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HOT WATER TREATMENT OF HOP RHIZOMES FOR NEMATODE CONTROL

Soaking hop rhizomes in hot water—122° F for 10 minutes or 125° F for five minutes—kills nematodes and does not injure the rhizomes, according to tests at Davis. Fumigating hop yards before planting controls root-knot and dagger nematodes more effectively than side-dressing chisel applications. However, stock planted after fumigation must be free of nematodes.

Surveys of hop yards in Sacramento County, begun in 1959, showed the root-knot nematode, *Meloidogyne hapla*, and the dagger nematode, *Xiphinema americanum*, to be widely distributed and abundant. Root-knot nematode populations of 10 larvae per cc of soil were common. The general population of the dagger nematode (adults and larvae) was approximately 1 per cc of soil but sometimes went up to 3 per cc of soil.

Hops are a perennial plant; therefore, the first field trials were attempts to control nematodes around the living plant. DBCP (1,2-dibromo-3-chloropropane) applied as a side-dressing chisel application (dosages: 2.5 gallons per acre (gpa) and 4 gpa destroyed nine-tenths of the root-knot larvae. However, three months after treatment the population level was approximately the same as before fumigation.

The unsatisfactory results obtained with side-dressing treatments led to the consideration of preplanting fumigation. It was necessary to obtain nematode-free planting stock for use after soil treatment to study the effect of the reduction of plant parasitic nematodes on the growth and yield of replanted hops. Planting stock consists of rhizomes taken from the grower's own hop yard at the time of root pruning. Because of the wide distribution of plant parasitic nematodes, especially root-knot nematode, rhizomes throughout the hop growing areas are invariably infested.

The purpose of the present study was to determine a hot water treatment that would insure nematode-free planting stock without injuring plants. The hot water treatments used in this study were selected from those found to be successful on grape cuttings by Lear and Lider in 1959. These treatments were conducted on hop rhizomes (*Humulus lupulus* L. var. California cluster) infested with root-knot nematodes.

Seven treatments

The experiment consisted of seven hot water treatments and one check, each replicated four times. The replicates each consisted of 25 rhizomes, thus 100 rhizomes were treated at each temperature and time. Treatment chambers consisted of constant temperature water baths constructed from commercial milk coolers with a capacity of 120 gallons. Each replicate of 25 rhizomes was treated individually. Rhizomes were completely submerged in the treatment tank for the required time interval for each temperature. Immediately after treatment, the rhizomes were immersed in a cold water bath (70° F), removed, dried and stored at 40° F for one week.

To evaluate plant response to treatment, four rhizomes were taken at random from each replicate and planted separately in autoclaved greenhouse soil. One month later, measurements were made of top weight and length attained by each hop vine and recorded in the table. At the time the rhizomes were planted, cortical shavings were taken from 10 other plants in each replicate. These were mixed with autoclaved greenhouse soil and planted with seedling tomatoes. Four pots were planted with the shavings from the ten plants for each treated replicate. One month after planting, the root-knot galls on tomatoes in each group of four pots were counted.

GROWTH RESPONSE OF HOP ROOT CUTTINGS EXPOSED TO HOT WATER TREATMENTS AND ROOT-KNOT GALL COUNTS FROM TOMATO INDICATOR PLANTS

Treatment Temp. °F	Treatment Interval min.	Mean weight tops (g.)	Mean length tops (cm.)	Galls/ indicator plant*
Check	..	12.7	200.5	37 ± 33
118	30	6.3	89.7	0 ± 0
120	15	6.5	99.6	0 ± 0
122	10	10.7	169.7	0 ± 0
125	5	10.3	201.8	0 ± 0
127	4	4.2	76.2	0 ± 0
130	3	9.4	165.4	0 ± 0
135	2	1.2	26.6	0 ± 0
	LSD:		LSD:	
		.05 4.6		.05 80.7
		.01 6.1		.01 106.5

* Mean of 4 replicates and standard error of the mean.

The total for each four-pot group represented the survival of root-knot nematode in each treatment replicate.

All treatments were compared to the planted check rhizomes for top weight, top length and mortality. The table shows that nematodes were eradicated from the hop rhizomes at all temperatures and times tested. However, this eradication was coincident with plant injury at 118° F for 30 minutes; 120° F for 15 min.; 127° F for 4 min. and 135° F for 2 min.

Treatments at 120° F for 15 min. were the least injurious of this group, as shown in the table.

