Relationships Between Yield of Three Maize Hybrids and Severity of Southern Leaf Blight Caused by Race O of *Bipolaris maydis*

K. J. BYRNES, Former Graduate Research Assistant, J. K. PATAKY, Associate Professor, and D. G. WHITE, Associate Professor, Department of Plant Pathology, University of Illinois, Urbana 61801

ABSTRACT

Byrnes, K. J., Pataky, J. K., and White, D. G. 1989. Relationships between yield of three maize hybrids and severity of southern leaf blight caused by race O of *Bipolaris maydis*. Plant Disease 73:834-840.

Southern leaf blight (SLB), caused by race O of *Bipolaris maydis*, adversely affected yield of three maize hybrids, B73 × Mo17, FR27 × Pa91, and Pioneer 3183, evaluated at nine locations. Severity of SLB in mid- to late August ranged from 0–5% on FR27 × Pa91 at Tolono, IL, to 10–40% on Pioneer 3183 at Urbana, IL. Regressions of yield on area under the curve and on severity of SLB were significant for seven, six, and four of the nine locations for Pioneer 3183, B73 × Mo17, and FR27 × Pa91, respectively. Yield of FR27 × Pa91 and B73 × Mo17 was reduced about 0.7–0.8% for each 1% increase in severity of SLB between 0 and 25%. For Pioneer 3183, yield was reduced about 0.6–0.7% for each 1% increase in severity between 0 and 25%. Yield of Pioneer 3183 decreased an additional 23% when severity increased from 25 to 40%. The effects of SLB on yield of maize varied by location, as indicated by differences in slope coefficients from regression models. Unknown factors associated with location may have influenced this relationship.

Additional keywords: corn, *Helminthosporium maydis*, southern corn leaf blight, *Zea mays* L.

Several investigators have documented yield losses of economic importance in maize (*Zea mays* L.) due to southern leaf blight (SLB) caused by *Bipolaris maydis* (Nisik.) Shoemaker. Prior to the epidemics of 1970 and 1971 caused by race T of *B. maydis*, Ullstrup and Miles (18) compared the effects of leaf blights of maize caused by Helminthosporia fungi and concluded that in the presence of severe epidemics of SLB, yields of resistant hybrids were 7–22 q/ha higher than yields of susceptible hybrids. After the epidemic of SLB in 1970, several investigators evaluated the "destructive potential" of race T of *B. maydis* by manipulating levels of severity of SLB through various methods, including altering planting date and location (8), fungicides (15), time of application and concentration of inoculum (2), and blends of T-cms and normal cytoplasm maize (9,13,17). These studies resulted in useful information about potential yield reductions resulting from severe epidemics of SLB, but quantitative relationships between yield and severity of SLB were not characterized.

Research supported in part by the Illinois Agricultural Experiment Station, Urbana, as part of projects 68-0323 and 68-0350 and by Illinois Foundation Seeds, Inc., Tolono.

Present address of first author: Pioneer Hi-Bred International, Inc., Department of Research Specialists, 216 Jackson Street, P.O. Box 128, New Holland, PA 17557.

Accepted for publication 3 May 1989 (submitted for electronic processing).

Information on the general relationships between yield of maize and severity of SLB is available from at least three studies (1,6,7). Ayers et al (1) reported a linear relationship between the yield of Pioneer 3306 T-cms maize and severity of SLB (resulting from race T of *B. maydis*) assessed 73 days after planting. Fisher et al (6) reported significant relationships between yield of 20 maize hybrids and severity of SLB 3–4 wk after midsilk. Slope coefficients for linear regressions of percent maximum yield on severity of SLB were −0.40 and −0.44 for race T and race O of *B. maydis*, respectively (6), indicating that crop loss models were similar for the two races even though race T produces a toxin and attacks husks and ears and race O does not. Gregory et al (7) published a yield loss equation for race T of *B. maydis*: $Y = 0.69\ (X)$, where Y is the percent yield loss for the hybrid Asgrow ATC-75 and X is severity of SLB at dough stage. Whereas all of these models have been useful in making decisions about the management of SLB, they have not been verified and were based on responses from a single location (6), for a single hybrid (7), or for only race T and not for race O (1,7). Further development of crop loss models for SLB based on reactions to race O of *B. maydis* seems prudent for the central corn belt of the United States, where race O predominates over race T (16) and where T-cms hybrids are no longer grown. Likewise, in a recent survey of species of *Bipolaris* and *Exserohilum* on maize, Leonard et al (12) reported 0–48% incidence of *B. maydis* on corn leaves sampled from 10 fields in mid-July to early August in eastern and western North Carolina; all 75 isolates of *B. maydis* from their survey were race O. Thus, additional evaluation of the endemic occurrence of race O of *B. maydis* seems necessary.

Agronomic stability, as discussed by Eberhardt and Russell (5), is the ability of a genotype to perform consistently over several environments relative to environmental means. A genotype that yields above the environmental mean in a high-yield environment but below the environmental mean in a low-yield environment would be considered to be agronomically unstable. Likewise, a genotype is unstable if it yields above the mean in a low-yield environment and below the mean in a high-yield environment. In developing a crop loss model for Cylindrocladium black rot of peanuts, Pataky et al (14) reported that a general model was not applicable over environments for a peanut line that appeared to be agronomically unstable. Similarly, if inferences about crop losses due to SLB are to be made for the central corn belt region of the United States based on models derived from a limited set of hybrids and locations, it is necessary to evaluate potential interactions among agronomic stability of maize hybrids, environments, and crop loss models for SLB.

