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# THE RELATIONSHIP BETWEEN SOIL AMENDMENTS AND NEMATODES IN AN AVOCADO GROVE

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A new strategy for managing *Phytophthora* root rot of avocado is to promote soil conditions that suppress *Phytopthora cinnamomi.* Suppressive soils have high levels of calcium and organic matter and a reduced incidence of *Phytophthora* root rot. Applying a calcium source and an organic mulch to an avocado grove could simulate a suppressive soil and also benefit avocado production by conserving water, controlling weeds, and reducing nematode populations.

Practically nothing is known about nematodes in avocado groves. Yet these soil-inhabiting roundworms feed on roots, transmit plant viruses, contribute to organic-matter decomposition, and may indicate soil quality. Plant-parasitic nematodes may affect avocado root growth directly. Other nematodes than the plant-parasites (bacterivorous nematodes, fungivorous nematodes, and omnivorous nematodes) also may affect avocado ~ but indirectly, by feeding on the bacteria and fungi that break down organic mulches applied to a grove soil.

The present study was initiated as the nematode component of a long-term investigation implemented by Drs. John Menge and Howard Ohr at South Coast Field Station that is evaluating soil amendments as a new management practice for avocado production. Our goal is to determine how nematode biodiversity and abundance affects avocado growth and organic mulch decomposition in a young, 2-yr-old avocado grove. We are comparing the effects of an untreated control and a fungicide (Ridomil) with alfalfa hay and gypsum ($CaSO4$). We monitored tree canopy volume, fruit biomass, alfalfa hay decomposition, microbial activity, soil properties, and nematodes in an avocado grove throughout a six month period (early summer to late autumn).

Decomposition was monitored using 100 litterbags constructed of nylon window screen and filled with 10 g alfalfa hay (= 5 g leaves + 5 g stems). Twenty litterbags were assayed at initiation of the study. Eighty litterbags were placed in the grove and then retrieved and assayed on four dates throughout the study. Nematode biodiversity was assessed at the genus level of resolution, and nematode abundance was determined by feeding groups. Microbial activity of soil and litter samples was determined using the substrate induced respiration (SIR) method.

The results show important trends in tree growth among soil and mulch treatments (Figure 1). Trees with alfalfa were larger than the trees with other treatments, and trees with alfalfa plus gypsum produced more fruit The positive effect on fruit was observed on every sampling date throughout the study.

To determine how the addition of gypsum changed the decomposition of alfalfa, we compared the decomposition of alfalfa leaves and stems in the presence and absenceof gypsum (Figure 2). Gypsum seemed to increase the rate of alfalfa decomposition. Specifically, on day-14 the decomposition of alfalfa leaves was greater (p=0.1) when gypsum was present. Overall, alfalfa stems decomposed more slowly than the leaves, but on day-28 the decomposition of stems was greater (p=0.01) with gypsum. The early production of more fruit in the alfalfa + gypsum treatment may have been related to the more rapid mineralization of nutrients that occurs with more rapid decomposition.

We monitored the nematode community to determine how soil management practices affected the soil biota. Nematode biodiversity in the avocado grove included 29 genera (Table 2), the majority of which were bacterivorous and fungivorous nematodes contributing to organic-matter decomposition. In early summer (sampling day 0), numbers of these decomposer nematodes were similar in the control and Ridornil treatments (Figure 3), suggesting that decomposition with these soil treatments resulted from the equal contributions of bacteria and fungi. The addition of alfalfa mulch stimulated the decomposer nematodes, particularly the bacterivorous nematodes, a result implying that the addition of alfalfa mulch selectively enhanced bacterial activity. In contrast, the gypsum treatment appeared to stimulate the fungivorous nematodes, implying the selective stimulation of fungal activity. Interestingly, the plant-parasitic nematodes *Paratylenchus* and *Tylenchorhynchus* were also most abundant in the gypsum treatment. Plant-parasites were absent from the alfalfa treatments, where any biological control activity would be greatest

In late autumn (sampling day 177), nematode communities in the alfalfa treatments were dominated by bacterivorous nematodes, with fungivorous nematodes being less numerous than in early summer (Figure 4). Numbers of bacterivores and fungivores were about the same with the gypsum treatment, and this also differed from the early summer results. Overall, the data show that soil and alfalfa treatments changed nematode community structure from that community structure present with the control treatment, and the decomposition of alfalfa mulch was influenced more by bacterivorous nematodes than by fungivorous nematodes. The strong effect of gypsum on the nematode community was unexpected and warrants further investigation.