Mortality rate

Information obtained from this experiment and confirmed by hop growers indicates that the mortality rate of untreated hop rhizomes is between 10 and 15 per cent. The highest mortality observed in the treated rhizomes occurred at 135° F for 2 min. With this treatment, 63 per cent of the treated rhizomes failed to grow. With the 127° F for 4 min. treatment, a 44 per cent mortality was observed. The mortality rate among the other treatments was considerably lower: 118° F for 30 min. and 120° F for 15 min.—18 per cent; 130° F for 3 min. and check—12 per cent; 122° F for 10 min. and 125° F for 5 min.—6 per cent. The latter four conformed to the expected mortality rates observed in untreated field plantings with rhizomes.

A hot water treatment for hop rhizomes may be selected of 122° F for 10 min.; 125° F for 5 min. or 130° F for 3 min., according to these tests. These treatments were equally effective and showed no injury at either the .05 level of significance or at the .01 level of significance. Of these three, the 130° F for 3 min. treatment is probably the least desirable. A high temperature and short period of exposure allows the least margin of error. The desirable hot water treatment should combine low temperature and a long period of exposure. In this experiment, either 122° F for 10 min. or 125° F for 5 min. treatments would allow for a greater margin of error and are therefore more desirable.

Preplanting fumigation and subsequent planting with nematode free stock is now possible. Treatments with dichloropropene-dichloropropane mixture at rates of 20 gpa, 40 gpa and 60 gpa have been successful for nematode control in hop yards. Pretreatment sampling indicated an average population of two root-knot larvae per cc of soil and one dagger nematode per cc of soil. Three and one-half months after treatment (at all dosage rates) root-knot larvae and dagger nematodes could not be recovered either by the Baermann funnel or by wet screening. Eight months after treatment root-knot and dagger nematodes were recovered from the 20 gpa plots but not from the other treatments.

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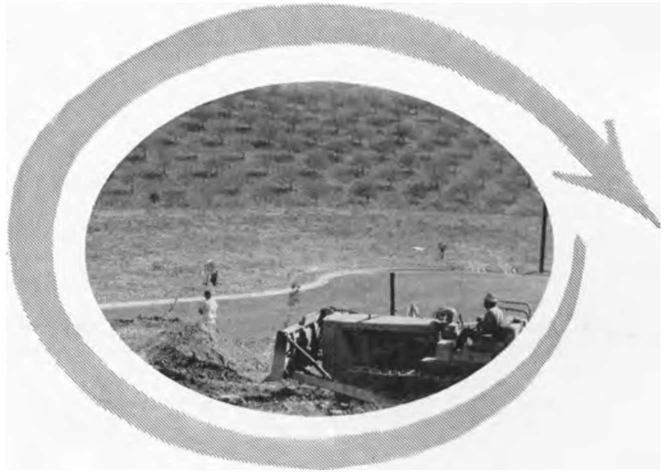

The Econo

FARM

Urban and suburban areas are moving closer to many California farms. More people create additional trouble and expense that may cause the farmer to consider selling and either moving to a new location or using the money to invest in other businesses. Any farmer facing such a decision should know the facts about relocation—how much his land is worth, how much actual profit he can make from its sale and how to go about the complicated process of selling.

The influx of additional people to a farming area creates several kinds of problems for the farmer. Costs are higher; taxes, water, and labor all take a larger share of the farmer's sales dollar. Too many people are a nuisance for the farmer; they complain about noise and dust, and sometimes trespass or pilfer his crops. Cars and factories bring smog which lowers his yields. Finally, the farmer finds himself cramped, unable to expand into additional acreage. All of these problems add up to a lower return on the farmer's investment.

Should a farmer faced with these problems relocate his farm? The economic time to relocate is when the returns on the value of the present operation become less than the returns which could be obtained if the money were invested in some other location or enterprise. In other words, a farmer should relocate if the money invested in his farm could be earning more at another location.

The first step for any farmer planning to relocate is to find out what his property is worth in its present use—what we shall call the agricultural value of the property. Here are the steps for determining agricultural value.

Gross annual income

First, determine the gross annual income from the farm. Consider, for example, a 10-acre farm in floriculture producing Column stock at the rate of 850 bundles per acre, or 8,500 bundles per year. If Column stock sold for $1.40 per bundle, the total income would be $11,900; that is, production times price.

Then determine the expenses of production for one year. Include all cash costs; include the value of work done by the owner and his family; and include the interest and depreciation on equipment which would be taken along if the farm was relocated. If the farm is to remain at its present location for at least five more years, include the depreciation on fixed facilities such as buildings and irrigation systems. Do *not* include interest on the real estate.

To continue the example, let's assume that the total annual expenses on the Column stock farm are $9,000. Next, subtract the total annual expenses from the