This paper reports on the development of crop loss models for SLB caused by race O of *B. maydis* for maize hybrids that were considered agronomically stable and unstable in locations with various yield potentials.

MATERIALS AND METHODS

Experiments were done in 1985 and 1986 at a total of nine locations that represented various yield environments (Table 1). Dates of planting, inoculations, disease ratings, and harvests (Table 1) were based on normal production practices for maize and plant growth stage at each location. Standard production practices were followed.

Each treatment design was a six × three factorial arranged in a split plot of a randomized block experimental design with four replications. Six inoculation-fungicide treatments were applied to main plots. Seed of three hybrids were planted in subplots consisting of six rows about 6 m long;

Table 1. Locations and timetable of procedures for experiments to evaluate relationships between yield of maize and southern leaf blight

Location	Planting date	Inoculations 1	2	3	4	Disease ratings 1	2	3	4	Harvest date
					1985					
Arcanum, OH	25 Apr.	24 May	31 May	14 June	24 June	3 July	12 July	31 July	12 Aug.	7 Oct.
Painter Creek, OH	23 Apr.	24 May	31 May	14 June	24 June	3 July	12 July	31 July[a]	12 Aug.	2 Oct.
Urbana, IL	28 Apr.	26 May	1 June	16 June	27 June	7 July	19 July	3 Aug.	15 Aug.	25 Sept.
					1986					
Decatur, IL	30 Apr.	5 June	10 June	17 June	27 June	9 July	23 July	6 Aug.[a]	22 Aug.	10 Oct.
Paris, IL	24 Apr.	3 June	9 June	16 June	25 June	8 July	18 July	4 Aug.[a]	18 Aug.	15 Oct.
Pesotum, IL	8 May	5 June	13 June	20 June	1 July	8 July	17 July	6 Aug.	20 Aug.	17 Oct.
Sullivan, IL	1 May	5 June	13 June	20 June	1 July	9 July	22 July	7 Aug.[a]	22 Aug.	8 Oct.
Tolona, IL	5 May	3 June	9 June	17 June	1 July	10 July	18 July	7 Aug.	21 Aug.	31 Oct.
Urbana, IL	25 Apr.	27 May	6 June	16 June	26 June	6 July	14 July	28 July[a]	16 Aug.[a]	8 Oct.

[a]Stalk penetrometer ratings made on plants in one of the border rows.

rows were spaced 76 cm apart and the middle four were treatment rows. Populations were about 62,000 plants per hectare. In order to reduce interplot spread of the pathogen, main plots were bordered by additional rows of B73 × Mo17*rhm*, a hybrid resistant to SLB.

Three maize hybrids were selected for variable reactions to SLB and yield stability under different environments. B73 × Mo17, Pioneer 3183, and FR27 × Pa91 are intermediate, susceptible, and intermediate, respectively, in resistance to race O of *B. maydis*. B73 × Mo17 and Pioneer 3183 show stable yield performance over environments, but FR27 × Pa91 is variable.

Different levels of severity of SLB were achieved by altering numbers and timing of inoculations and applications of fungicides. One treatment was an untreated control, and one treatment was protected at each inoculation time with mancozeb (Dithane M-45) at a rate of 1.7 kg/ha. The remaining four treatments included one, two, three, or four inoculations beginning at the fifth-leaf stage. Inoculations were sequential at about 1- to 2-wk intervals. Treatments that were not inoculated on a particular inoculation date (Table 1) were protected with mancozeb.

Inoculum was prepared by mixing sterile wheat and oat grain with a spore suspension of race O of *B. maydis* and incubating at ambient temperature for 2 wk. The inoculum was air-dried for storage and rehydrated before use. Approximately 50 grains of the inoculum were placed in each plant whorl.

Severity of SLB was assessed a total of four times at about 2-wk intervals beginning at pollination (Table 1). Severity was rated from 0 to 100% of the total leaf area diseased on a plot basis using pictorial keys illustrating various levels of leaf blight. Area under the curve (AUC) was calculated from the first to last assessments (19).

Incidence and severity of other pests also were noted. Stalk quality data were collected from some experiments (Table 1). Stalk penetrometer ratings (3) were taken on one of the outer treatment rows of each subplot. At the Urbana, IL, locations, lodging, rind strength of stalks, standing strength of stalks, and plants killed prematurely were measured in the other outer treatment row as described by K. J. Byrnes (M.Sc. thesis, University of Delaware). Yield was measured from the middle two treatment rows and converted to reflect a moisture content of 15.5%. All plots were harvested by small plot combines except for those in Urbana, which were harvested by hand.

Table 2. Means and ranges of severity of southern leaf blight (SLB), area under the curve (AUC), and yield for three maize hybrids grown at nine locations

