Inheritance of Resistance in Tomato to Target Leaf Spot

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ABSTRACT

A method for evaluating tomato seedlings for reaction to *Corynespora cassiicola*, which incites target leaf spot, was developed. Useful levels of seedling resistance were found in P.I. 120265 (*Lycopersicon esculentum*) from Turkey and P.I. 112215 (*L. pimpinellifolium*) from Ecuador. When each line was crossed with the susceptible cultivar 'Ife No. 1', the F_1 and F_2 and backcross progenies indicated that resistance was controlled by a single recessive gene. The F_1 and F_2 progenies from the cross of P.I. 120265 × P.I. 112215 were uniformly highly resistant, suggesting that the gene for resistance was the same in both.

Twelve additional introductions showed slight resistance and 228 introductions were highly susceptible.

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Target leaf spot of tomato, incited by *Corynespora cassiicola* (Berk. & Curt.) Wei, is a serious disease in southern Nigeria, particularly during the dry season. Tomato plants appear to be most susceptible at the seedling stage and just prior to and during fruiting. Yield reductions and often death of plant result from rapid defoliation accompanied by lesioning of petioles, stems, and occasionally of fruit.

C. cassiicola is a pathogen of worldwide importance with a very wide host range. It has been reported on a number of crops in the United States (2, 5, 7, 10, 11, 13) and in West Africa (4). According to Wei (16) it was first reported on tomato (*Lycopersicon esculentum* Mill.) by F. C. Deighton (6) from material collected in Sierra Leone. It was subsequently reported on the same host by Mohanty & Mohanty in India (8), by Simmonds (12) in Queensland, Australia, and by Blazquez (3) in the United States.

Over one hundred tomato varieties and breeding lines from the United States were observed in the field in Nigeria but no distinct resistance was apparent. The objectives of the present study were to screen available plant introductions for sources of genetic resistance and to study the mode of inheritance of resistance.

MATERIALS AND METHODS.–Two hundred and eighteen introductions of *Lycopersicon esculentum*, nine of *L. pimpinellifolium* L., 12 of *L. esculentum* × *L. pimpinellifolium*, one of *L. peruvianum* L., and two of *L. glandulosum* L. were obtained from the North Central Regional Plant Introduction Station, Ames, Iowa, and evaluated for reaction to *C. cassiicola*. Ife Tomato No. 1 was included as a susceptible check since it had been found very susceptible in both field and greenhouse tests in Nigeria. The tomato seedlings were grown in "Jiffy Mix" in 20-cm pots and inoculated at the four-leaf stage. Inoculum was prepared by washing conidia from 5-day-old *C. cassiicola* cultures on potato-dextrose agar (PDA) plates exposed to continuous, white fluorescent light 2,690 lx (250 ft-c). The inoculum, after being filtered through a single layer of cheesecloth, was adjusted to ca. 80,000 spores/ml and Tween 80 (one drop/100 ml spore suspension) was added as a wetting agent. The plants were sprayed with the spore suspension until the upper and lower leaf surfaces, as well as the stems, were uniformly wet. The inoculated plants were then placed in a mist chamber at 20-24 C for 24 hr and subsequently transferred to a greenhouse bench.

RESULTS AND DISCUSSION.–Water-soaked areas on leaves were apparent after the 24 hr in the moist chamber. Twenty-seven hr after inoculation there were irregular lesions on the leaves; by 36 hr there were elongated lesions on the petioles and stems. The coalescence of these lesions led to a rapid death of the most susceptible lines. Disease reactions

TABLE 1. Tomato accessions showing resistance to target leaf spot[a]

High resistance		Slight resistance	
P.I. No.	Origin	P.I. No.	Origin
120265[b]	Turkey	79532[c]	Peru
112215[c]	Ecuador	91918	Bulgaria
		97321	Mexico
		100697	Peru
		108245[d]	Germany
		110595[c]	England
		114038[d]	Honduras
		124132[d]	India
		126417	Peru
		126430[c]	Peru
		126433[c]	Peru
		126436[c]	Peru

[a] 228 additional accessions from the regional collection were found to be susceptible. Numbers are not listed, but will be supplied upon request.

[b] All numbers refer to accessions of *Lycopersicon esculentum* except as otherwise noted.

[c] *Lycopersicon pimpinellifolium*.

[d] *L. esculentum* × *L. pimpinellifolium*.

ranged from susceptible to highly resistant, with the majority being susceptible (Table 1). Twelve introductions were scored as having slight resistance. Of these, four were *L. esculentum*, five were *L. pimpinellifolium*, and three were *L. esculentum* X *L. pimpinellifolium*. Two introductions, P.I. 112215 (*L. pimpinellifolium*) and P.I. 120265 (*L. esculentum*) were scored as highly resistant. These lines had minute foliar lesions and no stem lesions (Fig. 1).

