

Effect of Light Duration on Verticillium Wilt of Tomato

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ABSTRACT

Photoperiod (8,608 lux, or 800 ft-c intensity) drastically affected development of *Verticillium* wilt of tomato. Symptom development at a 4-hour photoperiod was more rapid and more pronounced and there were fewer escapes in susceptible cultivars than at an 8-, 12-, or 16-hour period.

Several workers (3, 4, 6, 8) have described techniques for screening plant species for resistance to *Verticillium* wilt incited by *Verticillium albo-atrum* Reinke and Berth. Most techniques involved modifications of the root-dip method described by Wellman (7) for use with *Fusarium* wilt of tomato (*Lycopersicon esculentum*). Our initial experiences with the root-dip method in greenhouse and plant house for screening tomato cultivars and breeding

lines for resistance to *Verticillium* wilt were unreliable because often little to no disease developed. Worse yet, occasionally misleading results were obtained when the extremely susceptible cultivar 'Bonny Best' developed symptoms and the tolerant cultivars 'Florida MH-1' and 'Walter' (2) did not. Moreover, under controlled growth room conditions [14 hours daily photoperiod, 8,608 lux (800 ft-c) light intensity, and 21 C temperature] symptom development was mild and slow. It rapidly became apparent that a modification of our root-dip method was needed to obtain consistent, reliable results.

Foster and Walker (1) demonstrated that light duration materially affected development of *Fusarium* wilt of tomato. Therefore, an experiment was carried out, and repeated twice, to determine the effect of light duration on the development of *Verticillium* wilt of tomato. Because the results from these three experiments were nearly identical, only the third experiment is reported.

MATERIALS AND METHODS.—Two-week-old seedlings of three tomato cultivars (Bonny Best, Florida MH-1, and Walter) were root-dip inoculated (7) with *V. albo-atrum*, transplanted into a sterile peat-vermiculite mix contained in styrofoam "Speedling" trays, and incubated with noninoculated seedlings of each cultivar in four growth rooms at 22 C and 8,608 lux (800 ft-c) illumination. Daily photoperiod of 4, 8, 12, and 16 hours light (cool-white fluorescent) duration were established. Each experimental unit consisted of 40 seedlings, and was replicated five times in each room.

The *V. albo-atrum* isolate used for inoculum was cultured 2 weeks at 21 C under 80.7 lux (70 ft-c)

TABLE 1. Percent infected and dead tomato plants following root-dip inoculation with *Verticillium albo-atrum* and incubation at various photoperiods at 8,608 lux (800 ft-c) light intensity

Photoperiod (hours)	Cultivar ^a	Time following inoculation						Weight reduction (%)
		12 hours		19 hours		33 hours		
		infected (%)	dead (%)	infected (%)	dead (%)	infected (%)	dead (%)	
4	BB	37	4	99	85	99	99	100
4	Wal	39	10	95	73	98	98	98
4	MH-1	36	12	91	73	96	96	97
8	BB	15	0	72	2	90	9	24
8	Wal	13	1	53	2	80	7	33
8	MH-1	19	0.5	65	4	89	7	53
12	BB	26	1	53	1	98	3	21
12	Wal	20	0	29	0	90	0	18
12	MH-1	27	6	47	7	94	9	34
16	BB	20	0.5	27	0.5	98	1	33
16	Wal	11	0	18	0	97	0.6	17
16	MH-1	19	3	26	3	98	3	15

^aBB = Bonny Best, Wal = Walter, MH-1 = Florida MH-1.

^bWeight of noninoculated plants - weight of inoculated plants ÷ weight of noninoculated plants × 100.

TABLE 2. Percent tomato plants with wilt symptoms 3 weeks after inoculation with *Verticillium albo-atrum* and incubation at 8,608 lux (800 ft-c) and 21 C (compilation of two tests)

Tomato line	Plants with symptoms (%)
Bonny Best	81
Tropic	11
AREC-Bradenton lines	
1	92
2	75
3	0
4	0
Purdue lines ^a	
1	100
2	100
3	92
4	4
5	0
Auburn line ^b	82

^aSeed supplied by E. Tigchelaar, Purdue University, Lafayette, Indiana.

^bSeed supplied by W. Greenleaf, Auburn University, Auburn, Alabama.

continuous illumination on potato-dextrose agar in petri dishes. The cultures were comminuted in sterile deionized water, and the resulting dense mycelial-conidial suspension (3.93×10^6 spores/ml) was used as inoculum.

All plants were examined weekly for external symptoms of *Verticillium* wilt. At the conclusion of the test (33 days after inoculating), all surviving plants were cut off at soil line and fresh weights were determined. At this time, stem sections were excised from five randomly selected plants of each experimental unit. All inoculated seedlings yielded *V. albo-atrum* colonies; no noninoculated seedlings did.

RESULTS.—All noninoculated plants, regardless of cultivar and daylength, remained disease-free throughout the entire experimental period. *Verticillium* wilt symptoms were apparent on some inoculated plants of each cultivar within 12 days. Symptoms at this time consisted principally of flaccidity of the cotyledons, and of a slight stunting of the plants. Approximately twice as many inoculated plants incubated at 4 hours daylength were symptomatic as at 8, 12, or 16 hours daylength (Table 1). Disease severity also was more pronounced at 4 hours daylength than at 8, 12, or 16 hours (8% dead at 4 hours vs. 1.5% at 8, 12, and 16 hours). A week later 95% (mean of three cultivars) of the inoculated plants at 4 hours exhibited symptoms and 78% were dead. At 8, 12, and 16 hours 63, 43, and 24%, respectively, of the plants exhibited symptoms and only a few were dead. Nearly all the inoculated plants, regardless of light duration,

exhibited *Verticillium* wilt symptoms when the test was terminated. Many of the plants incubated at 8, 12, and 16 hours exhibited very slight, inconspicuous symptoms, and only a mean of 5% died. This was in contrast to the 4-hour incubated plants, of which 98% died.

Plant fresh weights were reduced 98, 37, 24, and 21% (weight noninoculated plants - weight inoculated plants ÷ weight noninoculated plants × 100) respectively, at 4, 8, 12, and 16 hours daily photoperiod (Table 1).

DISCUSSION.—Light duration drastically affected the development of *Verticillium* wilt of tomato following root-dip inoculation and incubation at 22 C and 8,608 lux (800 ft-c) light intensity. Symptoms development was more rapid and much more pronounced at a 4-hour daily illumination period than at an 8-, 12-, or 16-hour period. The shorter the light period, the greater the fresh weight loss caused by *Verticillium* wilt, and the fewer escapes.

Further tests run in conjunction with the Florida Agricultural Experiment Station tomato breeding program demonstrated that Tropic, which possesses the *Ve* gene for resistance to *Verticillium* wilt (5), remained healthy when root-dip inoculated and incubated at 21 C with 4 hours of daily illumination at 8,608 lux (800 ft-c) intensity (Table 2). It would appear that the method should be of value to tomato breeders and geneticists for rapidly evaluating tomato lines and cultivars with greater reliability than using ambient illumination periods.

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ERRATUM, VOLUME 65

Page 2, column 1, line 37: instead of "1961," the date should be "1966."

Page 256, column one, lines 5-9. Author requests editor-changed sentence be restored to original wording. It should read: "The medium contained 20 g strained peach baby food, 20 g agar, and 0.1 g chloramphenicol per liter and 13 ml of the medium was dispensed into each plate."

ERRATUM, VOLUME 64

Page 1501, Table 3, boxheadings under "Soil moisture" should be interchanged. The first column should be headed "At time of incubation (P_w)," and the second should be headed "During recovery (P_w)."