Variable, year, and location	B73 × Mo17 Mean	Range	Pioneer 3183 Mean	Range	FR27 × Pa91 Mean	Range
Severity of SLB[a]						
1985 Arcanum, OH	12	2–20	19	5–25	6	2–10
Painter Creek, OH	8	2–15	16	1–25	4	0–10
Urbana, IL	20	10–30	31	10–40	8	2–15
1986 Decatur, IL	12	2–20	16	2–30	7	2–15
Paris, IL	10	2–30	16	5–30	6	2–10
Pesotum, IL	4	1–15	8	1–20	2	0–10
Sullivan, IL	9	2–20	14	2–30	6	2–10
Tolono, IL	3	0–8	7	1–15	2	0–5
Urbana, IL	6	1–10	7	1–15	3	0–8
AUC						
1985 Arcanum, OH	400	79–668	770	158–1,015	275	40–550
Painter Creek, OH	329	79–630	697	158–1,132	246	0–472
Urbana, IL	584	171–836	1,052	272–1,462	269	45–519
1986 Decatur, IL	350	80–930	588	101–1,233	261	46–520
Paris, IL	335	59–812	541	126–1,322	191	44–439
Pesotum, IL	174	33–593	327	34–820	94	17–367
Sullivan, IL	342	84–955	595	99–1,405	211	60–508
Tolono, IL	128	0–306	268	34–668	75	0–180
Urbana, IL	182	20–434	278	20–706	104	0–275
Yield (q/ha)						
1985 Arcanum, OH	100	67–119	102	92–110	102	59–124
Painter Creek, OH	123	104–139	113	100–143	125	108–138
Urbana, IL	101	85–133	76	49–119	125	115–134
1986 Decatur, IL	101	75–128	113	98–129	97	81–114
Paris, IL	95	77–126	106	85–132	107	89–129
Pesotum, IL	59	37–79	79	63–102	65	53–79
Sullivan, IL	66	46–85	77	56–100	65	52–81
Tolono, IL	58	36–81	90	64–114	67	50–84
Urbana, IL	111	88–142	117	87–137	111	89–130

[a]Percentage of total leaf area diseased at fourth rating in mid- to late August.

Linear, quadratic, and cubic regressions of yield (q/ha) on each rating of severity of SLB and on AUC were evaluated for each hybrid at each location. *F* statistics were examined to compare the overall significance ($P < 0.05$) of the models and the significance of polynomial terms. Error terms used in *F* tests were from the full model (i.e., the ANOVA of the factorial treatment design). Coefficients of determination (r^2) estimated the proportion of variation in yield that was explained by disease assessments. Residuals from regression were examined for homogeneity, linearity, and outliers. Yields from each experimental unit were converted to percent maximum yield, by hybrid and location, with the intercepts of the appropriate regression equation used as the best estimate of maximum yield for a given hybrid and location. Percent maximum yield then was regressed on AUC and each rating of severity of SLB, with hybrids and locations as qualitative variables. Intercepts from regressions of

