-13	C-71
KB	108 ab	180 b	167 bc	46 b
523	75 b	196 ab	129 cd	84 a
YDC	118 a	116 c	105 d	100 a
NAG	126 a	227 a	224 a	97 a
SNR	41 b	171 b	184 ab	43 b

[y]Bacteria were grown in 523 broth to a turbidity of 50 Klett units, diluted serially to 10^{-8} and a 0.1 ml volume was assayed. Numbers are the mean of four plates and those in the same column followed by the same letter are not significantly different according to Duncan's multiple range test, $P \geqslant 0.05$.

[z]Abbreviations: KB = King's Medium B; 523, Kado et al. (5); YDC = yeast extract + dextrose + $CaCO_3$; NAG = Difco® nutrient agar plus 0.5% glucose; and SNR = sorbitol neutral red.

RESULTS

Natural occurrence and pathogenicity.—Corn plants or leaves naturally infected with BLB were observed in the field or received from 5 to 12 counties each year from 1973 to 1976. The disease was identified in 27 counties in the Coastal Plain, but it was rarely found in central Georgia and never in north Georgia. Symptoms were first observed in late April to early June each year, and the earliest infection recorded was 29 April, 7 May, and 22 May in 1976, 1974, and 1975, respectively, in Grady and Decatur counties in southwest Georgia. Naturally infected corn also was noted in a field that was under continuous corn culture in Decatur county in all 3 yr. Naturally infected corn was observed in continuous corn culture in two other fields in both 1974 and 1975, but naturally infected corn plants also were found in fields of corn following other crops. Several strains (20 to 30) were tested for pathogenicity on corn in the greenhouse each year from 1973 to 1975, and highly virulent strains of *P. avenae* were found each year. Several unidentified bacteria isolated from lesions on rotted stalks, ears, and flower primordia were also tested. Some were virulent on corn, but none produced bacterial blight lesions (11) on young corn plants.

Symptoms of bacterial blight were seen on numerous cultivars of corn, but natural infection was most commonly observed in Pioneer 3030. Natural epidemics were observed in Pioneer 3030 planted in the same field at the Coastal Plain Station from 1974 to 1976 in a corn-winter rye rotation.

In greenhouse tests, the following cultivars, in addition to those previously reported (11), were susceptible to one or more strains of *P. avenae*: T-72-55 and Holley wheat; Ora and Elan oats; Fla. X65-202-113 barley; Explorer rye; Triticale 5846; Starr pearl millet;

foxtail millet (*Setaria italica* L.) 'P.I. 216544'; proso millet (*Panicum miliaceum* L.) 'P. I. 196292'; and Dekalb BR54, Dekalb C-42y, Ga. 615, RF700, and 19839 sorghum. In contrast, no symptoms were produced on plants of crops other than corn artificially inoculated with *P. avenae* in experiments in the field, and *P. avenae* was never isolated from lesions on weeds or other crops in nature. Numerous attempts were made to isolate *P. avenae* from lesions resembling BLB on several cultivars of wheat, oats, rye, barley, and pearl millet planted in fields following corn with BLB. Some colonies that resembled *P. avenae* were isolated on King's Medium B but BLB symptoms were never produced when corn was inoculated with those cultures.

Selective medium.—Colonies of the four strains (C-9, C-11, C-13, and C-71) of *P. avenae* were visible after 2 days of incubation at 37 C on SNR agar. By 3 days, the colonies were approximately 1 mm in diameter with a thin margin spreading to 2 mm. By 5 days, they were 3-4 mm in diameter, opaque with pinkish centers, umbonate, rough, and spreading with an entire margin. The characteristic margin was best revealed under a dissecting microscope using oblique illumination (Fig. 1). Strains C-13 grew as mixtures of rough and smooth colonies. After 5 days, the smooth colonies were 1 to 2 mm in diameter, glistening, convex, and circular with entire margins, and opaque with light pinkish centers.

