PHYTOPHTHORA ROOT AND RUNNER ROT OF CRANBERRY IN WISCONSIN- THE CURRENT SITUATION

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Root and runner rot of cranberry has been recognized in Wisconsin since 1987 (4). This disease is present in all cranberry-growing regions of the state and affects all common commercially-grown cultivars. Affected plants usually are located in low-lying or poorly drained areas of beds. To date, *Phytophthora* spp. have been recovered from necrotic roots or runners collected in 46 of 63 (73.0%) beds at 26 of 34 (76.5%) marshes. *Phytophthora* spp. have also been recovered from apparently healthy vines collected in 10 of 11 (90.9%) beds where symptoms of root and runner rot were not evident. In addition, a baiting bioassay was developed to detect *Phytophthora* spp. in cranberry field soils (2). Phytopththora spp. were detected in 16 of 17 (94.1%) beds where the disease was present and in 5 of 6 (83.3%) beds where disease symptoms were not evident. Water collected in irrigation and drainage canals at five marshes were assayed for the presence of *Phytophthora* spp. *Phytophthora* spp. were recovered from water samples collected in both the spring and fall at four marshes where root and runner rot was present but were not detected in water samples collected at a marsh where symptoms of the disease were not evident.

Six distinct morphological types of isolates in at least two species (tentatively identified as *P. cryptogea* and *P. megaspemza)* have been isolated from necrotic roots and runners, cranberry field soils, and irrigation and drainage water. *Phytophthora* cinnamomi, a cause of root and runner rot of cranberry in Massachusetts and New Jersey (l), has not been detected in Wisconsin cranberry beds. Pathogenicity of P. cryptogea, the most frequently isolated species of *Phytophthora,* was determined in the greenhouse with cuttings grown from dormant l-year-old upright stems (cv. Searles) planted in a pasteurized mixture of sand and peat (5:l,v/v) that was artificially infested with inoculum (pooled from three isolates) at rates of 0, 2, 5, or 10% (v/v) (3). Plants were grown for 13 weeks and received four biweekly flooding periods of 0, 2, 4, or 6 days. At the end of the experiment, fresh shoot weight was determined. Shoot growth was related inversely to both inoculum rate and flooding duration (Figures 1 & 2). However, flooding duration had a greater negative impact on shoot growth than did incoculum rate. Young plants (5-6 weeks of age) were affected more severely than were older plants (19-21 weeks of age). Relative virulence of four of the six morphological types from Wisconsin and *P. cinnamomi* from Massachusetts was compared with 0 and 5% inoculum and 0 and 2 days of flooding. Shoot growth was reduced by three of the four morphological types from Wisconsin but only when plants were flooded (Figure 3). However, *P. cinnamomi* reduced shoot growth both with and without flooding. In the absence of inoculum, flooding also reduced shoot growth.

Currently, no fungicide is registered to control *Phytophthora* spp. on cranberry. However, fungicides that are selectively effective against these fungi are known (5), and some are commercially available for use on other crops. During 1990 and 1991, the fungicides metalaxyl (Ridomil), fosetyl-A1 (Aliette), and oxadixyl (San-371) were evaluated in field trials conducted at two commercial cranberry marshes in separate geographical areas of Wisconsin. At each site, plots were established in an area of a bed devoid of vines where plants had died from root and runner rot. Each plot consisted of 20 rooted cranberry cuttings (cv. Stevens) planted inside a 30-cm-diameter plastic PVC ring embedded in the soil. Fungicides were applied monthly from June through October (total

of five applications) during 1990 and from June through September (total of four applications) during 1991. The plants were subjected to normal cultural practices and naturally occurring inoculum. In October 1991, plants were collected and shoot weights were determined. Plants also were assayed for infection by *Phytophthora* spp. There was a significant difference in plant survival at one of the two locations (Table l), but mean shoot weight did not differ significantly among treatments at either location. However, there was a significant difference in the number of plants infected with *Phytophthora* spp. at both locations. Infection by *Phytophthora* spp. was reduced by metalaxyl and oxadixyl but not by fosetyl-A1.

In a companion trial conducted at only one of the grower locations, metalaxyl and fosetyl-A1 were applied to established vines for two seasons. Plots (2 X 2 m) were located at the periphery of an area of a bed where vines had died from the disease. These treatments also were evaluated in October 1991. Yield from untreated plots was greater than yields from lots treated with either fungicide, although the difference in yield was not statistically significant (Table 2). The number of flowers in untreated plots was significantly greater than the number of flowers in fungicide-treated plots. There was a significant reduction in percentage of uprights flowering in plots treated with fosetyl-A1 and a significant reduction in the number of flowers per flowering upright in plots treated with metalaxyl. It appears that under the application schedule used, these fungicides may adversely affect differentiation and development of cranberry flowers.