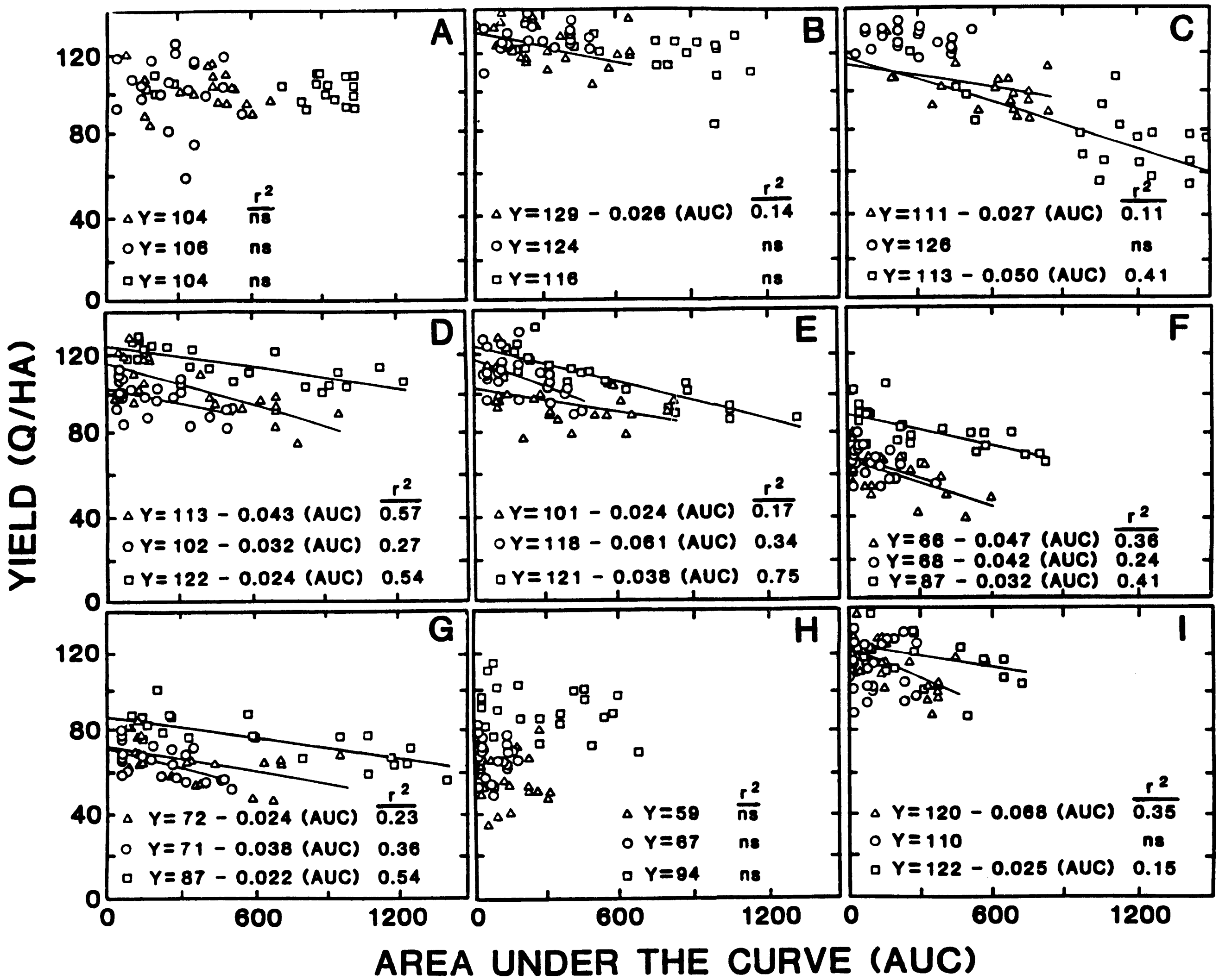

Fig. 1. Regressions of yield (q/ha) on area under the curve of southern leaf blight for three maize hybrids grown at nine locations in 1985 and 1986: **(A)** Arcanum, OH; **(B)** Painter Creek, OH; **(C)** Urbana, IL; **(D)** Decatur, IL; **(E)** Paris, IL; **(F)** Pesotum, IL; **(G)** Sullivan, IL; **(H)** Tolono, IL; and **(I)** Urbana, IL. Hybrids: B73 × Mo17 (□), Pioneer 3183 (○), and FR27 × Pa91 (△).

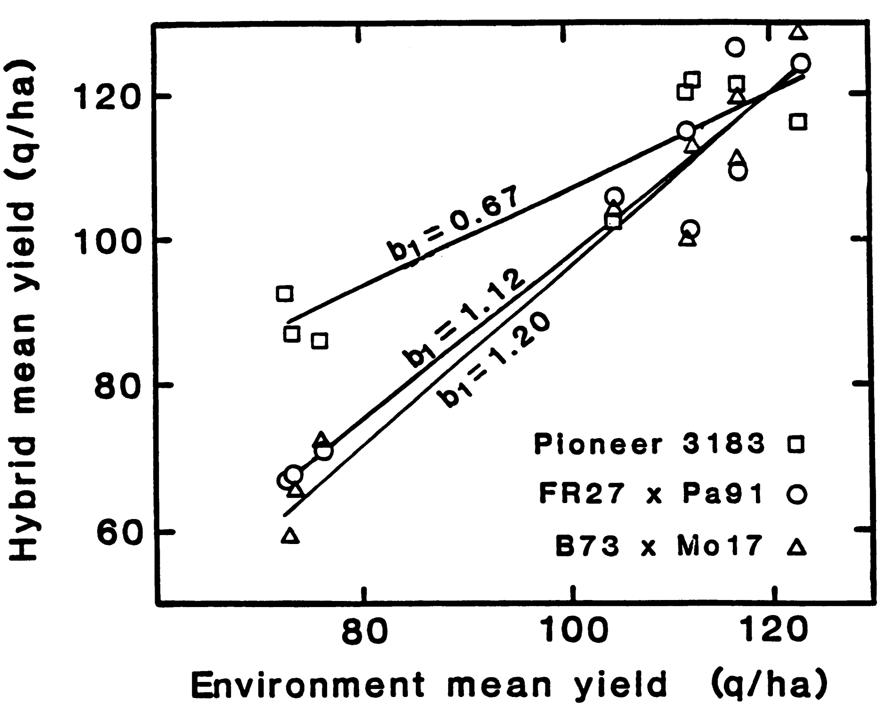

Fig. 2. Regressions of hybrid mean yield on environmental mean yield for three maize hybrids grown at nine locations.

yield on AUC also were used as the best estimates of yield in the absence of disease in order to evaluate stability of hybrids. The intercepts for each hybrid (performance in the absence of disease) at each location were regressed on the means of the intercepts for the three hybrids at a location (environmental mean). Relationships between stalk quality and SLB were evaluated by including the parameters of stalk quality as independent variables in yield models and by regressing stalk quality variables on SLB variables.

RESULTS

The six inoculation-fungicide treatments resulted in a range of severity of SLB and AUC for each hybrid at each location (Table 2, Fig. 1). For example, severity of SLB ranged from 0–5% on FR27 × Pa91 at Tolono, IL, in 1986 to 10–40% on Pioneer 3183 at Urbana in 1985 (Table 2). Likewise, AUC ranged from 0–180 to 272–1,462 for those two experiments, respectively (Table 2). At each location, severity of SLB at the fourth rating in mid- to late August and

AUC were lowest on FR27 × Pa91 and highest on Pioneer 3183. Thus, relative to each other, FR27 × Pa91, B73 × Mo17, and Pioneer 3183 could be considered resistant, intermediate, and susceptible, respectively, to SLB. These categories are relative, however, and may differ if compared with other maize hybrids.

Tolono, Pesotum, and Sullivan, IL, were relatively low-yield environments, with grand mean yields below 80 q/ha. The other six locations were relatively high-yield environments, with grand mean yields above 100 q/ha. Consequently, the data from this experiment alone were not suitable for evaluating the stability of the three hybrids by regression because of a clustering of data at low- and high-yield environments and because of too few hybrids and locations in the trial. Nevertheless, regressions of intercepts from yield on AUC for each hybrid (i.e., the best estimate of the yield of a hybrid at a location in the absence of disease) on means of the intercepts at a location (i.e., the best estimate of environmental mean yield in the absence of disease) resulted in slopes of 0.67, 1.12, and 1.20 for Pioneer 3183, FR27 × Pa91, and B73 × Mo17, respectively (Fig. 2). These slopes differed among the three hybrids primarily because of the relatively high yields of Pioneer 3183 in the low-yield environments compared with those of FR27 × Pa91 and B73 × Mo17. In the high-yield environments, the best estimates of yield in the absence of disease were similar for the three hybrids (Fig. 2). Actual mean yield of the hybrids (over all treatments) was slightly higher for FR27 × Pa91 than the other hybrids in four of the six high-yield environments, which was partly due to the lower amount of SLB on FR27 × Pa91 at those locations (Table 2). Actual hybrid mean yield was highest for Pioneer 3183 in the three low-yield environments in spite of relatively high amounts of SLB at Pesotum and Sullivan (Table 2).