With most strains, the number of colonies per plate was significantly less on SNR than on NAG: however, counts on SNR agar often were equal to or greater than counts on the other media (Table 1). The plating efficiencies [(mean number of colonies on SNR) ÷ (mean number of colonies on NAG) × 100] of SNR medium for strains C-9, C-11, C-13, and C-71 were 33, 76, 82, and 44%, respectively.

For isolation of *P. avenae* from soil, SNR agar was superior to NAG. Many soil samples were successfully assayed at dilutions of 1:10 on SNR. Also, colonies of most other bacteria were smaller in diameter and easily distinguished from the rough, spreading colonies of *P. avenae*. As few as 10^3 viable cells of *P. avenae*/g air dried soil were detected on SNR agar immediately after field soil was infested (Table 2).

Survival in soil and plant debris.—The pathogen was not recovered from field soil collected in fields of corn infected with bacterial leaf blight in June and August, 1975, from naturally infected green leaves buried in soil, or from dead or dying leaves taken from standing stalks in August and September. The inoculated green leaves contained 5.7×10^{10} cells of *P. avenae*/g air dry tissue when they were buried at Tifton. *Pseudomonas avenae* was isolated from the buried tissue after 2 wk, but not after 3 and 4 wk. There were approximately 1.6×10^7 cells of *P. avenae*/g of air-dry tissue 2 wk after the tissue was buried, indicating a half-life (16) of 2 days. No pathogenic cultures were isolated from eight other samplings at Tifton, and the pathogen was not recovered from soil or leaf tissues buried in soil at Experiment, Georgia.

Selected plants of six corn cultivars were inoculated artificially on the Coastal Plain Station in 1974 and an epidemic of BLB was obtained in the field (14 × 41 m). The field was irrigated with an overhead sprinkler system when necessary to maintain optimum growth. The corn was followed with a crop of pearl millet; then a mixed planting of wheat, oats, rye, barley, and Triticale 72S. Numerous attempts to isolate *P. avenae* from various kinds of lesions on the millet and small grains were unsuccessful. Corn was planted in 1975, and BLB symptoms were observed 7 wk later when the plants were 0.3 to 1 m tall. However, since the disease had appeared 24 days earlier in a field 90 m away, it was not possible to determine the point of origin of the inoculum. In 1976 ten cultivars of corn were planted into corn residue in a 0.3-ha field where approximately 4,000 plants were naturally or artificially inoculated with *P. avenae* the previous year. The field also was irrigated once with an overhead sprinkler system, but there was abundant rainfall during most of the growing season. Symptoms of BLB were not observed on any of approximately 10,000 plants in the field in 1976. All plants were examined every 5 to 8 days from the time the plants were 30 to 50 cm tall until 2 or 3 wk after tasseling.

Resistance.—The ratings for resistance of six different cultivars of corn to BLB were similar in field tests in 1974 and 1975. Pioneer 3030 was the most susceptible of six cultivars (Seneca Chief, Golden Security, Funk's G 4761, Gold Cup, Golden Bantam, and Pioneer 3030) tested in 1974 and among the most susceptible of the 33 tested in 1975 (Table 3). Visible BLB symptoms were evident 5 to 7 days after inoculation in susceptible cultivars grown in the field at air temperatures of 10 to 32 C in both years. Secondary spread of the pathogen from plant to plant

TABLE 2. Recovery of two strains of *Pseudomonas avenae* added to field soil[a]

Strain	Bacteria added (no. per gram of soil)	Bacteria recovered[b] (no. per gram of soil)	Recovery[c] (%)
C-9	3,240	250	7.8 a
	32,400	1200	3.7 ab
	324,000	2200	0.7 b
C-13	2,140	440	21.0 a
	21,400	3600	17.0 ab
	240,000	4100	1.9 b

[a]One-half ml of an appropriate dilution of a 50-Klett suspension of the bacterium was added to a 4.5 g sample of field soil collected 19 June 1975. The soil was mixed immediately, diluted, and assayed (13).

