EVIDENCE FOR THE DEVELOPMENT OF A "BIOLOGICAL VACUUM" IN SOIL FOLLOWING PRE-PLANT SOIL FUMIGATIONS OR DRENCHES

by
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Soil sterilization reduces soil microbe populations that are beneficial as well as those that are detrimental to plant growth. Following soil fumigation, plant parasitic nematode species can be reduced to nondetectable levels (1). Subsequently-planted trees or vines respond favorably to the treatment for at least these reasons: 1) The lack of soil pests, 2) The lack of microbes not usually considered as pests or disease incitants, and 3) These plants also exhibit an "increased growth response" (IGR) due to changes in nutrient availability (2). Participants in soil fumigations have occasionally observed a fourth phenomenon in that the first microbes that are reintroduced into fumigated soil develop greater abundance than if they were introduced into nonfumigated soil. These organisms appear to be filling a "biological vacuum" but since the treated vines or trees also grow many times faster than the nontreated it has been difficult to quantify the impact of a biological vacuum. In a separate paper at this conference an example involving Vapam was presented illustrating the importance of remnant roots as a protective habitat for endoparasitic nematodes and the ability of those nematodes to rebuild quickly within treated soil. In conducting those same experiments we inadvertently observed a "biological vacuum" effect in more quantifiable terms.

Six months before various tree and vine crops were replanted a variety of "softer" soil drench treatments were compared. Nematodes in the field included *Pratylenchus vulnus*, *Tylenchulus semipenetrans*, and *Paratylenchus hamatus*. The latter nematode is usually an ectoparasite but in a few crops including Dr. Huey Rose this nematode occurs as an endoparasite. In fact, the bareroot roses we planted to the field were contaminated with a low population level of *P. hamatus* at planting. A drench treatment of 366 kg/ha 1,3-D resulted in no plant parasitic nematodes on six of seven hosts. Six months after planting, however, a population of *P. hamatus* was present at threefold the level present in the nontreated sites when planted to rose. By contrast, the

nontreated sites had *P. hamatus*, *P. vulnus*, and *T. semipenetrans* across all seven crops. This threefold population increase over the nontreated also occurred after drenches of Vapam and Acrolein (see Table 1). By contrast, treatments of marigold tea plus urea resulted in *P. hamatus* populations on rose very similar to those of the nontreated, and very similar to those on the other crops planted. In this experiment the marigold and urea treatment provided tree and vine growth at slightly less than those treated with Acrolein, 1,3-D or Vapam. For tree and vine crops the existence of a biological vacuum carries two significant impacts. First, we should be learning how to add back or stimulate beneficial organisms after soil treatment. Secondly, treatments that might miss specific life stages of soil pests need to be evaluated for at least two growing years after treatment. The MIT and Acrolein treatments, for example, can be expected to result in very high populations of *P. vulnus* in the second year.

Literature Cited

1. California Agriculture. 1994. Vol. 38(3), pp. 22-28.

2. Phytopathology. 1979. Vol. 69(8), pp. 793-797.

Table 1. Plant biomass and nematode populations one full year after planting *P. hamatus* contaminated roses into infested soil that had received three conventional biocides compared to a "softer" treatment of marigold tea plus urea.

Soil Treatment	Plant Growth (g/plant)	Nematodes/250 cm^3 soil	
		P. hamatus	*P. vulnus*
1,3-D	1185 ns	742 a	0 a
MIT	1108	802 a	227 a
Acrolein	1068	743 a	81 a
Marigold Tea Plus Urea	779	243 b	295 a
Nontreated Control	969	204 b	1292 b

Variance of the means was analyzed and subjected to a T test. Means in each column followed by a different letter are significantly different from each other ($P < 0.05$).