Significant relationships between yield and SLB were observed at seven, six, and four of the nine locations for B73 × Mo17, Pioneer 3183, and FR27 × Pa91, respectively (Fig. 1). Over hybrids and locations, AUC was a slightly better independent variable than severity of SLB as interpreted from regression analyses (Fig. 3, Table 3).

Relationships between yield and AUC were significant for all three hybrids at two of the low-yield environments, Pesotum and Sullivan (Fig. 1). Coefficients of determination were relatively low (r^2 ranging from 0.23 to 0.54), indicating that yield was affected by factors other than SLB. Highest r^2 values were observed when the range of AUC was greatest, i.e., Pioneer 3183 at Sullivan, where r^2 = 0.54 and AUC ranged from 99 to 1,405. Levels of SLB were relatively low at Tolono, a third low-yield location, and regressions of yield on AUC were not significant (Table 2, Fig. 1).

In the high-yield environments, regressions of yield on AUC were significant for five, four, and two of the six trials for B73 × Mo17, Pioneer 3183, and FR27 × Pa91, respectively (Fig. 1). As with the low-yield environments, coefficients of determination were relatively low (r^2 ranging from 0.11 to

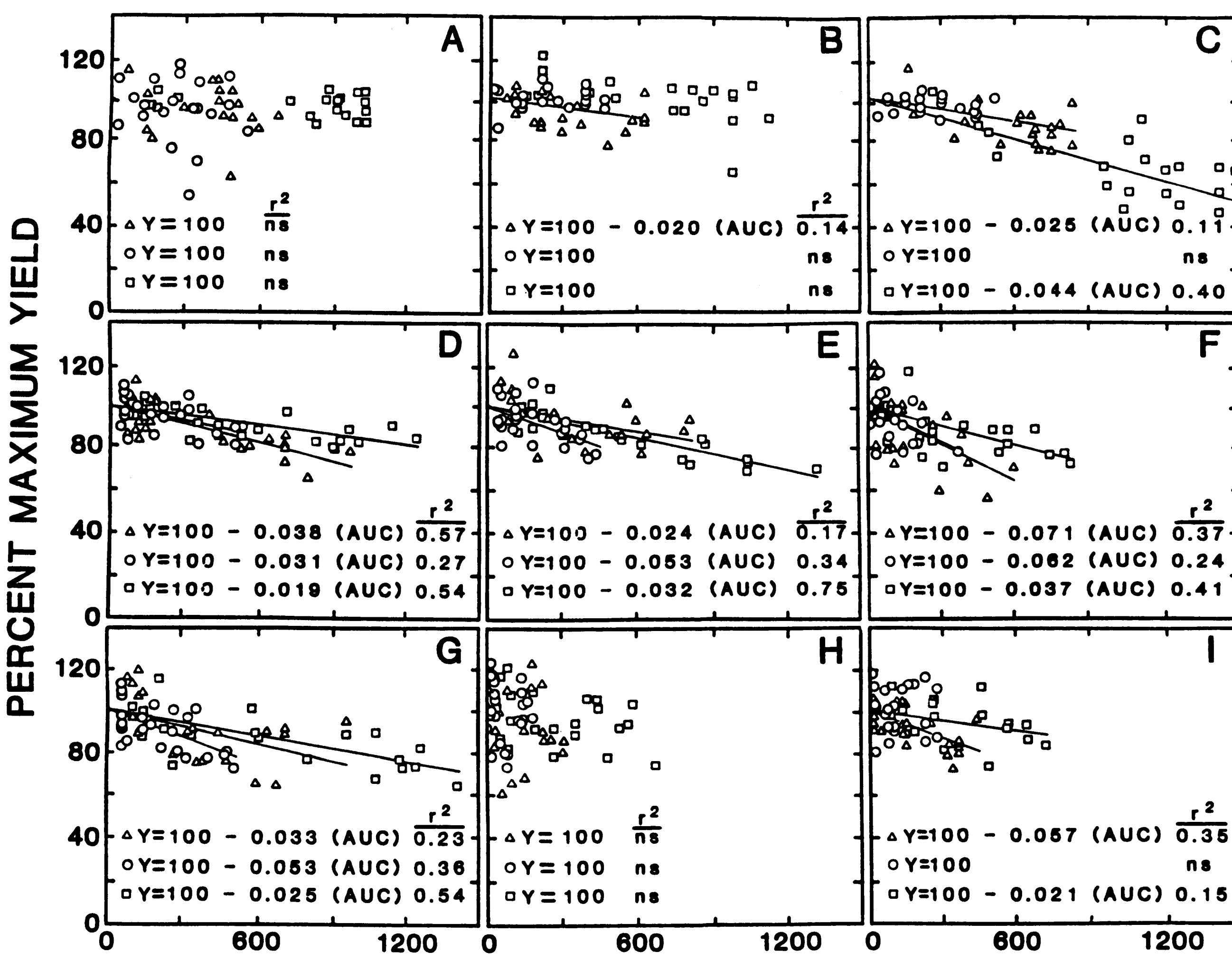

Fig. 3. Regressions of percent maximum yield on area under the curve of southern leaf blight for three maize hybrids grown at nine locations in 1985 and 1986: **(A)** Arcanum, OH; **(B)** Painter Creek, OH; **(C)** Urbana, IL; **(D)** Decatur, IL; **(E)** Paris, IL; **(F)** Pesotum, IL; **(G)** Sullivan, IL; **(H)** Tolono, IL; and **(I)** Urbana, IL. Hybrids: B73 × Mo17 (□), Pioneer 3183 (○), and FR27 × Pa91 (△).

