COOPERATIVE EXTENSION
UNIVERSITY OF CALIFORNIA

Date: July 7, 1978
To: Mr. David H. Chaney, Farm Advisor, Sutter/Yuba Counties

DAVIS, CALIFORNIA

From: W. H. Hart W. H. Hart
Title: Extension Nematologist
Address: UC Davis
Re: Your letter of 7/3/78 concerning northern black walnut and prune rootstocks as affected by the root lesion nematode, Pratylenchus vulnus.

It is difficult to compare the effects of a plant parasitic nematode on various hosts by a single criterium. Some excellent host plants (those in which the nematode reproduces freely) are injured severely. These we consider susceptible to the nema. Other plants may be excellent hosts but show little or no effects of the populations in their roots. These are considered tolerant. This situation may be further complicated by the methods of testing used, such as greenhouse or field, where soil populations of other possibly aggravating organisms would be different. Soil type and irrigation practice may also affect the results.

The rootstocks you listed -- northern California black walnut, Myro seedling, Myro 29C and Marianna 2624 -- are all excellent hosts of P. vulnus. A number of field trials have indicated that a significant growth response from preplant soil treatment can be achieved with most of these rootstocks. Greenhouse/lathhouse container tests with most of these rootstocks have shown that all are good hosts with reduced growth measurably less than similar plants grown without nematodes.

Lownsbery and Serr 1963 (see attached copy) state, "Because there appears to be no correlation between rootstock susceptibility to root-lesion disease and rootstock suitability as a host for P. vulnus, nematode counts from rootstocks grown in infested soil will not suffice to find rootstocks with which to avoid root-lesion disease. Disease symptoms should be used as the primary criteria."

Attached are copies of two reprints by B. F. Lownsbery, et al., which provide data and discuss the points mentioned above.

WHH:RG

PROCEEDINGS OF THE AMERICAN SOCIETY FOR HORTICULTURAL SCIENCE, Vol. 82, 1963.

Fruit and Nut Tree Rootstocks as Hosts for a Root-lesion Nematode, *Pratylenchus vulnus*[1]

By B. F. Lownsbery and E. F. Serr,[2] *Department of Nematology and Department of Pomology, University of California, Davis, California*

For best use of rootstocks in nematode infested soils it is necessary to know the rootstock's performance as a host of a parasite, as well as its reaction as a "suscept" (9) for the nematode pathogen. To do this one must rate rootstocks on two entirely separate scales. A host can be rated by the number of parasites it supports. A suscept is a plant in which disease can be produced, and it can be rated by the magnitude of disease symptoms resulting from interaction with a pathogen. A severely diseased plant would have a high rating as a suscept. Ratings on these two scales are not necessarily correlated. It is possible for a plant to be a host without being a suscept and vice-versa. In the search for rootstocks with which to avoid economic loss by nematode disease, those which are neither suscepts nor hosts are first choices. Where these are not available two less satisfactory kinds of rootstocks may be useful. The first of these are the hosts which are not suscepts. The second are the rootstocks which are entered and initially stunted by the nematodes, but eventually fail to support them (suscepts which are not hosts).

Serr and Day (7) and Day and Serr (1) have studied a large number of rootstocks in their roles as suscepts in the root-lesion disease caused or incited by *Pratylenchus vulnus* Allen and Jensen. Thus far we have not found a better method for studying this disease reaction than the fairly long-term orchard study method which they used. We have, however, improved our method for recovering *P. vulnus*, from soil and roots. Using this improved method we have attempted to classify some of these rootstocks in their other role, as hosts for *P. vulnus,* thus supplementing the information obtained by Day and Serr.

Methods

Three separate trials were made, all of 6 months duration, and all including *Juglans hindsii* (Northern California Black Walnut). A quantity of silt loam, naturally infested with *P. vulnus,* was thoroughly mixed for each trial. Plants were grown in a lathhouse in 3 gal cans (trials 1 and 3), or 6 inch pots (trial 2).

The population density of *P. vulnus* in the soil was determined at the beginning and end of the trials. After the soil was thoroughly mixed, 50 cc samples were placed on a tissue-covered rack in a funnel, under an intermittent mist of warmed tap water (Fig. 1). The time clock regulated mist was on 1.5 of each 10 min. The water

[1]Received for publication December 3, 1962.

