

TABLE 2. Inarched declining pear trees had trunks as large as normal trees with no decline symptoms; however, declining trees not inarched were significantly reduced in trunk size.

Fall leaf color	Number of trees	Trunk circumference (inches)
Normal	467	13.07
Red (trees inarched)*	225	13.04
Red (trees not inarched)*	121	11.52
Difference required for significance	5%	.33
	1%	.44

\* Representative bark samples from these trees had phloem necrosis at the bud union.

expected yield increase due to the 28-year-old inarches was .8 ton in 1962, more than adequate to cover the costs of inarching. Due to less severe decline ratings in 1963, the expected yield increase due to inarching was .5 ton per acre. This orchard has a low incidence of decline; however, if the rate of decline increases it would be expected that the inarched trees would be less severely affected, and the cost of inarching could be paid for over a shorter period of years.

### Trunk growth

Trunk circumference measurements of 811 five-year-old pear trees in Sutter County showed that declining trees responded to inarched domestic French seedlings. Three-year-old pear trees with pear decline symptoms the previous spring (including red leaves and plugged conductive tissue at the bud union, on microscopic examination), were inarched with three domestic French seedlings per tree in the spring of 1962.

In the fall of 1963, randomly scattered inarched trees with decline symptoms had trunk circumference measurements nearly identical to the trees with no decline. Randomly scattered trees showing decline symptoms in the fall of 1962 without inarching, averaged approximately 1.5 inches smaller in trunk circumference than either the normal or inarched declining trees (see table 2). It appears that the inarches not only saved the young trees, but sustained normal trunk growth.

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Stubby root nematode infestation was major factor in stunted growth of immature onions to left with leaves less than 5 inches in length, as compared with leaves over 10 inches long on onions from nematode-free soil seen to right in photo above.

## Nematocides Increase Onion Yields

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THESE TESTS BEGAN in August 1961 with a field of severely stunted onions found near Hesperia, San Bernardino County. In approximately 20% of this field, the onions were immature and leaves were less than 5 inches in length. Healthy leaves were 10 inches or more in length, as shown in the photo.

Close-up of roots of these onions shows severe stunting, swollen tips with numerous branches, and a yellowish brown discoloration. Soil in the root zone of the stunted onions contained 2,000 or more stubby root nematodes per pint. Soil in the root zone of healthy plants contained an average of 44 stubby root nematodes per pint.

### Greenhouse test

Soil samples from the highly infested areas were taken into the greenhouse for pathogenicity tests. The soil was screened and half of it was exposed to the sun in a 1-inch layer for two days. The other half was stored in a large container to prevent drying and heating. After "treatment," both soils were placed in 6-inch pots and seeded to Yellow Globe onions.

At the time of potting, the soils were sampled for nematodes. Soil exposed to the sun contained no nematodes, while the nontreated soil had approximately 190 stubby root nematodes per pint. No other plant parasitic nematodes were present in these samples.

After a 90-day growing period in the greenhouse, the onions from both treatments were harvested and weighed. The soil containing no nematodes produced onions twice the dry weight of those grown in the nematode-infested soil. Roots of onions from nematode-infested soil were severely stunted, as shown in close-up of roots. The treated soil contained no nematodes at the end of 90 days. The nontreated soil had approximately the same number of nematodes as when the onions were first seeded.

### 1962 field trials

In March 1962, a fumigation trial for nematode control in onions was established in cooperation with August Realton, an onion grower near Adelanto, in the Mojave River basin. This plot was established in a field previously cropped to alfalfa for 20 years. A nematode survey showed that both the stubby root and root knot nematode were present. Experimental design consisted of 12 paired plots, each 12 x 100 ft in size. Telone at the rate of 20 gallons per acre, was injected at a depth of 8 inches on 12-inch centers for comparison with untreated check plots. The soil was cultipacked immediately after applying the nematocide. Considerable plant residue in the soil made fumigation difficult in this test and may have impaired the efficiency of the Telone. Sweet Spanish onions were seeded in these plots March 15, 1962.

Production was increased by 30 to 50% in nematocide trials where onion fields were infested with nematodes in San Bernardino County. Preliminary greenhouse tests indicated that stubby root nematode had been one of the main factors in reducing onion yields.

Soil samples were taken on April 25 from the treated and untreated plots to check for nematode populations. Samples from the untreated plots contained an average of 55 stubby root nematodes per pint of soil. This number increased to 282 by May 21, and did not change greatly thereafter. Soil temperatures were taken during the entire growing season and found to be below the range reported as most favorable for reproduction of stubby root nematode.

Dry onion yields increased from 48,199 pounds per acre in the nontreated soil to 66,032 pounds per acre in the nematocide-treated soil (table 1). This difference was highly significant at the 1% level.