0.75) and generally increased as the range of AUC increased. For example, the highest r^2 value of 0.75 was observed for Pioneer 3183 at Paris, IL, where AUC ranged from 126 to 1,322. Nevertheless, at some locations (e.g., Arcanum and Painter Creek in Ohio) the range of AUC was relatively large but regressions were not significant.

Slope coefficients from regressions of percent maximum yield on AUC varied from −0.020 to −0.071 for B73 × Mo17, from −0.019 to −0.044 for Pioneer 3183, and from −0.031 to −0.062 for FR27 × Pa91 (Fig. 3). There were no apparent relationships among slope coefficients and hybrids, environmental yield, or ranges of AUC. In most cases, variability in yield resulted in nonsignificant t tests among slope coefficients. Thus, when the data were combined over locations, a linear regression model, $Y = 100 - 0.0198\ (X)$, described the relationship between percent maximum yield (Y) and AUC (X) for all three hybrids, with 22% of the variation in percent yield explained by the model (Fig. 4).

When percent maximum yield was regressed on severity of SLB rated in late July and early August (D3) and mid- to late August (D4), anaylses were similar to those for AUC (Table 4). Regressions were usually significant for B73 × Mo17 and Pioneer 3183 and less often significant for FR27 × Pa91 (Table 3), probably because of the low severity of SLB on FR27 × Pa91 (Table 2). Slope coefficients for regressions of percent yield on severity of SLB at the end of July or beginning of August (D3) ranged from −0.86 to −2.24 for B73 × Mo17, from −0.71 to −1.21 for Pioneer 3183, and from −1.21 to −2.25 for FR27 × Pa91 (Table 4). Slope coefficients for regressions of percent yield on severity of SLB at mid- to late August (D4) ranged from −0.46 to −3.07 for B73 × Mo17, from −0.71 to −1.53 for Pioneer 3183, and from −1.04 to −3.98 for FR27 × Pa91. When the data were combined over locations, a single regression equation, $Y = 100 - 0.78\ (X)$ described the relationship between percent yield (Y) and severity of SLB at mid- to late August (X); however, individual regressions were more appropriate for each hybrid (Fig. 5), as indicated by significant hybrid × location interactions. Regressions for B73 × Mo17 and FR27 × Pa91 were linear, with slope coefficients of −0.68 and −0.81, respectively, and were not significantly different from each other. Thus, for each 1% increase in severity of SLB (from 0 to 25%) at mid- to late August, yield of B73 × Mo17 and FR27 × Pa91 was reduced approximately 0.7–0.8%. The relationship for Pioneer 3183 was curvilinear, probably because of larger reductions in yield resulting from severity of SLB above 25% (Fig. 5). From 0 to 25% severity, the relationship for Pioneer 3183 was similar to that for B73 × Mo17 and FR27 × Pa91 and yield was reduced about 0.6–0.7% for each 1% increase in severity. From 25 to 40% severity, yield of Pioneer 3183 decreased approximately 23% (from about a 15% reduction in yield at 25% severity to about a 38% reduction in yield at 40% severity). Severity of SLB was not above 25% on FR27 × Pa91, and only one plot of B73 × Mo17 had severity above 25%. Thus, the curvilinear nature of the relationship for Pioneer

Table 3. Slope coefficients (b_1) and coefficients of determination (r^2) for significant regressions of percent maximum yield on severity of southern leaf blight (SLB) for three maize hybrids grown at nine locations

Location[a]	Disease rating[b]	B73 × Mo17 b_1	B73 × Mo17 r^2	Pioneer 3183 b_1	Pioneer 3183 r^2	FR27 × Pa91 b_1	FR27 × Pa91 r^2
			1985				
Painter Creek, OH	D3	−1.27	0.24	...	n.s.	...	n.s.
Urbana, IL	D4	−0.46	0.11	−0.75	0.38	...	n.s.
			1986				
Decatur, IL	D3	−1.32	0.53	−0.71	0.64	−1.21	0.26
	D4	−1.31	0.54	−0.71	0.53	−1.04	0.22
Paris, IL	D3	−0.86	0.32	−1.21	0.70	−2.25	0.37
	D4	−0.93	0.25	−1.11	0.75	−1.47	0.25
Pesotum, IL	D3	−2.24	0.34	−1.31	0.44	−1.97	0.22
	D4	−3.07	0.39	−1.53	0.38	−3.98	0.25
Sullivan, IL	D3	−1.21	0.49	−1.03	0.52	−2.01	0.34
	D4	−1.47	0.41	−0.96	0.51	−2.12	0.33
Urbana, IL	D3	−1.75	0.25	−0.63	0.11	...	n.s.
	D4	−1.74	0.41	−0.71	0.15	...	n.s.