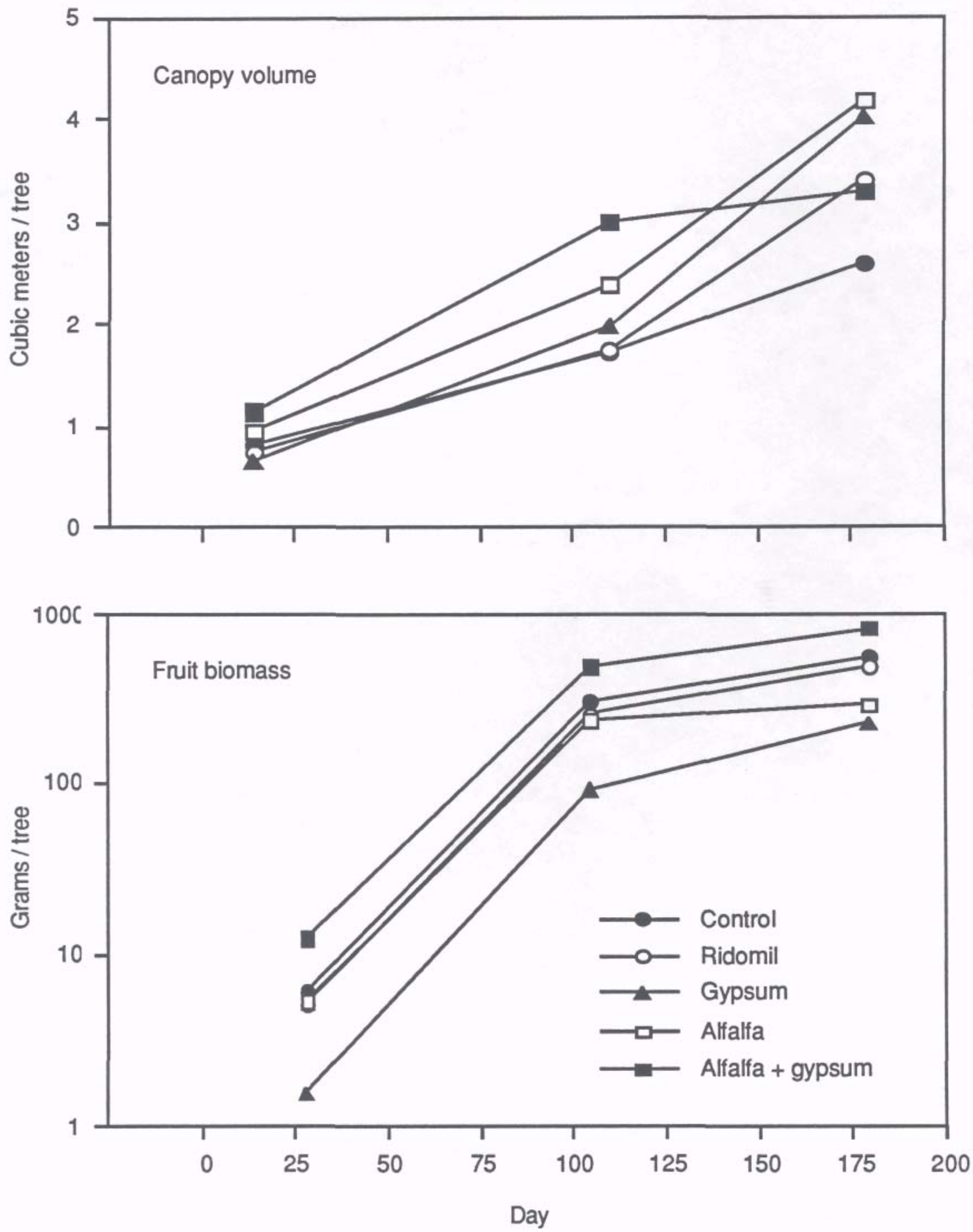


**Figure 1.** Effect of soil and mulch treatments on avocado tree growth and fruit biomass.

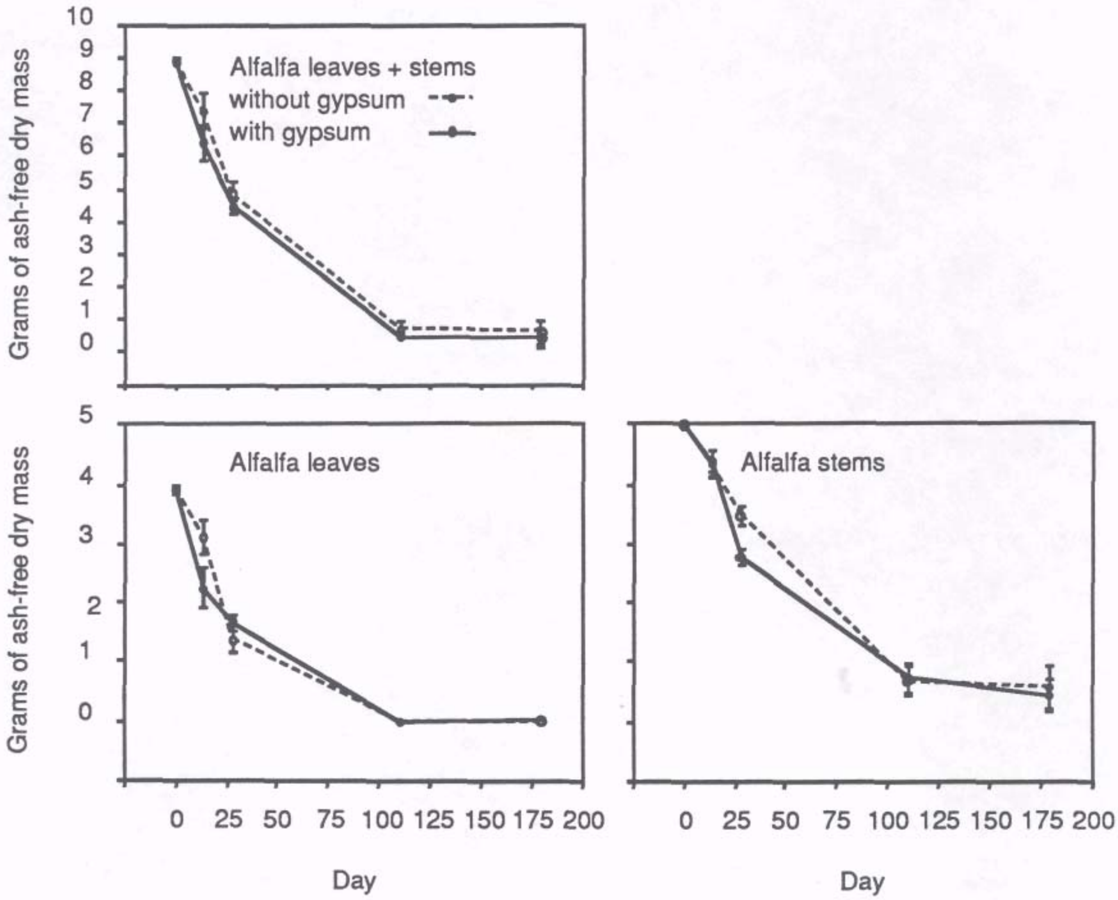


**Figure 2.** Decomposition of alfalfa leaves, stems, and hay (= leaves + stems) in the presence and absence of gypsum.

**Table 1.** T-test comparisons of mean alfalfa mass remaining on selected dates.

| Date* | Gypsum | n | Mass remaining (g) | t | p>t |
|---|---|---|---|---|---|
| | | | Alfalfa leaves | | |
| day-14 | absent | 10 | 3.11 | 1.890 | 0.078 |
| | present | 7 | 2.24 | | |
| | | | Alfalfa stems | | |
| day-28 | absent | 10 | 3.46 | 3.095 | 0.007 |
| | present | 9 | 2.77 | | |

*Alfalfa mass remaining on other dates did not differ in the presence or absence of gypsum.

