SUPPRESSIVE SOIL REDUCES CARNATION DISEASE[1]

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Fusarium wilt diseases caused by various specialized forms of the fungus *Fusarium oxysporum* Schlect. do not occur or are restricted in some field soils. These soils are designated Fusarium wilt-suppressive as contrasted to Fusarium wilt-conducive soils in which the disease readily develops. The wilt-suppressive soil used in this study was Chualar sandy loam obtained from a cultivated field near Soledad, California.

We began an initial experiment in May 1977, incorporating suppressive soil into a raised bench of steamed soil in a commercial carnation greenhouse. The grower had previously experienced severe plant losses to Fusarium wilt caused by *F. oxysporum f.* sp. *dianthi*. Eight liters of suppressive soil were spread over 3 square meters and incorporated into the top 10 to 15 centimeters (cm) of the 20-cm-deep benches. The amount added was about 1 percent on a volume basis. Both amended and nonamended comparison (control) plots were replicated five times.

Disease evaluations were begun 6 months after planting rooted cuttings of 'Tangerine Sim'. These were continued periodically until the planting was removed because it was no longer productive. Table 1 summarizes plant survival during this period.

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A second trial was begun in April 1978 at the University of California floriculture greenhouses in San Jose. Carnation soil from a commercial greenhouse was steamed, amended with suppressive soil at the rate of ½, 1, or 2 percent by volume, and then infested by adding soil containing the wilt pathogen.

Comparisons included a nonamended control and a treatment in which 1 percent of the local Yolo clay loam soil was used in lieu of the suppressive soil. Fusarium wilt diseases are known to occur in the local soil and it is therefore a wilt-conducive type. Two treatments were also included in which the soil was not infested with the pathogen after steaming. One of these was amended with

Table 1. Carnation Plant Survival in Amended and Nonamended Steamed Greenhouse Soil — Santa Clara County, 1977-78.

	Percent survival at following months after planting				
Treatment	6	7	8	11	12
Amended with Fusarium wilt-suppressive soil	97*	94	87	73	64
Not amended with suppressive soil	78*	62	42	25	19

*Means of five replications

1 percent suppressive soil and the other was not amended. All treatments were replicated four times.

Inoculum consisted of 25 milliliters of naturally infested soil (33×10^4 propagules per gram) spread on the surface of each 20.5- × 14- × 103-cm plant container. Rooted cuttings of 'Tangerine Sim' were planted seven per container (each of which was replication) and maintained according to typical commercial practices.

After 11 months, the entire planting was cut back to 20 cm, and the regrowth harvested June 26. There were no differences in dry weight of the surviving tops among the treatments with one exception: dry weight in the inoculated but nonamended soil was only 60 percent of that of the other treatments. This reflects the 50 percent mortality that occurred in this treatment.

Suppressive soil effectively reduced loss of carnations at all three concentrations (½, 1, and 2 percent by volume), and the local wilt-conducive soil did not (Table 2). However, amending the soil with suppressive soil where disease was not present (noninoculated) did not affect plant loss.

Table 2. Carnation Plant Survival in Treatments Amending Steamed Soil with Suppressive or Conducive Soil — San Jose, 1979.

Preplant Treatment	Rate (%)	Number of surviving plants*
Soil infested with Fusarium wilt pathogen:		
Suppressive soil	0.5	6.0 bc
Suppressive soil	1.0	6.0 bc
Suppressive soil	2.0	7.0 c
Conducive soil	1.0	4.8 ab
Nonamended check	—	3.5 a
Soil not infested with Fusarium wilt pathogen:		
Suppressive soil	1.0	6.5 bc
Nonamended check	—	6.3 bc

*Figures are means of four replications; those followed by the same letter are not significantly different at 95% confidence level.

It is common knowledge that disease resulting from the introduction of plant pathogenic organisms develops more rapidly and is generally more severe in steamed or chemically fumigated soil than in untreated soil. The suppressive agents in a soil are of a biological origin, since steaming and methyl bromide fumigation destroy the suppressive effects. Also, probably more than one organism causes the suppressiveness. S.N. Smith, Department of Plant Pathology, University of California, Berkeley, has recently shown that certain bacteria are responsible for part of the effect.

Additional trials are being conducted with wilt-suppressive soils in carnation plantings in various parts of the state.

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