[2]C. J. Alley, C. J. Hansen, H. T. Hartman, D. E. Kester, and K. Uriu kindly supplied some of the plant materials tested. J. T. Mitchell and S. M. Paracer gave technical assistance.

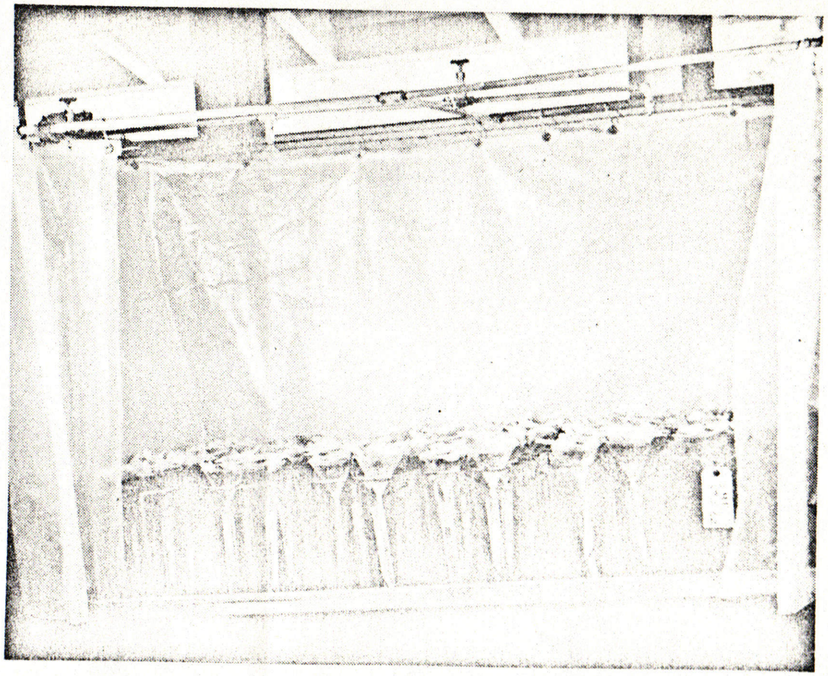

Fig. 1. Extraction of *Pratylenchus vulnus* from soil and root samples incubating under a heated, intermittent mist.

supply for the mist was kept at 140° F, and the temperature under the mist fluctuated about a mean of 72°. Nematodes were collected in 80 ml test tubes under the funnels. Tubing extensions on funnel stems delivered the nematodes to the bottoms of the test tubes. Tubes were allowed to overflow. Rate of overflow was insufficient to carry away nematodes. After 1 week's extraction 60 ml of the supernatant liquid in each test tube was drawn off by aspiration and the nematodes in an aliquot of the remaining 20 ml were counted.

At the end of each growing trial *P. vulnus* was recovered in a like manner from each root system, cut sufficiently to fit onto the racks in one or more funnels. Large diameter main roots were excluded. There were some differences in mean root caliper of the different rootstock species, resulting from differences in root form. A 2-week extraction period was used for the roots. The total number of *P. vulnus* recovered from each root system was added to the total calculated from the aliquot to be present in the soil. This total *P. vulnus* for each replicate was divided by root weight in g to obtain the final number of *P. vulnus* per g of root.

The mist recovery used here is an adaptation of a seed germination procedure used by D. R. Viglierchio. It differs from previously reported mist extractions (e.g. 5, 8) in the use of an intermittent, rather than a continuous mist of heated, rather than unheated water. The intermittent mist minimizes the problem of nematode loss by overflow, and the use of warm water produces a temperature in the funnels favorable for extraction. An advantage of any mist extraction is the dissipation of materials toxic to nematodes arising from roots and associated microorganisms.

Results and Conclusions

Final numbers of *P. vulnus* per replicate were significantly higher (Student's "T" test) for all rootstocks than for the corresponding fallow treatments (Table 1). This indicates that all rootstocks tested are hosts for *P. vulnus*. Because of high variability in the results, it is not possible to rank the rootstocks precisely as to suitability as hosts for this nematode. It is possible, however, to distinguish some of the best hosts (Tables 1 and 2)—these include Chinese wingnut, *Pterocarya stenoptera*, and Paradox hybrids, *Juglans hindsii* × *J. regia*.

