COMPARATIVE YIELD LOSS ESTIMATES DUE TO BLAST IN SOME UPLAND RICE CULTIVARS

A.S. PRABHU[1], J.C. FARIA[1] & F.J.P. ZIMMERMANN[1]
[1]Centro Nacional de Pesquisa de Arroz e Feijão (CNPAF/EMBRAPA), Caixa Postal 179,
74000 Goiânia, Goiás, Brasil.

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ABSTRACT

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Leaf and panicle blast severities and grain yield of some upland rice cultivars were measured in three successive years in field plots unprotected or protected with fungicides. The variation in disease severities in different plots was used to establish relationships between severity of leaf and panicle blast and yield. Linear multiple regression equations for each cultivar by year were developed to estimate the yield decrease in different cultivars per unit increase in disease. Leaf blast severities at maximum tillering or booting stage and panicle blast 25 days after heading accounted for variation in grain yield in most of the cultivars. General equations combining five early and eight medium-duration rice cultivars were developed. The estimated percentage losses in grain yield due to blast were 2.7 and 1.5 for one percent increase in blast in the early and medium-duration cultivars, respectively.

RESUMO

Estimativas comparativas de perdas devidas à brusone em cultivares de arroz de sequeiro.

Foram avaliadas severidades da brusone nas folhas e nas panículas e a produtividade nas parcelas não protegidas e protegidas com fungicida em experimentos conduzidos durante três anos sucessivos. As variações em severidades nas parcelas foram utilizadas para estabelecer relacionamentos entre brusone nas folhas, panículas e produtividade. Foram desenvolvidas equações de regressão múltipla por cultivar e ano para estimar decréscimo na produvidade por unidade de aumento da doença. A severidade da brusone na fase de perfilhamento máximo ou emborrachamento e brusone nas panículas 25 dias após emissão das panículas explicou a variação em produtividade na maioria das cultivares. Equações generalizadas combinando cinco cultivares precoces e oito cultivares de ciclo médio foram desenvolvidas. Os percentuais de perdas devido a brusone foram 2,7 e 1,5 para um por cento de aumento da brusone das cultivares de ciclo precoce e de ciclo médio, respectivamente.

INTRODUCTION

Upland rice constitutes around 77percent of the 5.4 million hectares under rice cultivation in Brazil. Blast caused by *Pyricularia oryzae* Cav. is the principal rice disease. The disease is more severe under upland conditions than in irrigated areas, due to heavy and continuous dew periods and the increased disease susceptibility of rice plants under dry soil conditions (Prabhu, 1983). Despite the increased use of fungicides (Santana et al., 1978), the average yields of upland rice during 1980-82 were as low as 1.5 metric tons/ha. Even though blast has been considered as one of the major contributing factors to the decreasing low yields, there are no reliable quantitative estimates of yield losses.

Several experimental approaches for assessing yield loss in different crops have been reported (Van der Plank, 1963; James, 1974; Burleigh, 1980; Loomis & Adams, 1983; Seem, 1984). Yield losses in cereal diseases, in general, are estimated by utilizing regression models relating loss to disease at a critical stage or different stages of host growth or the area under disease progress curve (Burleigh et al., 1972; James, 1974; Buchanan, 1975; Calpouzos et al., 1976; Teng & Shane, 1984). In irrigated rice, the relationships of grain yield to incidence of leaf and panicle blast have been studied in Japan and India (Goto, 1975; Padmanabhan, 1965). In Japan, a method has been developed to estimate yield losses based on panicle blast severities 30 days after heading (Katsube & Koshimizu, 1970). The existing methods for measuring disease-yield loss relationships are limited in scope and are mainly adapted to specific edaphic and climatic conditions.

The relationship of rice yield to blast under upland conditions is quite variable among farms, years, and cultivars. Much of the variation in yield response to blast can be attributed to differences in disease level. Leaf and panicle blast cause different effects on grain yield. Leaf blast intensities at any growth stage seldom reach levels to stop grain development, but affect grain weight in upland rice. On the contrary, panicle blast causes grain sterility and yield loss relationship is greatly influenced by the time and intensity of infection (Prabhu & Faria, 1982).