Information on the relative resistance of cranberry cultivars to *Phytophthora* root and runner rot is inadequate. In Wisconsin, the disease affects all common commercially-grown cultivars (4). In research conducted in Massachusetts (l), differences in susceptibility to root rot caused by *P cinnamomi* were identified among cultivars commonly grown in that region. Six cultivars commercially grown in Wisconsin (Ben Lear, Crowley, McFarlin, Pilgrim, Searles, and Stevens) currently are being evaluated in field trials initiated June 1991 at two commercial cranberry marshes in separate geographical areas. At each site, the trial is located in an area of a bed where vines had died from disease. Each plot consists of 10 cranberry cuttings planted inside a 15-cm-diameter plastic PVC ring embedded in the soil. The plants are subjected to normal cultural practices and naturally occurring inoculum. During 1991, few plants died at either location and preliminary results are inconclusive. At one location, there was a significant difference ($P<0.005$) in percent plant survival based on 100 plants): Ben Lear - 98.0, Crowley - 98.0, McFarlin - 97.0, Pilgrim - 90.0, Searles - 98.0, and Stevens - 99.0. However, at the other location there was no significant difference ($P>0.750$) in plant survival: Ben Lear - 99.0, Crowley - 98.0, McFarlin - 100.0, Pilgrim - 99.0, Searles - 99.0, and Stevens - 99.0. In October 1992, plants will be evaluated for mortality and total shoot length of surviving plants will be measured.

_____*Phytophthora* spp. isolated from Wisconsin cranberry fields are pathogenic. Thus, it is important that effective disease management strategies be identified if the productivity of Wisconsin's cranberry industry is to be increased. An integrated approach to disease management--involving fungicides, host resistance, and cultural practices--should provide the most effective and consistent means for control.

LITERATURE CITED

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Table 1. Effect of fungicides on growth of cranberry (cv. Stevens) and infection by *Phytophthora* spp.

Fungicide efficacy parameter	Location	Treatment(y) Control	Fosetyl-A1	Metalaxyl	Oxadixyl	P[z]
Plants surviving (%)	1	86.7	81.0	93.5	88.6	CO.005
	2	98.0	98.5	96.9	97.9	>0.750
Shoot weight/plant (g)	1	0.656	0.751	0.773	0.701	0.648
	2	0.418	0.359	0.363	0.453	0.143
Plants infected with *Phytophthora* spp. (%)	1	10.8	11.8	0.0	2.6	<0.005
	2	17.0	13.3	0.5	5.7	<0.005

w. In June 1990, plots were established in an area of a bed where vines had died from disease. Each plot consisted of 20 rooted cranberry cuttings planted inside a 30-cm-diameter PVC ring embedded in soil. Treatments were replicated ten times in a randomized complete block design.

x. In October 1991, plants were collected and oven-dried weights of shoots were measured. Plants were assayed for infection by *Phytophthora* spp. by plating rooted stems onto a medium selective for *Phytophthora* spp. Values of percent plant survival and percent plant infection are based on approximately 200 plants. Values of shoot weights are the means of ten replicate plots.

y. Fungicides were applied monthly from June through October (five applications) in 1990 and from June through September (four applications) in 1991. Fosetyl-A1 was applied at a rate of 4 lbs/acre (5 lbs Aliette 80 WP/acre). Metalaxyl was applied at a rate of 1.75 lbs/acre (7 pints Ridomil 2E/acre). Oxadixyl was applied at a rate of 1.75 lbs/acre (7 lbs SAN-371 25 WP/acre).

z. Significance level. Plant survival and plant infection data were analyzed with a Chi-square test for independence. Shoot weight data were analyzed with analysis of variance.

Table 2. Effect of fungicides on yield, yield components, and productivity variables of cranberry (cv. Ben Lear)[w]

Yield and productivity variable [x]	Treatment[y]			
	Control	Fosetyl-A1	Metalaxyl	P[z]
Yield (g)	35.41	15.43	13.36	0.071
Number of uprights	248.0	205.6	226.6	0.403
Weight (g) of uprights	57.59	48.80	53.03	0.518
Individual upright weight (g)	0.23	0.24	0.23	0.845
Uprights flowering (%) (no. flowering uprights/no. uprights)	14.6 a	4.3 b	8.1 ab	0.016
Number of flowers/flowering upright	3.1 a	3.3 a	2.2 b	0.003
Number of flowers	119.5 a	32.4 b	48.9 b	0.015
Number of berries	29.2	13.4	11.6	0.077
Fruit set (%) (no. berries/no. flowers)	22.9	50.8	23.2	0.634
fruit retention (%) no. marketable berries/no. flowers)	18.6	24.8	18.8	0.934
Individual berry weight	1.57	1.06	1.18	0.195

w. In June 1990, plots (2 X 2 m) were established along the periphery of an area of a bed where vines had died from disease. Treatments were replicated eight times in a completely randomized design.

