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## **Pythiaceous Fungi and Plant-Parasitic Nematodes in California Pear Orchards**

### **I. Occurrence and Pathogenicity of Pythiaceous Fungi in Orchard Soils**

**Carl W. Nichols, S. M. Garnsey, R. L. Rackham,  
S. M. Gotan, and C. N. Mahannah**

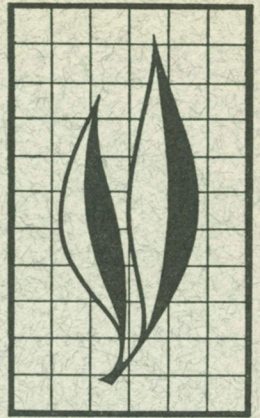
### **II. Incidence and Distribution of Parasitic Nematodes in Orchard Soils**

**Alex M. French, B. F. Lownsbery, S. M. Ayoub, A. C. Weiner,  
and N. El-Gholl**

### **III. Effect of Reduction of Nematode Populations by Soil Fumigation on Subsequent Growth of Pear Seedlings**

**B. F. Lownsbery, J. T. Mitchell, and S. M. Paracer**





### Pythiaceous Fungi and Plant-Parasitic Nematodes in California Pear Orchards

I. During a year's survey of 126 California pear orchards with varying degrees of pear-decline damage, a total of 3,586 isolates of soil-borne fungi of the genera *Phytophthora* and *Pythium* were recovered, and, where possible, identified as to species.

A direct relationship was found between the severity of pear-decline damage in an orchard and the percentage of isolates from the orchard that were *Pythium* spp.; and a corresponding inverse relationship between pear-decline damage severity and the percentage of isolates that were *Phytophthora* spp.

Isolates of *Phytophthora cactorum* and *P. cryptogea* were found to be pathogenic on *Pyrus communis* L. hort. var. Winter Nelis and *Pyrus serotina* Rehd. seedlings. These pathogens were found infrequently, and it was concluded that pythiaceous fungi were not the primary cause of pear decline.

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### III. Effect of Reduction of Nematode Populations by Soil Fumigation on Subsequent Growth of Pear Seedlings<sup>1</sup>

#### INTRODUCTION

PEARS ARE NOT very susceptible to disease induced by root-knot nematodes, *Meloidogyne* spp. (Day and Tufts, 1944; Tyler, 1944), or the root-lesion nematode *Pratylenchus vulnus* Sher and Allen (Day and Serr, 1951). However, a survey of California pear orchards (French *et al.*, pp. 603-610, this issue) showed that other kinds of plant-parasitic nematodes are commonly associated

with pears in this state. The pin nematode *Paratylenchus hamatus* Thorne and Allen, and spiral nematodes, *Helicotylenchus* spp., are frequently present in high population densities. The effect of these nematodes on pears has never been studied. The experiment reported here is a first step in determining this effect.

#### METHODS

Soil from pear root zones in each of six heavily nematode-infested (table 1) pear orchards was thoroughly mixed, and divided into two 10-gal. portions, which were put into 10-gal. cans. The soil in one of these cans was treated with ethylene dibromide (Dowfume W-85; 83 per cent 1,2-dibromoethane by wt.) at the rate of 1.5 ml per can (approx. 16 gal. per acre). A polyethylene cover was taped over the can to retain the fumigant. Ethylene dibromide was chosen because Aldrich and Martin (1952) reported it to have fewer chemical and microbiological effects, other than the nematicidal one, than some soil fumigants. The chosen dosage was one which we had previously found to be effective in reducing nematode populations when applied under the conditions

established here. A fumigation period of one week was used, after which the treated soil was aerated for another week. During this two-week period the untreated soil was stored in a cool place. Then, in May, 1962, *Pyrus communis* var. Bartlett and *P. serotina* (*P. pyrifolia*, an Oriental pear) seedlings about 8 cm tall were transplanted into 6-inch clay plots of the fumigated and the untreated soils. Pear seedlings planted in untreated soil were paired on lathhouse benches with the same kind of seedlings growing in fumigated soils from the same source. There were 10 replicates of each soil source, soil treatment, and pear-seedling combination. Soil temperature was uncontrolled except for the use in summer of a plastic screen

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over the lath, combined with an intermittent mist on hotter days to keep summer maximums in the 80–90°F range.