The present study was undertaken to establish linear relations for determining the relative differences in yield losses due to leaf and panicle blast in some early and medium-duration upland rice cultivars.

MATERIALS AND METHODS

Field lay-out and treatments

Five experiments were conducted under upland conditions at Goiânia, Brazil, during three crop seasons of 1975/76, 1976/77, and 1977/78. A randomized complete block design was used for all experiments. During the first year (1975/76), twenty-one upland rice cultivars (IPEACO 562, IAC 5544, Tainan, Catalão, Fernandes, IAC 47, IAC 1246, Pratão, Montanha Liso, IAC 5032, IAC 5100, Amarelão, IAC 1131, IAC 162, Canela de Ferro, CICA 4, Batatais, IAC 25, Dourado Precoce, Pratão Precoce, and Edith Long) were seeded on 11 December in four replications. From these cultivars, five early-maturing cultivars (Batatais, IAC 25, Dourado Precoce, Pratão Precoce, and Edith Long) and nine medium-duration ones (IPEACO 562, IAC 5544, Tainan, Catalão, Fernandes, IAC 47, IAC 1246, Pratão, and Montanha Liso) were selected in the second year (1976/77), based on similar yield potential and varying degrees of susceptibility. The disease reaction of these cultivars ranged from 4 to 7 in the International Blast Nursery tests in Goiânia. The early-maturing (110 days) and medium-duration (140 days) cultivars were seeded in two separate experiments on 18 and 20 November, 1976, with six and four replications, respectively. In the third year (1977/78) the two experiments of the previous year were repeated using the same cultivars and number of replications, with the exception of the cv. Catalão, which was deleted from the medium-duration set due to kernel discoloration caused by fungi other than *P. oryzae*. The five early and eight medium-duration cultivars were seeded in two separate experiments on 21 and 23 November 1977, respectively.

Each plot consisted of sixteen 5m rows spaced 60 cm apart in the first year and 50 cm in the latter two years. A seeding rate of 50 to 60 seeds per linear meter was used in all experiments. All plots were fertilized with 50 kg N/ha, 60 kg P_2O_5/ha, and 30 kg K_2O/ha in the form of ammonium sulphate, simple superphosphate and potassium chloride, respectively. From approximately 25 days after planting until maturity, half of each plot (8 rows) was sprayed to the run-off point alternately with benomyl (250 g a.i/ha) and kasugamycin (20 ml a.i./ha). The sprays were administered at 7 to 12-day intervals. Yield data were taken from 8 m^2 areas of the central four rows of the treated and nontreated plots. All plots were protected against insect (*Spodoptira fugiperda, Moces latipes* etc.) damage by fortnightly sprays with endrin (20 ml a.i./ha).

Sampling and assessment of blast

Disease assessments were made on the naturally occurring epidemics in the experimental plots. Four half-meter observational row units, one in each of the four central rows, were demarcated with wooden stakes. Eight tillers per plot, two in each of the four observational units, were pretagged at random. Leaf blast evaluations were made individually on four leaves, counting downwards from the topmost leaf. Panicle blast severity was measured on all the panicles in the half-meter observational rows 25 days after heading. Severity of leaf blast was determined five times at intervals ranging from 10 to 15 days beginning with the first appearance of the disease.

The leaf blast severity (LBS), expressed as a percentage of leaf area affected, was calculated in two ways. In the initial stages, when the lesions were still isolated, the measurement was based on the number of lesions per leaf and the size of the lesions. Leaf lesions were classified into 3 types viz. Small ($2mm^2$), medium ($9mm^2$), and large ($44 mm^2$). The percentage of disease leaf area of the individual leaf was calculated by the formula: LBS = (2A + 9B + 44C)/total leaf area x 100, were A,B, and C represent the number of small, medium and large lesions, respectively. Total leaf area (mm^2) = length x width x 0.75 where 0.75 is an adjustment factor (Yoshida et al., 1972).