x. In October 1991 (before harvest), all upright shoots and fruit were removed from four 106-cm2 areas in the center portion of each plot. The four subsamples were combined to provide a single composite sample. Values are the means of eight replicate plots.

y. Fungicides were applied monthly from June through October (five applications) in 1990 and from June through September (four applications) in 1991. Fosetyl-A1 was applied at a rate of 4 lbs/acre (5 lbs Aliette 80 WP/acre). Metalaxyl was applied at a rate of 1.75 lbs/acre (7 pints Ridomil 2E/acre).

z. Significance level from an analysis of variance. Values in a row followed by the same letter do not differ significantly according to Fishers LSD (P=0.05).

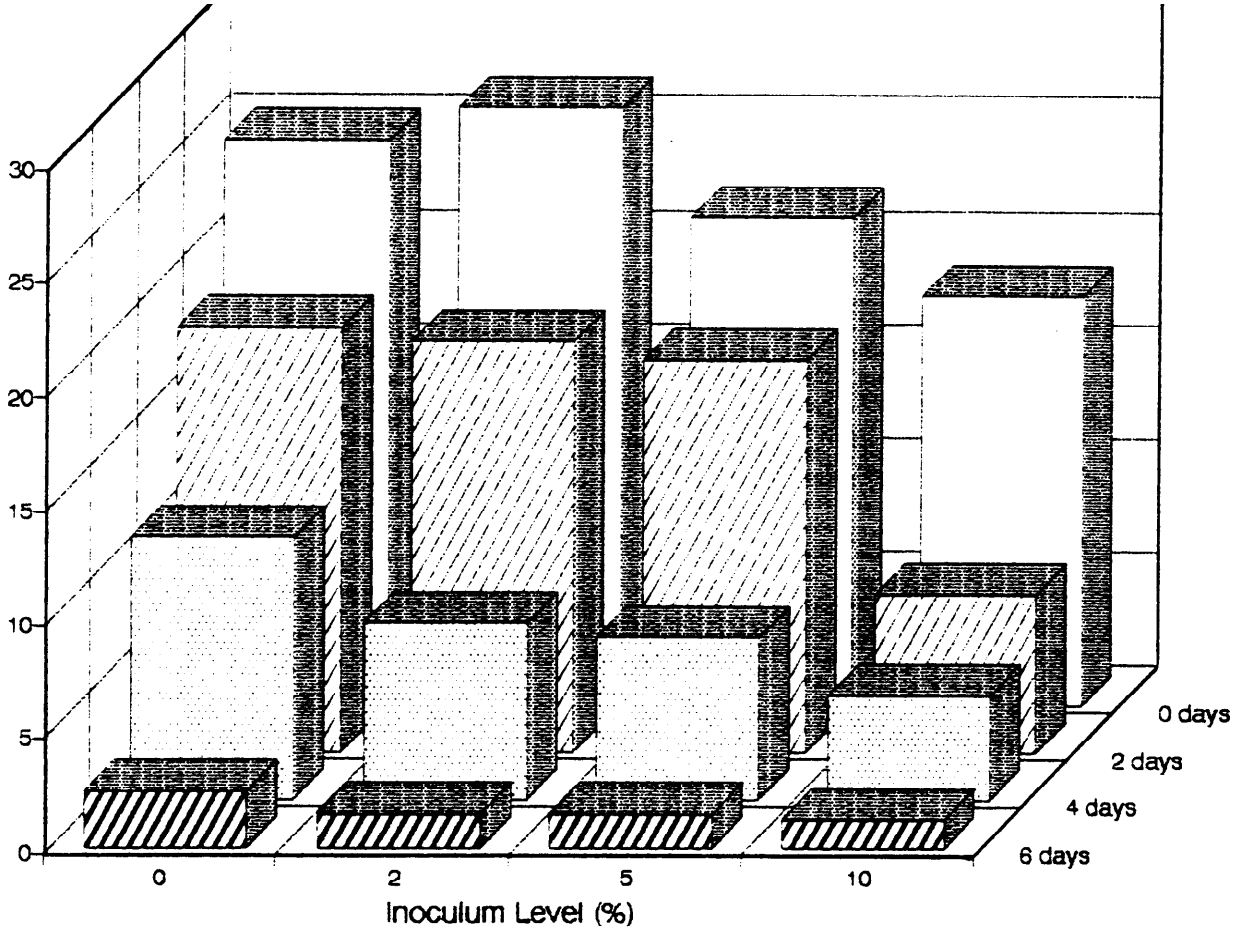

Figure 1. Influence of flooding on pathogenicity of *P. cryptogea* to cranberry (cv. Searles). Rooted cuttings, 5-6 weeks of age, were grown for 13 weeks and received four biweekly flooding periods. Data are the mean of eight replicate plants.

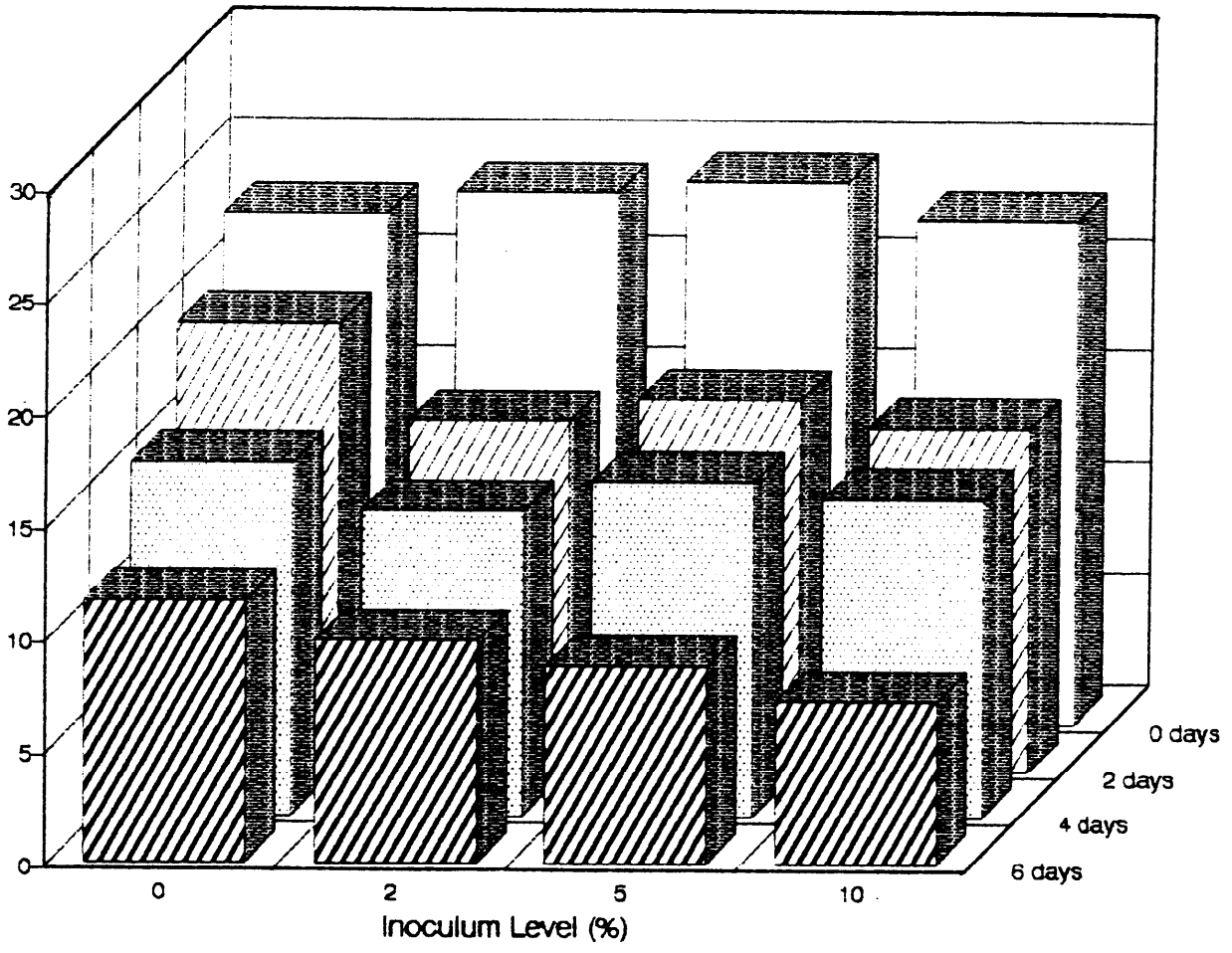

Figure 2. Influence of flooding on pathogenicity of *P. cyptogea* to cranberry (cv. Searles). Rooted cuttings, 19-21 weeks of age, were grown for 13 weeks and received four biweekly flooding periods. Data are the mean of eight replicate plants.