### 1963 field trial

A second experimental nematode control plot was established again in cooperation with August Reallon on the Golden Lands farm near Hesperia, in soils that had been previously planted to alfalfa. This soil contained stubby root, root knot, and root lesion nematodes.

TABLE 1. DRY ONION YIELDS FROM TELONE-TREATED AND NON-TREATED PLOTS, 1962, 1963.

Treatment	Dosage Gal/acre	Yield in lbs/acre <sup>a</sup>	
		1962 Adelanto	1963 Hesperia
None	—	48,199	45,060 <sup>b</sup>
Telone	15	—	54,113
Telone	20	66,032**	59,490
Telone	25	—	60,402

<sup>a</sup> 1962: Onions grown for 6 months, yields obtained from one row 60 feet long, rows on 32-inch centers.

1963: Onions grown for 6 months, yields obtained from two rows 60 feet long, rows on 32-inch centers.

<sup>b</sup> Linear increase in yield with increase in dosage of soil fumigant significant at the 0.01 level.

\*\* Difference significant at the 0.01 level.

TABLE 2. NEMATODES RECOVERED FROM ONE PINT OF SOIL, HESPERIA PLOT, 1963

Treatment	T. christiei			M. hapla			P. scribneri		
	4/29	7/1	8/15	4/29	7/1	8/15	4/29	7/1	8/15
None	51	45	218	96	0	81	62	18	86
Telone—15 gpa	7	55	88	24	1	14	35	10	39
Telone—20 gpa	5	32	43	1	0	4	21	3	24
Telone—25 gpa	1	11	33	0	0	1	10	3	12

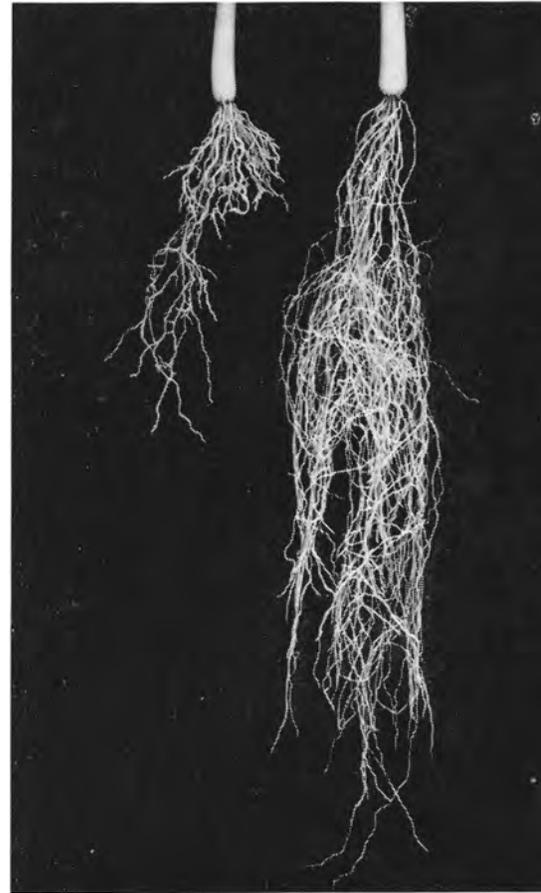
Telone (application similar to 1962 plot) was applied on February 27, 1963, at dosages of 15, 20, and 25 gallons per acre to plots 12 x 60 ft in size, and replicated six times. Sweet Spanish onions were planted on March 11, 1963.

Soil samples taken from the treated areas showed good nematode control when compared with the checks. Nematode populations increased during most of the growing season, as shown in table 2.

Yields increased 9,053, 14,430, and 15,342 lbs per acre following treatment with 15, 20, and 25 gallons per acre of Telone, respectively. The trend for increased yields, as nematocide dosages were increased, was significant at the 1% level. The increase in yield resulting from treatment with 20 gallons per acre of Telone over that treated at 15 gallons per acre was highly profitable at both low and high market prices for onions; whereas, that between 20 and 25 gallons per acre was profitable only during high market values.

The three nematodes mentioned in the 1963 tests have been reported as being pathogenic to onions. However, the authors believe the stubby root nematode was the main reason for the stunted growth. The characteristic stunting of the roots, unnatural branching, and swollen and discolored root tips found in most of the untreated plots, add support for this conclusion. Although the soil temperatures were below the ideal reproduction range, the nematodes were able to actively feed and were capable of causing severe stunting on young onion seedlings. There was no evidence of a rapid increase of stubby root nematodes to very high levels following fumigation with Telone, but a moderate increase in nematode population was found in soil samples from one of the plots.

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Severely stunted onion roots, to left in photo above, from nematode-infested soil contrast with normal roots from treated soil after a 90-day growing period in greenhouse tests. Mature onion plant from nematode-infested field, photo below, shows severe root stunting and swollen tips with numerous branches, and a yellowish brown discoloration.