[a]None of the regressions were significant for Arcanum, OH, in 1985 and Tolono, IL, in 1986.
[b]D3 = severity of SLB at late July or early August; D4 = severity of SLB at mid- to late August.

Table 4. Slope coefficients (b_1) and coefficients of determination (r^2) for significant regressions of number of lodged stalks on area under the curve for three maize hybrids grown at nine locations

Location[a]	B73 × Mo17 b_1	B73 × Mo17 r^2	Pioneer 3183 b_1	Pioneer 3183 r^2	FR27 × Pa91 b_1	FR27 × Pa91 r^2
			1985			
Urbana, IL	n.s.	n.s.	n.s.	n.s.	−0.015	0.17
			1986			
Decatur, IL	−0.008	0.26	−0.007	0.22	−0.018	0.25
Pesotum, IL	n.s.	n.s.	−0.015	0.68	n.s.	n.s.
Urbana, IL	n.s.	n.s.	−0.008	0.22	n.s.	n.s.

[a]None of the regressions were significant for five of the nine locations.

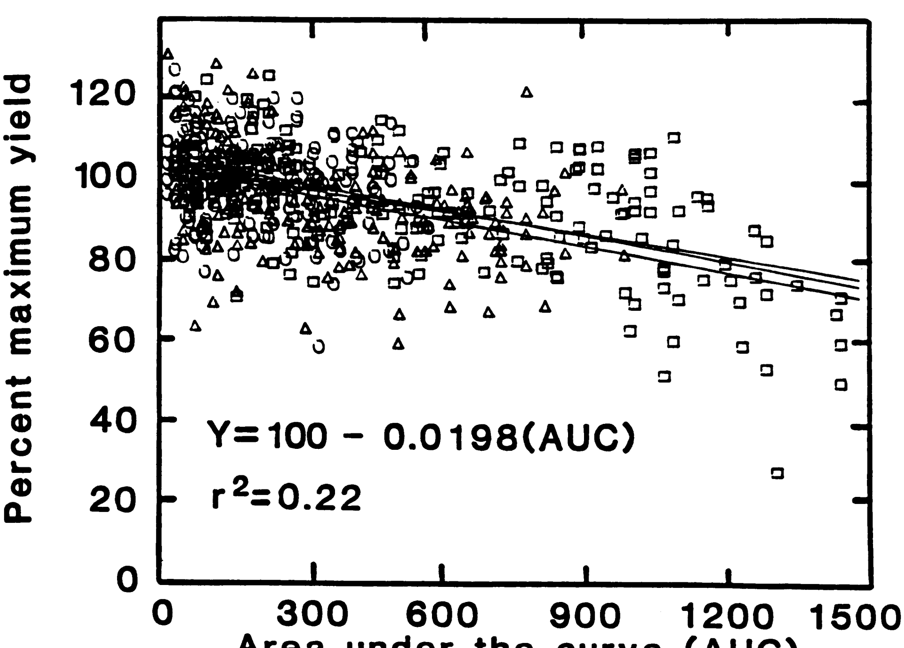

Fig. 4. Regression of percent maximum yield on area under the curve of southern leaf blight for the combined data of nine locations for three maize hybrids: B73 × Mo17 (□), Pioneer 3183 (○), and FR27 × Pa91 (△).

3183 could not be compared with the other two hybrids.

Including stalk quality variables (lodging, strength of rinds, plants killed prematurely, and standing strength of stalks) in yield loss models usually did not increase the variation in yield explained by the models. Likewise, regressions of stalk quality variables on severity of SLB and on AUC did not consistently explain the variation in the stalk quality data. For example, regressions of number of lodged stalks on AUC were significant for only one, two, and three locations for B73 × Mo17, FR27 × Pa91, and Pioneer 3183, respectively, and coefficients of determination were relatively low (Table 4). All stalk quality variables were slightly lower for FR27 × Pa91 than for the other two hybrids.

DISCUSSION

In this study, southern leaf blight adversely affected yield of maize, as has been documented previously (1,2,6–9,13, 15,17,18). Yield of Pioneer 3183 was reduced about 30–40% by severe SLB (AUC of 1,500 and severity of 40%). Reduction in yield for B73 × Mo17 and FR27 × Pa91 was usually less than 20 and 15%, respectively, and SLB was less severe than on Pioneer 3183. These reductions in yield were not nearly as large as those that resulted from the epidemics of SLB caused by race T of *B. maydis* on T-cms hybrids in 1970 and 1971. In this study, however, SLB was not as severe as in the epidemics of 1970 and 1971. Similarly, the relationships between yield losses and severity of SLB observed in this study may not be adequate to estimate yield losses under severe epidemics of SLB in the southern United States. Nevertheless, past and recent surveys suggest that race O of *B. maydis* often is prevalent at low levels and may be endemic in many areas of maize production (10–12,16). Thus, race O of *B. maydis* may persistently result in relatively small but significant yield losses, particularly if susceptible hybrids are grown.

Relationships between yield of maize and SLB were variable, as indicated by low r^2 values and scattered plots of residuals. Coefficients of determination, which ranged from 0.14 to 0.75 for individual models and were 0.22 for the combined models, were lower than those previously reported for yield loss studies with race T of *B. maydis* (6,7). These diverse deviations from regression indicate that yield was affected by factors other than SLB. Stalk quality factors did not explain a significantly greater portion of the variation in yield, even though foliar leaf blights predispose maize to stalk rots (4), resulting in greater reductions in yield from stalk rots and leaf blights than from leaf blights alone. Likewise, spatial patterns of yields from individual experimental units were not associated with field variation. Thus, the deviations from regression were considered to be due to experimental error of unknown origin. The resulting low r^2 values do not contradict the conclusion that SLB affects yield of maize; they merely indicate that a relatively low proportion of the variation in yield was explained by AUC or severity of SLB.