When the disease had advanced to a coalescence of the lesions, LBS was calculated by the length and width measurements of the diseased and healthy areas. LBS values based on the top three or four leaves of the eight pretagged tillers for each treated and untreated subplot were included in the final analysis.

The panicle blast severity (PBS) was measured by using a 5 grade scale based on the empty discoloured spikelets (0 = < 5%, 1 = 6 − 25%; 2 = 26 − 50%; 3 = 51 − 75%; 4 = 76 − 100%) and summated by the formula (McKinney, 1923):

$$\text{PBS} = \frac{(\text{Class value y Class frequency})\ 100}{\text{Total number of panicles x } 4}$$

The cultivars IAC 162, CICA-4, and Canela de Ferro of the experiment in 1975-76 were not included in the final analysis due to grain discoloration caused by other fungi.

The loss in yield expressed as percentage of the treated plot could not be used as a dependent variable for correlaging to blast severities, because complete control was not achieved in the treated plots. Consequently, the yield loss was related to percentage of the control obtained, which depended upon the degree of susceptibility of the cultivar or the rate at which the disease developed. The disease severities in different plots were quite variable, independent of the treatment. The yield data expressed as kg/ha at 13% dry matter and the variable disease levels obtained from 16 to 20 treated and untreated individual plots in the experiments were used to relate yield to leaf and panicle blast and to estimate loss.

The data were processed utilizing SAS (Statistical Analysis System) on an IBM 370/145 computer. General linear model procedure was used to study the causal relationships between grain yield and leaf blast severities at different growth stages and between leaf and panicle blast in different cultivars, years, and cultivar-year combinations. A multiple regression analysis technique was used with yield as the dependent variable to generate linear equations for each of the cultivars in different years. The independent variables were: X_1 = LBS1; X_2 = LBS2; X_3 = LBS3; X_4 = LBS4; X_5 = LBS5; X_6 = PBS. The significant LBS variable was identified by F — test.

The panicle blast severity (PBS) measured 25 days after heading represents independent variable X_6. The other independent variables X_1 to X_5 represent leaf blast severities (LBS) at five different dates during the disease progress. The dates of observations were, however, variable in different years. To develop combined equations according to year and cultivar, three leaf blast severity variables viz. LBS61, LBS75, and LBS89 were introduced, where LBS61 = LBS 64 DAS (1st year) + 62 DAS (2nd year) + LBS 57 DAS (3rd year); LBS75 = LBS 74 DAS (lst year) + LBS 79 DAS (2nd year) + LBS73 (3rd year); and LBS89 = LBS 89 DAS (1st year) + LBS 90 DAS (2nd year) + LBS 89 DAS (3rd year). The numbers following LBS represent days after seeding (DAS). The growth stages (0-9) referred to in this study were based on the standard scale used in the International Rice Testing Programs (Zadoks et al., 1974). Leaf blast severites 61,75, and 89 days after planting correspond to stem elongation, booting, and heading stages in the early-maturing cultivars; maximum tillering, stem elongation, and booting in the medium duration cultivars. Because of the large number of variables and the possible interaction effects, the final equations combining cultivar and year had to be developed by specifying PBS as an obligate independent variable. Equations of two independent variables with the highest R^2 values relating yeld to leaf and panicle blast were developed for early and medium-duration cultivars of upland rice.

The loss in yield was calculated from the regression equations (James et al., 1968). In the general equation, $y = b_0 + b_1 x_1 + b_2 x_2$ the intercept 'b_0' represented yield of the cultivar when there was no disease and the parameter b_1 and b_2 are partial regression coefficients which measured the rate of decrease in yield with unit increase in disease. The extrapolated yield, served as the check in the absence of disease-free plot. The loss in yield was calculated by using the formula: Loss(%) = $[b_1 \text{ or } (b_1 + b_2)/b_0]$ x100.

RESULTS

The contribution of leaf blast was significant and greater than panicle blast in some cultivars, while in others panicle blast alone accounted for more than 90% variability in grain yield (Table 1). The estimated loss per unit increase in disease was variable in different cultivars, being higher in cultivars with significant leaf blast contribution to yield variation.