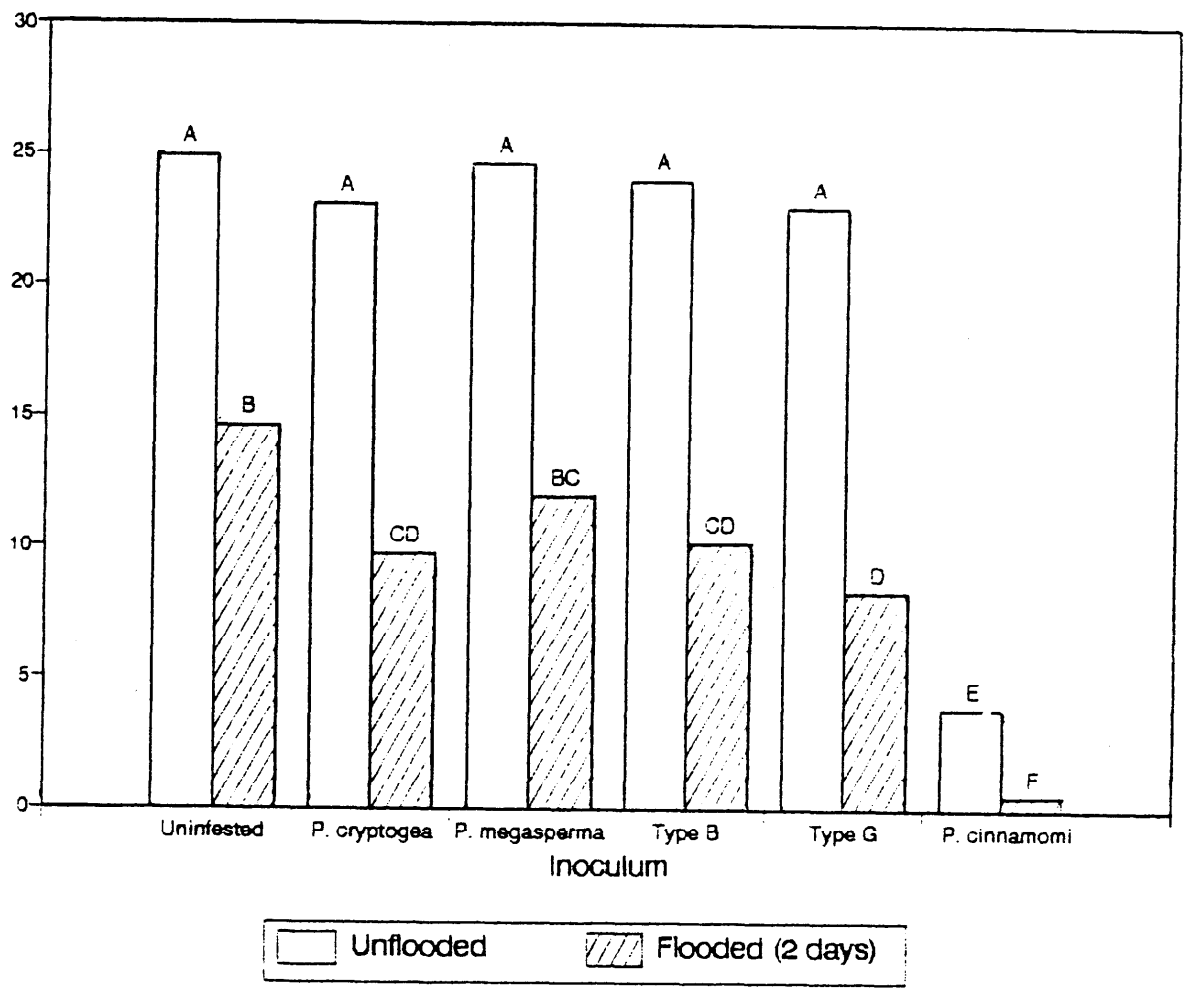

Figure 3. Relative virulence of *Phytophthora* spp. on cranberry (cv. Searles). Rooted cuttings, 7-8 weeks of age, were grown for 13 weeks and received four biweekly flooding periods. Data are the mean of ten replicate plants. Bars labeled with the same letter do not differ significantly according to Fishers LSD (P=0.05).