Five replicates were harvested after five months. The remaining five replicates were harvested after one year. Fresh weights for entire plants, with roots washed free of soil and blotted dry, were used as the criterion of

growth. Weights of plants grown in treated and in untreated soil were compared, using Student's *T* test (Paterson, 1939).

Nematode population levels in the soil were determined at planting time and at harvest times, with the use of a mist-extraction procedure (Lownsbery and Serr, 1963).

TABLE 1  
POPULATION LEVELS\* OF THE PRINCIPAL PLANT-PARASITIC NEMATODES  
IN THE SIX PEAR-ORCHARD SOILS UNDER STUDY BEFORE AND AFTER  
ONE YEAR'S GROWTH OF PEAR SEEDLINGS

| Source of soil        | Nematode   | Initial number<br>per 50 cc soil† |                  | Final number per 50 cc soil‡ |                  |                       |                  |
|-----------------------|--|-----------------------------------|------------------|------------------------------|------------------|-----------------------|------------------|
|                       |  | Untreated<br>soil                 | EDB-<br>treated‡ | <i>Pyrus communis</i>        |                  | <i>Pyrus serotina</i> |                  |
|                       |  |                                   |                  | Untreated<br>soil            | EDB-<br>treated‡ | Untreated<br>soil     | EDB-<br>treated‡ |
| Smith Flat, Calif.... | <i>Helicotylenchus</i> sp.§                          | 687 ± 188                         | 0 ± 0            | 370 ± 86                     | 0 ± 0            | 700 ± 372             | 2 ± 1            |
|                       | <i>Tylenchorhynchus brevidens</i>                    | 213 ± 52                          | 5 ± 5            | 655 ± 140                    | 0 ± 0            | 185 ± 96              | 0 ± 0            |
| Isleton, Calif.....   | <i>Paratylenchus hamatus</i>                         | 150 ± 37                          | 2 ± 1            | 390 ± 291                    | 259 ± 258        | 271 ± 123             | 772 ± 357        |
| Courtland, Calif..... | <i>Paratylenchus hamatus</i> ...                     | 75 ± 13                           | 2 ± 1            | 177 ± 75                     | 0 ± 0            | 358 ± 104             | 3091 ± 1942      |
| Courtland, Calif..... | <i>Helicotylenchus digonicus</i> and <i>H. sp.</i> § | 185 ± 30                          | 0 ± 0            | 285 ± 108                    | 0 ± 0            | 631 ± 371             | 0 ± 0            |
|                       | <i>Paratylenchus hamatus</i> ...                     | 45 ± 10                           | 1 ± 0.3          | 5 ± 4                        | 0 ± 0            | 192 ± 102             | 4 ± 4            |
| Lakeport, Calif.....  | <i>Paratylenchus hamatus</i> ...                     | 180 ± 62                          | 1 ± 0            | 0 ± 0                        | 0 ± 0            | 50 ± 19               | 6 ± 3            |
| Lakeport, Calif.....  | <i>Helicotylenchus digonicus</i>                     | 145 ± 26                          | 1 ± 1            | 230 ± 86                     | 0 ± 0            | 575 ± 121             | 0 ± 0            |
|                       | <i>Paratylenchus hamatus</i> ...                     | 55 ± 22                           | 2 ± 1            | 1 ± 1                        | 2 ± 2            | 75 ± 32               | 13 ± 4           |

\* Mean of 5 replicates and standard error of this mean.

† Recovered by one week's incubation under a heated intermittent mist.

‡ "Dowfume W 85" — 16 g/A.

§ An undescribed species of *Helicotylenchus*.

## RESULTS AND CONCLUSIONS

*Paratylenchus hamatus* Thorne and Allen, *Helicotylenchus digonicus* Perry, an undescribed species of *Helicotylenchus*, and *Tylenchorhynchus brevidens* Allen were present in these orchard soils. Fumigation with ethylene dibromide reduced the numbers of these nematodes in the treated soil (table 1). This reduction was maintained for the duration of the experiment for nine of the 12 comparisons (table 1).

Final weights of pear seedlings after one year's growth are given in table 2. Similar results were obtained for the replicates harvested after five months' growth. There were no highly significant differences between weights of

seedlings grown in fumigated and non-fumigated soils. One of the 12 differences was significant at the 5 per cent level.