TABLE 1 – Linear regression parameters in equations relating yield to leaf and panicle blast and the percentage loss per unit disease increase in medium-duration upland rice cultivars.

Cultivar	Regression parameters*				Percentage loss per unit disease increase (PBS or PBS + LBS)
	b_0	b_1	b_2	R^2**	
1975					
IPEACO 562	3225.4	– 30.6 (1.5)***	– 7.6 (1.6)	0.98	1.18
IAC 5544	1718.8	– 14.3 (3.2)	– 26.3 (12.2)	0.83	2.36
Tainan	1868.7	– 9.8 (2.6)	– 37.1 (8.6)	0.94	2.50
Catalão	2589.1	– 22.4 (3.1)		0.88	0.86
Fernandes	1471.3	– 13.7 (5.0)		0.54	0.93
IAC 47	1807.1	– 12.2 (1.9)	– 44.1 (12.5)	0.94	3.10
IAC 1246	1377.8	– 13.2 (2.7)		0.94	0.96
Pratão	1269.4	– 10.8 (4.6)		0.47	0.85
Montanha Liso	3012.5	– 29.7 (4.0)		0.90	0.98
IAC 5032	1634.2	– 16.3 (2.0)		0.90	0.99
IAC 5100	1466.8	– 5.5 (2.2)	– 40.9 (12.8)	0.90	3.16
Amarelão	1785.8	– 18.8 (5.4)		0.66	1.05
IAC 1131	1377.6	– 12.5 (2.4)		0.81	0.91
1976					
IAC 5544	3461.4	– 33.8 (8.2)		0.74	0.98
Fernandes	2665.5	– 19.3 (6.6)	– 26.3 (9.2)	0.92	1.71
IAC 47	2683.1	– 29.8 (4.1)	– 93.2 (44.2)	0.92	3.33
IAC 1246	3498.2	– 31.3 (7.4)		0.74	0.89
Pratão	3069.4	– 19.9 (3.4)	– 21.0 (6.3)	0.86	1.33
Montanha Liso	5548.0	– 49.6(26.9)	– 112.0 (49.0)	0.74	2.91
1977					
IAC 5544	2075.9	– 18.9 (6.0)		0.60	0.91
Fernandes	2105.6	– 17.5 (5.7)		0.59	0.83
IAC 47	2925.9	– 18.6 (7.6)	– 41.9 (18.4)	0.69	2.06
IAC 1246	3214.0	– 40.9 (9.4)		0.76	1.27
Pratão	3113.4	– 24.2 (7.3)	– 64.8 (28.4)	0.69	2.85
Montanha Liso	2340.6	– 13.8 (4.2)	– 41.5 (9.9)	0.86	2.36

* Equation $Y = a + b_1PBS + b_2LBS$, where Y = grain yield (kg/ha), PBS = Panicle blast severity (%); LBS = Leaf blast severity (%).

** Number of observations in analysis = 8, $P<0.01$.

*** Standard error.

TABLE 2 – Multiple linear equations to estimate yield loss due to blast in four early-duration upland rice cultivars*.

Cultivar	Regression equations** $Y = a + b_1 PBS + b_2LBS$	R^2***	Percentage loss per unit disease increase (PBS + LBS)
Dourado	Y = 4526.6 – 19.2 PBS – 91.9 LBS75 (9.5)*** (14.0)	0.53	2.45
Pratão Precoce	Y = 4716.1 – 15.7 PBS – 96.3 LBS75 (9.0) (25.9)	0.32	2.37
Batatais	Y = 4289.3 – 31.9 PBS – 70.7 LBS75 (8.5) (17.0)	0.60	2.39
IAC 25	Y = 4007.1 – 23.8 PBS – 95.5 LBS75 (5.5) (21.2)	0.72	2.90

* Based on average disease severities during three years.