Serr and Day (7) and Day and Serr (1) noted vigorous growth and little or no lesion formation on Chinese wingnut and Paradox hybrid in orchards in which adjacent Northern California Black

Table 1.—Numbers of *Pratylenchus vulnus* per container[a] before and after 4 months' growth of different rootstocks, or fallow.

Trial 1	
Initial number	4853 ± 767
Final number	
Juglans hindsii	96150 ± 25888 X[b]
Juglans rupestris	256768 ± 64464 X
Juglans hindsii x *J. regia*-Paradox hybrid (Gatgens selection)	211464 ± 63750 X
Juglans hindsii x *J. regia*-Paradox hybrid (Boyce selection)	170668 ± 64777 X
Juglans regia-Manregian (O.P. seedlings of P. I. 18256)	246827 ± 32339 X
Trial 2	
Initial number	1088 ± 170
Final number	
Ficus carica—fig, var. Kadota	35731 ± 8167 X
Juglans hindsii	15357 ± 4484 Y
Prunus persica—peach, var. S37	9532 ± 3565 YZ
Prunus amygdalus—almond, var. Texas	6410 ± 2200 YZ
Pyrus ussuriensis—Oriental pear	4007 ± 638 Z
Prunus avium—cherry, var. Mazzard	2884 ± 744 Z
Olea europaea—olive, var. Verdale	2197 ± 1057 Z
Vitis vinifera—grape, var. Thompson seedless	1560 ± 896 Z
Pyrus serotina—sand pear	752 ± 317 Z
fallow	80 ± 42 Z
Trial 3	
Initial number	4320 ± 398
Final number	
Pterocarya stenoptera—Chinese wingnut	504440 ± 86800 X
Prunus armeniaca—apricot, var. Royal	346535 ± 88900 XY
Juglans hindsii	280178 ± 122200 Y
Juglans major	243420 ± 48230 Y
Prunus cerasus—cherry, var. Stockton Morello	200684 ± 65700 YZ
Cydonia oblonga—quince, var. Angiers	180160 ± 47915 YZ
Prunus persica—peach, var. Lovell	170192 ± 79550 YZ
Prunus cerasifera x *P. munsoniana*—plum, var. Marianna 2624	152400 ± 54700 YZ
Pyrus communis—pear, var. Bartlett	140064 ± 100450 YZ
Juglans nigra x *J. hindsii*—Royal hybrid walnut	120770 ± 28306 YZ
Prunus cerasifera—plum, var. Myrobalan 29C	89688 ± 23655 Z
Malus sylvestris—apple, var. not known	71446 ± 23350 Z
fallow	282 ± 141 Z

[a]Mean and standard error of the mean. Trials 1 and 3: 5 replicates in 3 gal cans. Trial 2: 6 replicates in 6-inch pots.
[b]Means not followed by the same letter are significantly different at the 1% level. Duncan's Multiple Range Test.

Table 2.—Numbers of *Pratylenchus vulnus*[a] per g of root after 4 months' growth of different rootstocks.

Trial 1	
Juglans hindsii	5230 ± 1853 X[b]
Juglans rupestris	10096 ± 3184 X
Juglans hindsii x *J. regia*—Gatgens selection	7644 ± 2621 X
Juglans hindsii x J. regia—Boyce selection	7848 ± 3868 X
Juglans regia—Manregian (O. P. seedlings of P.I. 18256)	11993 ± 1953 X
Trial 2	
Ficus carica—fig. var. Kadota	1371 ± 284 X
Juglans hindsii	1229 ± 556 XY
Pyrus ussuriensis	713 ± 444 XYZ
Prunus amygdalus—almond, var. Texas	534 ± 198 XYZ
Prunus persica—peach, var. S37	357 ± 142 YZ
Olea europaea—olive, var. Verdalion	166 ± 96 YZ
Pyrus serotina—sand pear	124 ± 62 YZ
Prunus avium—cherry, var. Mazzard	120 ± 21 YZ
Vitis vinifera—grape, var. Thompson seedless	34 ± 20 Z
Trial 3	
Prunus cerasifera x *P. munsoniana*—plum (Marianna 2624)	6427 ± 3288 X
Pterocarya stenoptera—Chinese wingnut	6377 ± 555 XY
Prunus armeniaca—apricot, var. Royal	5033 ± 1583 Y
Pyrus communis—pear, var. Bartlett	4000 ± 1741 Y
Juglans major	3582 ± 495 Y
Juglans hindsii	3386 ± 1391 Y
Prunus cerasus—cherry, var. Stockton Morello	2209 ± 784 YZ
Malus sylvestris—apple, var. not known	1598 ± 542 YZ
Cydonia oblonga—quince, var. Angiers	1355 ± 252 YZ
Juglans nigra x *J. hindsii*—Royal hybrid walnut	1186 ± 416 YZ
Prunus persica—peach, var. Lovell	1050 ± 604 Z
Prunus cerasifera—plum, var. Myrobalan 29C	599 ± 170 Z

[a]See footnote Table 1.
[b]See footnote Table 1.