**Table 2.** Nematode genera detected in an avocado grove at South Coast Field Station.

| Plant feeders | Bacterivores | Fungivores | Ominvores |
|---|---|---|---|
| *Paratylenchus* | *Acrobeles* | *Aphelenchoides* | *Dorylaimellus* |
| *Tylenchorhynchus* | *Acrobeloides* | *Aphelenchus* | *Ecumenicus* |
| | *Alaimus* | *Filenchus* | *Prismatolaimus* |
| | *Anaplectus* | *Lelenchus* | *Thonus* |
| | *Cephalobus* | *Tylencholaimellus* | |
| | *Chiloplacus* | *Tylencholaimus* | |
| | *Diploscapter* | *Tylenchus* | |
| | *Eucephalobus* | | |
| | *Geomonhystera* | | |
| | *Heterocephalobus* | | |
| | *Mesorhabditis* | | |
| | *Panagrolaimus* | | |
| | *Parasitorhabditis* | | |
| | *Pareudiplogaster* | | |
| | *Pelodera* | | |
| | *Ypsylonellus* | | |
| 2 genera | 16 genera | 7 genera | 4 genera |

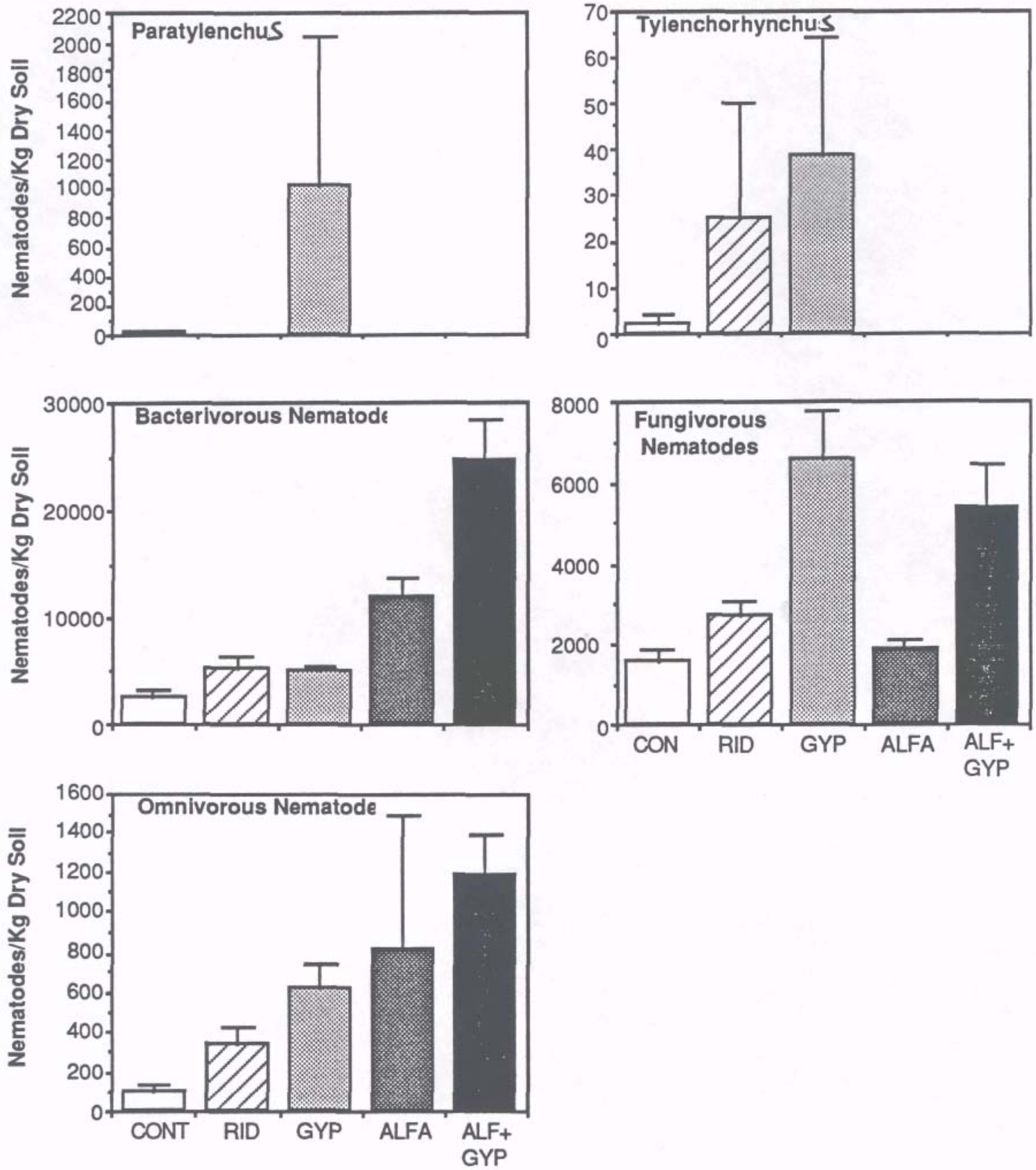


**Figure 3.** Nematode abundances with soil and alfalfa treatments in the early summer (sampling date 0).

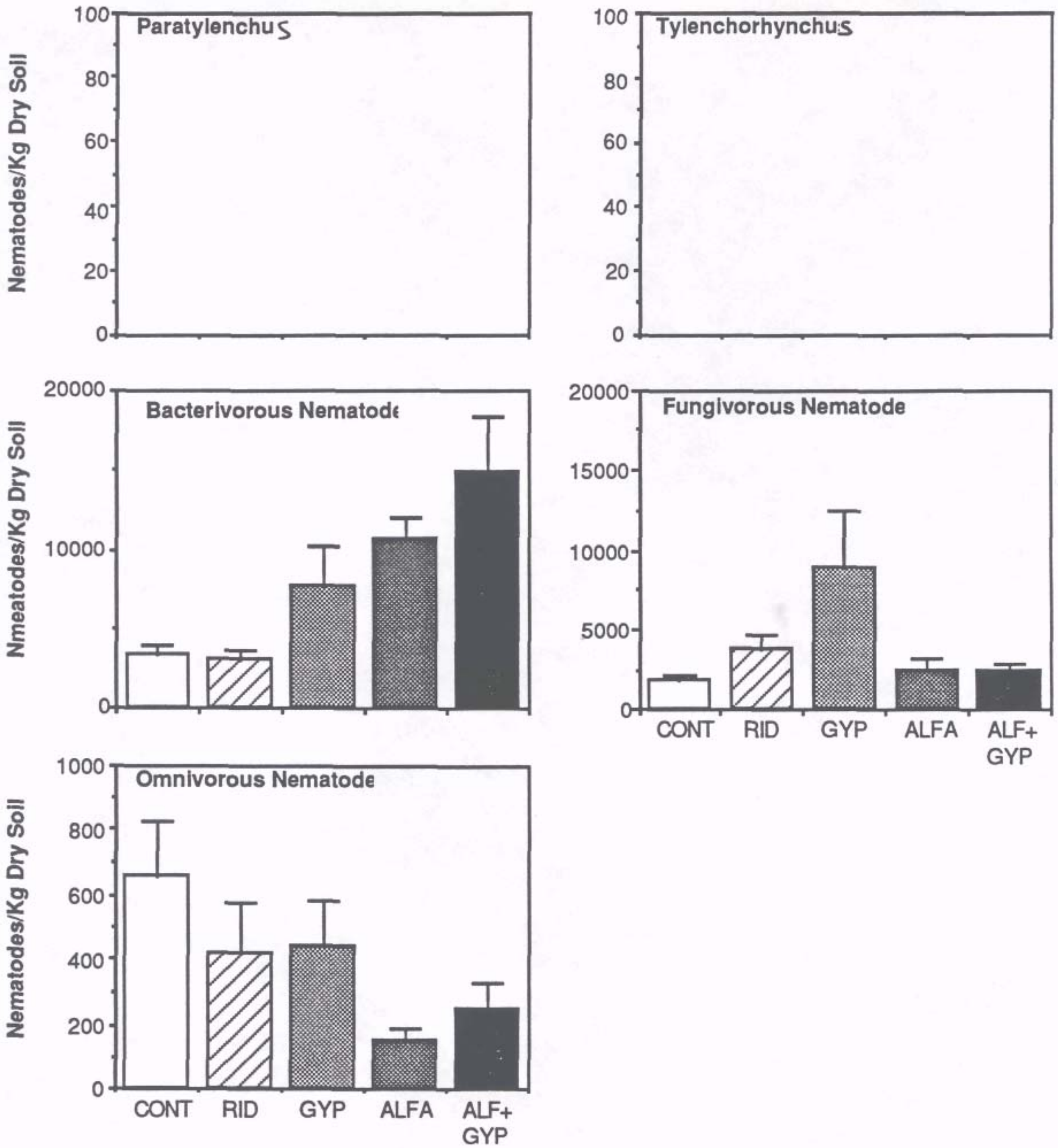


**Figure 4.** Nematode abundances with soil and alfalfa treatments in late autumn (sampling day 177).