** = estimated grain yield (kg/ha); PBS = panicle blast severity (%); LBS = leaf blast severity (%).

*** Number of observations in the analysis = 32; $P<0.01$

**** Standard error.

Regression equations for yield in the widely grown commercial cv. IAC 47 with one and two independent variables in the first and second years were $\hat{Y} = 1776.6 - 15.2$ PBS ($R^2 = 0.82$), $\hat{Y} = 1807.0 - 12.2$ PBS $- 44.1$ LBS ($R^2 = 0.94$); and $\hat{Y} = 3590.9 - 31.4$ PBS ($R^2 = 0.86$), $\hat{Y} = 2683.1 - 29.8$ PBS $-$ 93.2 LBS ($R^2 = 0.92$) respectively. In the third year the equation with PBS alone as independent variable was not significant.

TABLE 3 — Linear equations to estimate yield loss due to blast in eight medium-duration upland rice cultivars*.

Cultivar	Regression equation**	R^2***	Percentage loss per unit disease increase (PBS or PBS + LBS)
One independent variable			
IPEACO 562	$Y = 1424.6 - 10.2$ PBS (3.6)	0.27	0.71
IAC 5544	$Y = 1816.7 - 14.1$ PBS (4.1)	0.35	0.56
Catalão	$Y = 1525.4 - 10.4$ PBS (4.5)	0.27	0.68
Fernandes	$Y = 1876.4 - 16.2$ PBS (2.8)	0.57	0.86
IAC 47	$Y = 2557.1 - 21.3$ PBS (4.8)	0.46	0.83
IAC 1246	$Y = 1768.1 - 14.1$ PBS (4.6)	0.29	0.79
Pratão	$Y = 1802.8 - 13.8$ PBS (4.1)	0.32	0.76
Montanha Liso	$Y = 1877.5 - 15.3$ PBS (3.2)	0.50	0.81
Two independent variables			
IPEACO 562	$Y = 1600.3 - 9.9$ PBS $- 26.6$ LBS61 (3.3) (12.3)	0.39	2.28
IAC 5544	$Y = 2206.1 - 16.4$ PBS $- 18.8$ LBS61 (3.8) (7.6)	0.49	1.59
Fernandes	$Y = 2030.6 - 13.6$ PBS $- 22.4$ LBS61 (2.6) (8.5)	0.70	1.77
IAC 47	$Y = 2885.5 - 22.2$ PBS $- 17.4$ LBS61 (4.1) (5.7)	0.62	1.37
Pratão	$Y = 2064.1 - 13.8$ PBS $- 19.5$ LBS61 (3.7) (7.5)	0.49	1.61
Montanha Liso	$Y = 2828.7 - 22.0$ PBS $- 23.8$ LBS61 (2.8) (5.3)	0.74	1.62

* Equations based on the average disease severities during 3 years.

** = estimated grain yield (kg/ha); PBS = panicle blast severity (%); LBS_{61} = leaf blast severity (%); 61 days after seeding.

*** $P < 0.01$; number of observations in the analysis 24.

**** Standard error.

TABLE 4 — General equations to estimate yield lass due to blast in the early and medium-duration rice cultivars under upland conditions in Brazil*.

Regression equation** $Y = a + b_1 PBS + b_2 LBS$	R^2***	N****	Percentage loss per unit disease increase (PBS or PBS + LBS)
Early-duration cultivars			
$Y = 3380.44 - 28.42$ PBS (3.53)*****	0.29	140	0.84
$Y = 3427.50 - 19.43$ PBS $- 74.08$ LBS 75 (3.02) (8.08)	0.53	140	2.72
Medium-duration cultivars			
$Y = 1817.31 - 15.15$ PBS (1.18)	0.41	240	0.83
$Y = 1947.97 - 13.97$ PBS $- 15.31$ LBS 89 (1.17) (3.40)	0.45	240	1.50

* Equations based on pooled data during 3 years for 5 early — duration and 8 medium — duration cultivars.