[b]Numbers represent the mean of two 1-g (oven-dry weight) samples assayed (0.1 ml) in quadruplet on SNR agar.

[c]Numbers within a strain followed by the same letter are not significantly different according to Duncan's multiple range test, $P \geqslant 0.05$. There was no difference in percentage recovery between the two strains.

(and among leaves within a plant) was slower and lesions were smaller in resistant cultivars than in susceptible ones. In susceptible cultivars a shredded appearance and eventual death of leaves were common. Full-season field corn cultivars were more susceptible to BLB than short-season field corn cultivars and sweet corn, but one short-season field corn cultivar (McNair S338) and one sweet corn cultivar (Merit) were very susceptible (Table 3).

The apparent infection rate (r) was significantly greater in the susceptible cultivar Pioneer 3030 than in the resistant cultivar Pioneer 3369A 5 wk after inoculation (Fig. 2). The apparent infection rate was 0.17 vs. 0.14 plants/day, respectively, during the 31-day period preceding tasseling, and 0.19 vs. 0.09 plants/day, respectively, during the 1 wk immediately before tasseling in the susceptible and resistant cultivars. The apparent infection rate on Pioneer 3030 in four separate studies during the 3 yr was 0.18 to 0.21 plants/day during the 3 to 4 wk preceding tasseling and 0.19 to 0.25 plants/day during the 1 to 2 wk immediately before tasseling. In comparison, apparent infection rates in several resistant cultivars were 0.13 to 0.16 plants/day during the 3 to 4 wk before tasseling.

The pathogen spread more rapidly from older leaves to younger leaves in susceptible than in resistant plants, but during drought periods new tissues emerging from the whorls of infected susceptible plants frequently did not develop symptoms. No increase in leaf-blight rating or in number of plants with symptoms was observed after tasseling.

Chemical control.—There were no significant differences among treatments in the test with hexachlorophene. The chemical did not influence the number or size of the lesions on individual plants, and did not prevent the disease from becoming epidemic in the sprayed plots.

Severity of the disease.—The pathogen did not cause ear rot, lesions on stalks, or stalk rot in any of our field tests, and stalk rot symptoms were not produced when the bacterium was injected into stalks of 4- to 8-wk-old plants 0.6 to 1.2 m tall in the greenhouse. There was no significant difference in dry matter digestibility between green plants and blighted plants (72.4 vs. 71.8%).

TABLE 3. Bacterial leaf blight severity on corn cultivars in a field at Tifton, Georgia, in June 1975

Cultivar	Type of corn[x]	Bacterial leaf blight index, 35 days after inoculation[y]
Bonanza	SC	1.75 a[z]
Tendersweet	SC	2.00 ab
Golden Security	SC	2.00 abc
Pioneer 3145	FS	2.25 abcd
Coker 16	SS	2.50 a-e
Funks 4762	SS	2.50 a-e
DeKalb XL80	SS	2.50 a-e
Pioneer 3369A	SS	3.00 a-f
Silver Queen	SC	3.25 a-g
Funks 4761	FS	3.50 a-h
Funks 4810	SS	4.25 b-i
Funks 4811	FS	4.75 c-j
Coker 77	FS	4.50 c-j
Seneca Chief	SC	4.75 d-k
DeKalb XL 394	FS	5.50 f-l
DeKalb XL 395	FS	5.50 f-l
Coker 54	FS	6.00 g-l
Greenwood 747	FS	6.00 g-l
McNair Exp. 3011	FS	6.25 g-l
Funks 4949A	FS	6.25 h-l
Funks 5945	FS	6.33 h-l
PAG 751	FS	6.50 h-l
Funks 4864	FS	6.50 i-l
Greenwood 471	FS	6.75 i-l
Greenwood 4406	FS	7.00 i-l
Funks 495W-1	FS	7.00 i-l
Apache	SC	7.75 j-l
McNair S 338	SS	8.00 kl
Pioneer 3030	FS	8.50 l
McNair 508A	FS	8.50 l
Merit	SC	8.75 l
Coker 71	FS	8.75 l
McNair 508	FS	9.00 l

[x]Abbreviations: SC = sweet corn; SS = short season field corn; FS = full season field corn.