Walnut, *Juglans hindsii*, was seriously affected by root-lesion disease. Since that time considerable lesion formation has been noted on Paradox hybrid, and we have seen growth response of this rootstock to preplanting soil fumigation (4). Little or no lesion formation or stunting has been observed on Chinese wingnut. We now believe that *J. hindsii* is more susceptible than Paradox hybrid to root-lesion disease, and that Paradox hybrid is more susceptible than Chinese wingnut. Considering all the evidence now available it appears that rootstock susceptibility to root-lesion disease is not closely related to rootstock suitability as a host for *P. vulnus*. Seinhorst (6) reported a similar lack of correlation between disease susceptibility and suitability as a host for plants attacked by *P. penetrans*. Dropkin and Nelson (2) categorize plants as tolerant, resistant, susceptible, or intolerant depending on the growth of the plants and the growth of their nematode parasites. These categories would rate as follows as suscepts and hosts:

Dropkin and Nelson category	Rating as suscept	Rating as host
tolerant	low	high
resistant	low	low
susceptible	high	high
intolerant	high	low

Apparently *J. hindsii* is susceptible, Paradox hybrids range between susceptible and tolerant, and Chinese wingnut is tolerant. We do not have sufficient information to select rootstocks resistant to or intolerant of *P. vulnus* with certainty.

It is possible that differences in rootstock reaction to secondary aggravating organisms may also be involved in differences in root-lesion disease reaction. There is evidence that *P. vulnus* is required for production of the root-lesion disease of walnuts (3, 4), but the role played by aggravating organisms has not been studied.

Because there appears to be no correlation between rootstock susceptibility to root-lesion disease and rootstock suitability as a host for *P. vulnus*, nematode counts from rootstocks grown in infested soil will not suffice to find rootstocks with which to avoid root-lesion disease. Disease symptoms should be used as the primary criteria.

Summary

Twenty-four rootstocks, including stocks for walnut, almond, peach, apricot, plum, cherry, apple, pear, quince, fig, olive and grape, were tested for suitability as hosts for the root-lesion nematode, *Pratylenchus vulnus*. All rootstocks were hosts for this nematode. Among the better hosts were Chinese wingnut, *Pterocarya stenoptera,* not susceptible to root-lesion disease, and Paradox hybrids, *Juglans hindsii* × *J. regia,* with reduced susceptibility. Therefore, these rootstocks can best be described as tolerant. Because of the lack of correlation between rootstock suitability as a host for *P. vulnus* and rootstock susceptibility to root-lesion disease, disease symptoms, rather than nematode counts, will serve as the better criteria in a search for rootstocks with which to avoid root-lesion disease.

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see p. 635

PLANT-PARASITIC NEMATODES IN CALIFORNIA PRUNE ORCHARDS

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Supported in part by a grant from the California Prune Advisory Board.

ABSTRACT

Ninety-seven prune orchards, in the four prune-growing districts of California, were sampled. Pin nematodes, Paratylenchus spp., were found in 67% of these orchards; P. neoamblycephalus was the most common species. The dagger nematode, Xiphinema americanum, was found in 62%; ring nematodes, Criconemoides spp., with C. xenoplax the most frequent, in 38%; and the root-lesion nematode, Pratylenchus vulnus, in 7%. Some regional differences in species composition of nematode populations were noted.

Plant Dis. Reptr. 58: 633-636.

Over 90% of the prunes (Prunus domestica) in the United States are grown on about 2500 farms in four districts (Fig. 1) in California (8, 9, 11). Estimates made in 1972 (11) indicated that 57% of the acreage was in the Sacramento Valley, and 12% was in Napa and Sonoma counties.