** Y = grain yield (kg/ha); PBS = panicle blast severity (%); LBS = leaf blast severity (%).

*** $P < 0.001$.

**** N = Number of observations in the analysis.

***** Standard error.

Linear equations were developed for each of the four early-duration cultivars based on the pooled data of three years (Table 2). The models were chosen by adapting stepwise regression procedure. Leaf blast severities 75 days after planting, corresponding to booting stage contributed significantly to the variation in grain yield. In the four early maturing cultivars, leaf and panicle blast together resulted in yield losses ranging from 2.37 to 2.90% per unit disease increase.

The relationship between yield and disease remained the same when the equations were generated for each one of the medium-duration cultivars over years (Table 3). The equations based on the pooled data of three years for the cultivar IAC 47 showed that 46 and 62 percent of the variation was explained with one (LBS) and two independent variables (LBS and PBS), respectively. The addition of leaf blast severities to PBS as an independent variable improved the R^2 values. Leaf blast severities 61 days after planting corresponding to tillering stage contributed to variation in grain yield. The yield loss per unit increase of disease was least in IAC 47 and highest in IPEACO 562 among the cultivars in which LBS contributed significantly to the variation in yield.

The following generalized linear equations combining the eight medium-duration cultivars according to year were established: 1st year: $Y = 1433.14 - 9.90$ PBS $- 11.93$ LBS 89 ($R^2 = 0.62$); 2nd year: $Y = 1940.58 - 9.02$ PBS $- 27.70$LBS89 ($R^2 = 0.40$); 3rd year: $2527.00 - 21.02$PBS $-$ 20.76LBS89 ($R^2 = 0.64$). Leaf blast severities at the boot stage and panicle blast significantly contributed to the yield variation. Percentage yield loss per unit increase in blast among the years varied between 1.5 to 1.9.

Grain yield was also related to both panicle and leaf blast in a single equation based on the combined data from different cultivars and years (Table 4). Separate equations were developed for early and medium-maturing cultivars due to their differences in yield potential. The inclusion of LBS as an independent variable significantly improved the multiple correlation coefficents. The estimated percentage losses in grain yield due to blast were 2.7 and 1.5 for one percent increase in blast in the early and medium duration cultivars, respectively.

DISCUSSION

The development of epidemics in all three years was natural and no attempt was made to induce disease artificially. In general, typical leaf lesions made their appearance 25 to 30 days after seeding. The epidemic increased at a fast rate until approximately 60 days after planting and then slowed down due to leaf resistance to new infections and rapid growth of the foliage during rainy periods. The percentage leaf area affected again increased at the end of the booting or heading time when further growth of the foliage ceased.

Yield loss was related to leaf blast at different growth stages during disease progress and terminal panicle blast severity in a multiple-point model. A linear relationship between yield and leaf blast was found at one critical-point and also between yield and terminal panicle blast severities. The critical stage at which the disease severities affected yield, varied between cultivars. However, the disease at boot stage had mostly contributed to variation in yield when the cultivars and years were combined to develop general equations. The coefficients of determination did not increase with the inclusion of leaf blast severities at different points in a disease-progress curve, due to high correlation between the variables The studies conducted to estimate loss due to late blight of potato (James et al., 1972) and leaf rust of wheat (Burleigh et al., 1972) showed that yield loss — disease severity relationship is strengthened when estimates at several growth stages are incorporated into loss equation. The yield-loss relationships due to rice blast are, however, complicated by the indirect and direct effects of leaf and panicle blast. Both leaf blast and panicle beast have been reported to affect different yield components (Prabhu et al., 1986). The losses in grain weight were found to be variable depending upon the time of infection of the panicle (Prabhu & Faria, 1982). In the present study the panicle blast severities recorded 25 days after heading included the early as well as late infection.