[y]Bacterial leaf blight rating scale: 1 = no symptoms, and 10 = severe streaking on leaves of 15 or more plants in each row. Ratings of 1-3 were considered resistant, 3.01 to 5 moderately resistant; 5.01 - 8 susceptible, and >8 very susceptible.

[z]Numbers followed by the same letter are not significantly different according to Duncan's multiple range test, $P \geqslant 0.05$. Mean of 100 to 180 plants per cultivar.

DISCUSSION

Our research corroborates the finding of Johnson et al. (4) that most cultivars of corn are resistant to bacterial leaf blight caused by *P. avenae*. However, they reported that the pathogen caused stalk rot and ear rot in addition to leaf blight, and their strains caused a distinct soft rot, with a foul odor, on potato slices. We were unable to reproduce stalk and ear rots with *P. avenae*, and our strains did not rot potato slices (11). We frequently did observe stalk and shank rots similar to the symptoms reported by Rosen (10), especially on sweet corn in wet summer weather, but we did not isolate *P. avenae* from infected tissues. Occasionally small plants (15 to 30 cm tall) were killed when *P. avenae* was injected into the stems in greenhouse tests, but stalk rot symptoms did not occur on older plants in the greenhouse. We did not, however, inject the bacterium into the stalks of older plants in the field.

Since we were unable to recover the bacterium from infected leaf debris or soil, and no symptoms occurred on 100 to 800 plants of each of 10 cultivars planted into soil with debris from infected plants, it is possible that infested debris and soil do not play an important role in the epidemiology of BLB. However, since fewer than 2,000 viable cells/g of soil could not be detected on SNR, it is also possible that small numbers of *P. avenae* can survive in soil.

The pathogen is known to infect numerous hosts (4, 7, 9), but we were not able to isolate the bacterium from plants other than corn in nature. The disease occurs in vasey grass (*Paspalum urvillei* Steud) in Florida, and that host is considered a primary source of inoculum there (1). Vasey grass is reported to be common in south Georgia, (2) and we have observed it near a field of Pioneer 3030 infected with bacterial leaf blight.

Johnson et al. (4) reported that BLB symptoms rarely occurred below 21 to 24 C and Rosen (10) reported similar results with corn stalk rot caused by *Erwinia* spp. (10). However, we found that *P. avenae* caused severe leaf blight at a day-night temperature range of 18-14 C (12), and during three separate seasons we found the disease in fields when the mean daily temperature was 18 to 24 C. In artificially infested plants in fields at Tifton, BLB symptoms were observed 5 to 7 days after inoculation in susceptible cultivars at temperature ranges of 10 to 32 C.

We observed two morphologically distinct colony types in one of our strains (C-13) on SNR agar, and Johnson et al. (4) also reported two colony types, rough and smooth, on beef-peptone agar. Both colony types were virulent, but whether there is a relationship between colony morphology and survival ability of a strain is not known.

Bacterial leaf blight may cause severe defoliation in susceptible cultivars, but leaf symptoms were not severe in many of the sweet corn and field corn cultivars we tested. Leaves frequently were invaded by the northern corn leaf blight pathogen (*Helminthosporium turcicum*), the southern corn leaf blight pathogen (*H. maydis*), and other foliage disease pathogens as the plants matured and the influence of BLB on yield probably was confounded by the other foliage diseases. We have concluded that BLB will cause negligible economic loss if available resistant cultivars are planted.

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