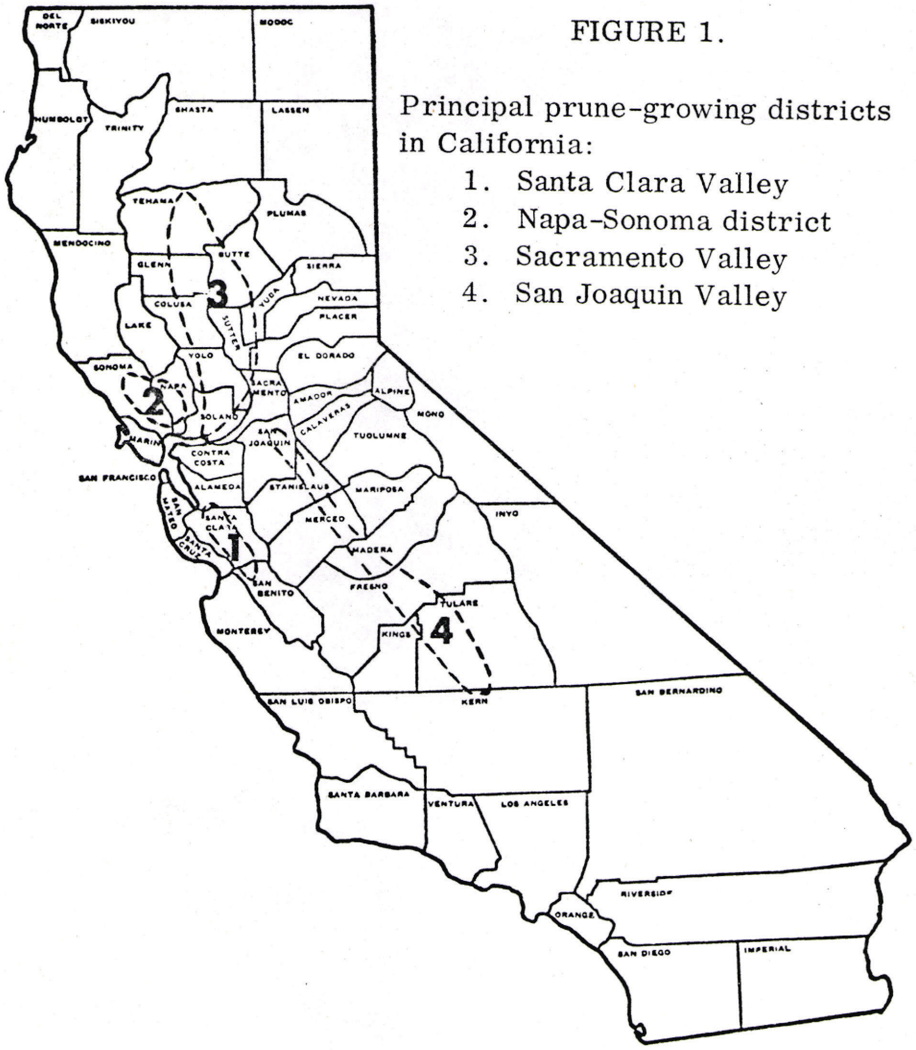

FIGURE 1.

Principal prune-growing districts in California:
1. Santa Clara Valley
2. Napa-Sonoma district
3. Sacramento Valley
4. San Joaquin Valley

Because of loss of land to urbanization, the Santa Clara Valley, once the most important prune-growing region, accounted for only 16%. Eight percent was in the San Joaquin Valley, largely in Tulare County.

As a first step in assessing the possible importance of plant-parasitic nematodes to prune growers, we sampled 97 orchards: 18 in the Santa Clara Valley, 14 in the Napa-Sonoma district, 55 in the Sacramento Valley, and 10 in the San Joaquin Valley. Soil and prune roots were collected between the 1- and 2-foot depths. Nematodes were recovered from the soil by the sieving and gravity method (1), often supplemented by other methods (4, 7), and from roots by incubation under mist (7).

The most commonly encountered plant-parasitic nematodes were the ectoparasitic *Paratylenchus* spp., found in 67% of all the orchards, and especially abundant in the Santa Clara Valley and the Napa-Sonoma district (Table 1). *P. neoamblycephalus* Geraert was the most common species overall, but *P. hamatus* Thorne & Allen was also common in the Sacramento Valley. Many of the unidentified *Paratylenchus* species may also have been *P. neoamblycephalus* or *P. hamatus*. In a few instances longer-speared species were seen. Pin nematodes were often recovered at the rate of four or more per cubic centimeter of soil.