We saw no qualitative differences (e.g., in leaf color, or root form) between pear seedlings grown in treated and in untreated soils. Because the principal effect of soil treatment was reduction in nematode population, we conclude that the nematodes present in these soils (table 1) did not limit the growth of *Pyrus communis* var. Bartlett, or *P. serotina* seedlings.

It is possible that *Paratylenchus hamatus* or *Helicotylenchus* spp. may limit pear growth under conditions



other than those which we provided. *Xiphinema americanum* Cobb, a virus vector (Fulton, 1962) which occurs in nearly all pear orchards, may be of importance. The present evidence, how-

ever, indicates that pears are less afflicted by nematode disease in California than are many other deciduous fruits (Lownsbury, Serr, and Hansen, 1959).

TABLE 2  
WEIGHTS OF PEAR SEEDLINGS\* AFTER ONE YEAR'S GROWTH IN ETHYLENE DIBROMIDE-TREATED† AND IN UNTREATED PEAR-ORCHARD SOILS

| Source of soil         | <i>Pyrus communis</i> var. Bartlett |           |                     | <i>Pyrus serotina</i> |           |                     |
|------------------------|-------------------------------------|-----------|---------------------|-----------------------|-----------|---------------------|
|                        | Soil treatment                      |           | LSD at the 1% level | Soil treatment        |           | LSD at the 1% level |
|                        | EDB-treated                         | Untreated |                     | EDB-treated           | Untreated |                     |
|                        | <i>gm</i>                           | <i>gm</i> |                     | <i>gm</i>             | <i>gm</i> |                     |
| Smith Flat, Calif..... | 41 ± 10                             | 28 ± 6    | 39                  | 52 ± 1                | 61 ± 4    | 15                  |
| Isleton, Calif.....    | 23 ± 4                              | 23 ± 2    | 15                  | 25 ± 4                | 31 ± 10   | 36                  |
| Courtland, Calif.....  | 40 ± 4                              | 28 ± 7    | 30                  | 49 ± 5                | 47 ± 6    | 26                  |
| Courtland, Calif.....  | 36 ± 5                              | 29 ± 5    | 24                  | 39 ± 16               | 52 ± 4    | 55                  |
| Lakeport, Calif.....   | 20 ± 7                              | 24 ± 5    | 29                  | 50 ± 11               | 70 ± 8    | 46                  |
| Lakeport, Calif.....   | 34 ± 5‡                             | 15 ± 4    | 21                  | 54 ± 4                | 43 ± 7    | 27                  |

\* Mean of 5 replicates and standard error of the mean.  
† "Dowfume W 85" — 16 g/A.  
‡ Significantly higher than the untreated at the 5% level (LSD = 15).

SUMMARY

When plant-parasitic nematode populations in pear orchard soils were reduced by fumigation with ethylene dibromide, the treatment resulted in no increase in growth of *Pyrus communis* var. Bartlett or *P. serotina* (Oriental pear) seedlings. The principal nematodes present in these soils were the pin nematode *Paratylenchus hamatus*

Thorne and Allen, the spiral nematode *Helicotylenchus digonicus* Perry, an undescribed species of *Helicotylenchus*, and the stunt nematode *Tylenchorhynchus brevidens* Allen. Therefore, no evidence was obtained to indicate a correlation between population density of these nematodes and pear vigor.

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Pear fruit and pear and apple seedlings trapped more *Pythium* spp. than the fruit of apple, lemon, and avocado, while few *Phytophthora* spp. were trapped in seedlings. *Phytophthora* spp. isolates were trapped most often in pear and apple fruit. Lemon and avocado fruit yielded a fair number of both genera.

II. Plant-parasitic nematodes of various types are prevalent in the upper root zone of pear trees in California. Monthly samplings over a 12-month period, from the same 126 orchards mentioned above, showed that the dagger nematode *Xiphinema americanum* and the pin nematode *Paratylenchus hamatus* occurred in more than 90 per cent of the orchards and in all pear-growing areas of the state. Other nematodes frequently found were species of *Tylenchorhynchus*, *Pratylenchus*, *Helicotylenchus*, *Meloidogyne*, and *Criconemoides*. No direct relationship was indicated between pear decline and nematodes in orchard soils.

III. Reduction of populations of pin nematodes, spiral nematodes, and stunt nematodes in orchard soil by fumigation with ethylene dibromide did not improve the growth of Bartlett or Oriental pear seedlings. The results suggest that these nematodes are not an important factor limiting growth of pears in California.



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