The susceptible cultivar, Ife No. 1, was crossed with P.I. 112215 and with P.I. 120265 to produce the F_1 and F_2 generations. Backcrosses to the susceptible and resistant parents were made with each F_1. F_1 and F_2 populations were produced from the cross P.I. 120265 X P.I. 112215.

Seedlings of Ife No. 1 were consistently highly

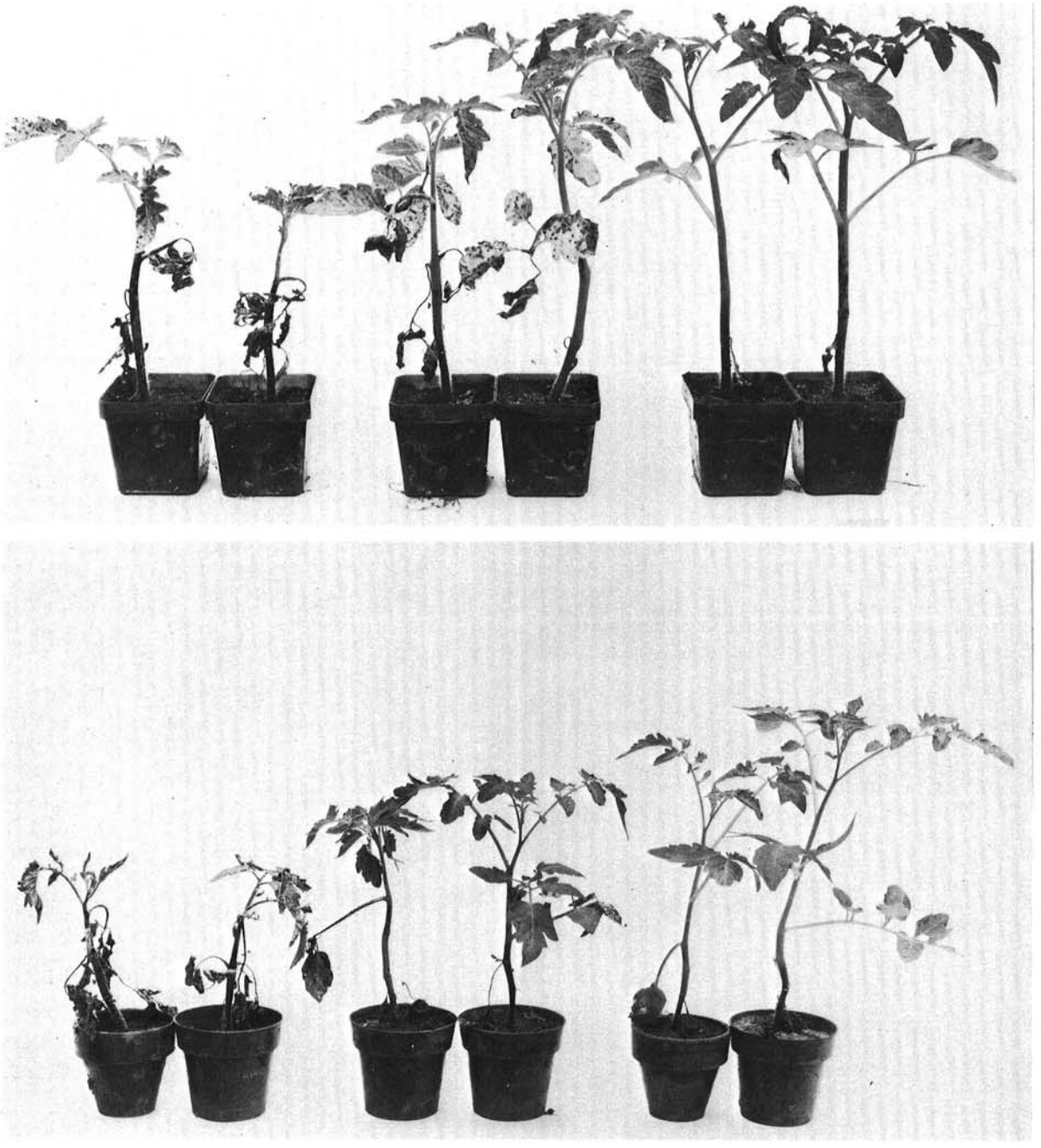

Fig. 1. Reaction of tomato to *Corynespora cassiicola*. Top, left to right: 'Ife No. 1', F_1, P.I. 120265. Bottom, left to right: Ife No. 1, F_1, P.I. 112215.