Xiphinema americanum Cobb was found in 62% of the orchards. This nematode, a vector for ringspot viruses (12), is associated with a wide variety of crop and noncrop plants, including grasses (12).

Criconemoides spp. occurred in 38% of the orchards sampled and, like the pin nematodes, were sometimes present in large numbers. The species most often identified was *C. xenoplax* Raski, but *C. mutabilis* Taylor was found occasionally in the Sacramento Valley.

Table 1. Occurrence of plant-parasitic nematodes in prune orchards in the prune-growing districts of California.

Nematode	Percent of sampled orchards infested: Santa Clara Valley	Napa-Sonoma	Sacramento Valley	San Joaquin Valley
Criconemoides mutabilis	0	0	4	10
C. xenoplax	11	36	20	10
C. sp.[a]	61	14	4	0
Helicotylenchus digonicus	0	0	4	0
H. dihystera	0	0	2	0
H. sp.[a]	0	0	2	0
Hemicycliophora sp.	0	0	2	0
Meloidogyne javanica	0	0	2	0
M. sp.[a]	0	7	2	10
Paralongidorus sp.[a]	0	0	2	0
Paratylenchus hamatus	0	0	18	0
P. neoamblycephalus	33	7	15	10
P. sp.[a]	57	80	22	60
Pratylenchus vulnus	0	0	11	10
Trichodorus sp.[a]	0	0	4	0
Xiphinema americanum	17	100	60	90
No plant-parasitic nematodes recovered	17	0	5	10

[a]Species not identified.

The root-lesion nematode, Pratylenchus vulnus Allen & Jensen, was found both in the soil and in prune roots in the Sacramento and San Joaquin valleys. The two prevalent prune rootstocks in California, Myrobalan 29 C and Marianna 2624, are hosts for P. vulnus (7), and are susceptible to root-lesion disease. P. vulnus is most widely distributed in California on walnuts (5), and has been associated with diseases of many perennial fruit, nut, and ornamental crops (12).

Spiral nematodes, Helicotylenchus spp., were found only infrequently in the prune orchards. Helicotylenchus digonicus Perry is known to parasitize both grass (10) and pears (6), and H. dihystera (Cobb) Sher parasitizes a variety of woody and nonwoody plants (12).

Root-knot nematodes, Meloidogyne javanica (Treub) Chitwood and Meloidogyne sp., were seldom observed. In one instance, however, an unidentified prune rootstock was galled by M. javanica. Myrobalan 29 C and Marianna 2624 are immune to root-knot nematodes (3). Other Myrobalans and peach, used occasionally as prune rootstocks, are hosts for some root-knot nematodes (2).

Grass and weeds were present in many of the orchards sampled. These plants are believed to be hosts for Merlinius brevidens (Allen) Siddiqi, Pratylenchus minyus Sher & Allen, and P. thornei Sher & Allen, found in the samples but not included in Table 1.

The pathogenicity of pin nematodes, ring nematodes, and root-lesion nematodes to prunes is being studied presently.

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FUNGICIDES FOR THE CONTROL OF TARGET LEAFSPOT, SOIL ROT, AND POWDERY MILDEW OF CUCUMBER

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ABSTRACT

Benomyl applied weekly to cucumber foliage gave excellent control of target leafspot (Corynespora cassiicola), a disease that was rather difficult to control with chlorothalonil or zinc + maneb. Sodium azide appeared promising for the control of soil rot (Rhizoctonia solani) and combinations of azide with benomyl or with chlorothalonil resulted in excellent control of the disease. Both chlorothalonil and zinc + maneb gave satisfactory control of powdery mildew (Erysiphe cichoracearum), although the disease appears infrequently in Florida and is of little consequence.

Plant Dis. Reptr. 58: 636-639.

For many years downy mildew, Pseudoperonospora cubensis (Berk. & Curt.) Rostow., was the most common and destructive cucumber disease in Florida. With the introduction and wide use of the downy mildew-resistant variety Ashley, however, anthracnose, Colletotrichum lagenarium (Pass.) Ell. & Halst., became the most prevalent foliage disease and caused considerable damage. Then the Poinsett variety was released that was resistant to downy mildew, powdery mildew, Erysiphe cichoracearum DC., anthracnose, and angular leaf spot,