Analyses based on AUC and severity of SLB were relatively similar, although AUC resulted in significant models at a few more locations than did severity of SLB. Slope coefficients for AUC models were less variable, and a single combined model was appropriate when AUC was used. The somewhat more robust models resulting from AUC may have resulted from the fact that AUC considered the development of epidemics (i.e., the entire disease progress curve) or that in being derived from multiple disease assessments, AUC was less subject to random experimental error associated with a single disease assessment. Nevertheless, severity of SLB at the third or fourth rating (late July to early August and mid- to late August, respectively) was a simpler method to assess SLB and was somewhat easier to interpret in terms of disease management. For example, a slope coefficient of 0.0198 based on AUC indicated that yield of maize was reduced about 2% for each increase of 100 AUC units. An AUC unit (severity-days) may be difficult for anyone but plant pathologists to understand and assess. In contrast, a slope coefficient of 0.7 or 0.8 based on severity of SLB at mid- to late August indicated that yield of maize was reduced about 0.7–0.8% for each 1% increase in the total leaf area infected.

The relationships between yield of maize and severity of SLB in mid- to late August were similar in this study to those reported by Gregory et al (7) for race T of *B. maydis*. They reported yield reductions of about 0.7% for each 1% increase in severity of SLB on Asgrow ATC-75 T-cms hybrid maize at the dough stage (18 and 25 August 1975 and 1976, respectively). Thus, relationships between races T and O of *B. maydis* appeared to be similar when the results of these two studies were compared. Fisher et al (6) also observed similar effects on yield between races T and O of *B. maydis*, although their slope coefficients were −0.40 and −0.44, respectively. Thus, SLB had a less severe effect on yield than in our studies and in those by Gregory et al.

The effects of SLB on yield of maize may vary by environment, as indicated by differences in slope coefficients among locations. For example, severity of SLB on Pioneer 3183 ranged from 5 to 25% at Arcanum and from 1 to 25% at Painter Creek, but yield was not decreased. At Urbana in 1985, however, 25% severity on Pioneer 3183 resulted in a 30% reduction in yield. There were no apparent associations among these differences in location and the susceptibility of a hybrid to *B. maydis*, yield potential of the location, or stalk quality factors. Likewise, there was no evidence from these data to suggest that yield loss models varied among hybrids that differed in yield stability. These data suggest that differences among locations and experimental error of unknown sources resulted in substantial variation in yield that could not be explained by SLB. Thus, while our combined models

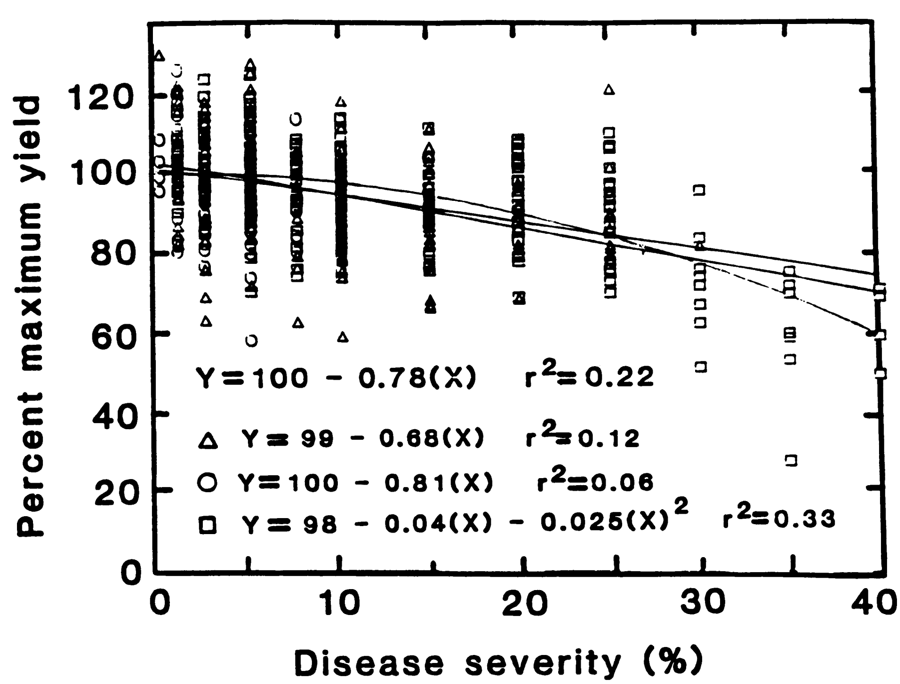

Fig. 5. Regression of percent maximum yield on severity (fourth rating) of southern leaf blight for the combined data of nine locations for three maize hybrids: B73 × Mo17 (□), Pioneer 3183 (○), and FR27 × Pa91 (△).

give the best estimate of the effects of SLB on yield in the absence of other information, unknown factors may affect this relationship, which needs further investigation.

ACKNOWLEDGMENTS

We thank M. A. Mikel and D. P. Deutscher, Illinois Foundation Seeds, Inc., for assistance with field trials in Ohio and Illinois, respectively.

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