TABLE 2. Reactions of 'Ife No. 1' (*Lycopersicon esculentum*), P.I. 120265 (*L. esculentum*), and progenies to *Corynespora cassiicola*

Parent or family	Generation	Disease reaction[a]			Ratio tested	χ^2
		S	I	R		
Ife No. 1	P_1	15	0	0		
P.I. 120265	P_2	0	0	29		
Ife No. 1 × P.I. 120265	F_1	0	20	0		
P.I. 120265 × Ife No. 1	F_1	0	13	0		
Ife No. 1 × P.I. 120265	F_2	36	53	24	1:2:1	2.99
P.I. 120265 × Ife No. 1	F_2	21	31	17	1:2:1	1.18
P.I. 120265 × (Ife No. 1 × P.I. 120265)	BC	0	75	57	0:1:1	2.44
Ife No. 1 × (Ife No. 1 × P.I. 120265)	BC[b]	96	0	0	1:0:0	
(Ife No. 1 × P.I. 120265) × Ife No. 1	BC[b]	69	1	0	1:0:0	
(Ife No. 1 × P.I. 120265) × Ife No. 1	BC	31	22	0	1:1:0	1.52

[a] S = susceptible, I = intermediate, R = resistant.
[b] No attempt was made initially to separate plants in this generation into two classes. This was done in a second experiment and the test against the expected ratio is given.

TABLE 3. Reaction Ife No. 1 (*Lycopersicon esculentum*), P.I. 112215 (*L. pimpinellifolium*), and progenies to *Corynespora cassiicola*

Parent or family	Generation	Disease reaction[a]			Ratio tested	χ^2
		S	I	R		
Ife No. 1	P_1	11	0	0		
P.I. 112215	P_2	0	0	12		
P.I. 112215 × Ife No. 1	F_1	0	4	0		
P.I. 112215 × Ife No. 1	F_2	22	41	16	1:2:1	.83
P.I. 112215 × (P.I. 112215 × Ife No. 1)	BC	0	7	9	0:1:1	.26
(P.I. 112215 × Ife No. 1) × P.I. 112215	BC	0	28	25	0:1:1	.16
Ife No. 1 × (P.I. 112215 × Ife No. 1)	BC[b]	9	0	0	1:0:0	
Ife No. 1 × (P.I. 112215 × Ife No. 1)	BC	21	28	0	1:1:0	1.00
(P.I. 112215 × Ife No. 1) × Ife No. 1	BC[b]	17	0	0	1:0:0	

[a] S = susceptible, I = intermediate, R = resistant.
[b] No attempt was made initially to separate plants in this generation into two classes. This was done in a second experiment and the test against the expected ratio is given.

susceptible and those of P.I. 120265 and P.I. 112215 were highly resistant to *C. cassiicola*. F_1 plants from both crosses were intermediate to the parents and segregation in the F_2 populations suggested that susceptibility was incompletely dominant and that resistance was due to the homozygous recessive condition of one gene (Tables 2 & 3). Backcrosses of F_1 plants from both crosses to the appropriate resistant parent produced segregating progenies that did not deviate significantly from an expected ratio of 1:1, intermediate:resistant. Backcrosses of F_1 plants to Ife No. 1 produced progenies that were susceptible. In the initial tests, no distinction was made between susceptible and intermediate plants. However, in a later test, the plants were separated into distinct classes to test against an expected ratio of 1 susceptible: 1 intermediate. F_1 and F_2 plants resulting from the cross P.I. 120265 × P.I. 112215 were uniformly highly resistant (Table 4), indicating that the gene controlling resistance was the same in both parents.

Suitable levels of resistance were not found among the many widely-grown cultivars that have been grown in the field at the University of Ife, Nigeria. However, certain other cultivars and breeding lines may carry resistance since some introductions found to be resistant in these tests have contributed genetic material. P.I. 112215 has been used in breeding lines V544 and V545 at the Vineland, Ontario station and in the production of the cultivar 'Improved Bay State' (E. A. Kerr, Vineland, Ontario; *personal communication*). P.I. 79532 (*L. pimpinellifolium*) which was found to have slight resistance to target

TABLE 4. Test for allelism in families resulting from the hybridization of P.I. 120265 × P.I. 112215

Parent or family	Generation	Disease reaction[a]		
		S	I	R
P.I. 120265 × P.I. 112215	F_1	0	0	4
P.I. 120265 × P.I. 112215	F_2	0	0	39

[a] S = susceptible, I = intermediate, R = resistant.

leaf spot, has been used in producing the cultivars 'Wabash' and 'Dwarf Italian' (1), 'Walter' (14), 'Tropic' (15), and 'Vendor' (9) through the cultivar 'Indian River' (1). Blazquez (3) has also reported partial resistance in some of the currently-grown varieties in Florida.

These results suggest that there may be a higher frequency of genes controlling a level of resistance to target leaf spot in *L. pimpinellifolium* than in *L. esculentum*. Of the 21 introductions of either *L. pimpinellifolium* or *L. esculentum* × *L. pimpinellifolium*, nine showed some degree of resistance whereas only five of more than 200 accessions of *L. esculentum* showed some seedling resistance. However, the two introductions, P.I. 120265 and P.I. 112215, that were highly resistant apparently carry the same gene even though they belong to different species.

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