Due to inter-plot interference, complete control of either leaf or panicle blast was not achieved in test plots despite the fungicide application at regular intervals. The percentage control was also variable in different years and cultivars. The coefficients of determination of the equations developed for cultivars in different years were higher than cultivar-year combinations. In linear equations developed to relate blast to yield in the widely grown upland rice cultivar IAC 47, while 82% of the variation in yield was explained by panicle blast, both leaf and panicle blast together accounted for 94% during the first year. However, in most of the cultivars panicle blast alone significantly contributed to the variation in grain yield. The generalized equations combining cultivars and years, may not have any predictive value because of the differences in onset and the rate at which the epidemic develops. The simple linear equations based on blast severities and yield in different years only allow comparative estimation of losses between the cultivars. Because yield losses per unit increase in disease were variable among the cultivars, differential sensibility to disease stress probably exists. The method utilized in this paper combining leaf and panicle blast in a multiple regression equation will be useful in estimating potential yield loss caused by *P. oryzae* in other rice cultivars. Even though the loss per unit increase due to leaf blast is nearly half of the total loss considering the low upland rice yields and economics of disease control, panicles need to be protected with appropriate fungicides to reduce yield loss due to rice blast.

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EVALUATION OF COWPEA LINES FOR RESISTANCE TO WILT CAUSED BY *FUSARIUM OXYSPORUM* F. SP. *TRACHEIPHILUM*

E.A. FAWOLE*
Agricultural Biology Department University of Ibadan.

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ABSTRACT

FAWOLE, E.A. Evaluation of cowpea lines for resistance to wilt caused by *Fusarium oxysporum* f.sp. *tracheiphilum*. Fitopatol. bras. (14):232-234. 1989.

Fusarium oxysporum f.sp *tracheiphilum*, the causal agent of *Fusarium* wilt of cowpea, was isolated and identified from cowpea. Six cowpea lines IT82E-16, IT83S-951, IT83S-960, TVX347, TVX1948-01F and Benin Local were screened for resistance to *F. oxysporum* f.sp. *tracheiphilum*. Fourteen-day-old seedlings were root-dip inoculated by dipping the root system which was wounded with a sterile dissecting needle into a spore suspension containing 10^4 conidia per ml. Assessment of disease intensity was carried out using a resistance rating category as follows: 0% = immunity, 1 — 10% = highly resistant, 11 — 20% = moderately resistant, 21 — 40% = moderately susceptible, 41 — 60% = susceptible, 70% — highly susceptible. Of all the six cowpea lines screened TVX347 was the most resistant with only 4% infection, and IT83S-951 was the most susceptible with 48% infection.

RESUMO

Avaliação de linhas de caupi para resistência a murcha causada por *Fusarium oxysporum* f.sp. *tracheiphilum.*

Fusarium oxysporum f. sp. *tracheiphilum*, o agente causal da murcha de Fusarium em caupi, foi isolado de caupi e identificado. Seis linhas de caupi IT82E-16, IT83S-951, IT83S-960, TVX347, TVX1948-01F e "Benin Local" foram avaliadas para resistência a *F. oxysporum* f. sp. *tracheiphilum*. Raízes de plântulas com 14 dias foram inoculadas mergulhando o sistema radicular ferido com agulha de dissecação esterelizada, em uma suspensão de esporos contendo 10^4 conídios/ml. A avaliação da intensidade de doença foi realizada usando a seguinte escala de avaliação de resistência: 0% = imunidade, 1 — 10% = altamente resistente, 11 — 20% = moderadamente resistente, 21 — 40% = moderadamente susceptível, 41 — 60% = susceptível, 70% = altamente susceptível. De todas as seis linhas de caupi avaliadas TVX347 foi a mais resistente com apenas 4% de infecção, e IT83S-951 foi a mais susceptível com 48% de infecção.

INTRODUCTION

Several fungal diseases attack cowpea, of which one of the most important is vascular wilt disease caused by *Fusarium oxysporum* f.sp. *tracheiphilum* (Smith) Snyder and Hansen (Williams, 1975; Singh and Allen, 1979). It was first observed in Nigeria in 1974 (Oyekan, 1977). Over 50% of plant mortality due to the wilt was observed in cultivars Local Brown, Local White, Mala and Ife Brown when grown in a field that was naturally infested by the pathogen (Oyekan,

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*Present address: Plant Pathology Division
Cocoa Research Institute of Nig.,
Private Mail Bag 5244,
IBADAN.