Preplant fumigations of planting sites

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With rising costs, agriculturalists are continually seeking more efficient agronomic practices. Some deciduous tree fruit growers have cut costs by treating individual tree sites rather than fumigating the entire field before planting. These spot treatments may include such treatments as soil profile modification, fumigation, and fertilization—individually or in combination.

Although nematodes can be especially destructive to perennial crops during the early years of root development, and getting the plant off to the proper start is of primary importance, nematodes will return regardless of the extent of preplant fumigation. Do we need to go to the extra expense of fumigating every square foot of field surface? Utilizing recent advances in pesticide monitoring, we set out to determine the degree of nematode control achieved after using methyl bromide or 1,3-Dicholoropropene (1,3-D) nematicides as spot treatments.

Trunk Circumference of Peach Trees on Treated Sites, 1975 and 1976

Treatment	1975	1976
Backhoed + methyl bromide	19.60 cm a*	27.30 cm a
Backhoed + telone	13.55 cm a	20.38 cm a
Methyl bromide only	13.29 cm a	20.04 cm a
Backhoed only	11.65 cm a	20.30 cm a
No treatment (check)	9.99 cm b	15.54 cm b

*Mean separation within each column by Duncan's multiple range test, 5% level.

Laboratory findings

Using our own data and the data from researchers at UC Davis, we determined that at temperatures higher than 15°C a 24 hour exposure of 20 µg per ml of methyl bromide in the soil water is sufficient to control second stage juveniles of root knot nematode. This nematoxic dosage level is referred to as lx.

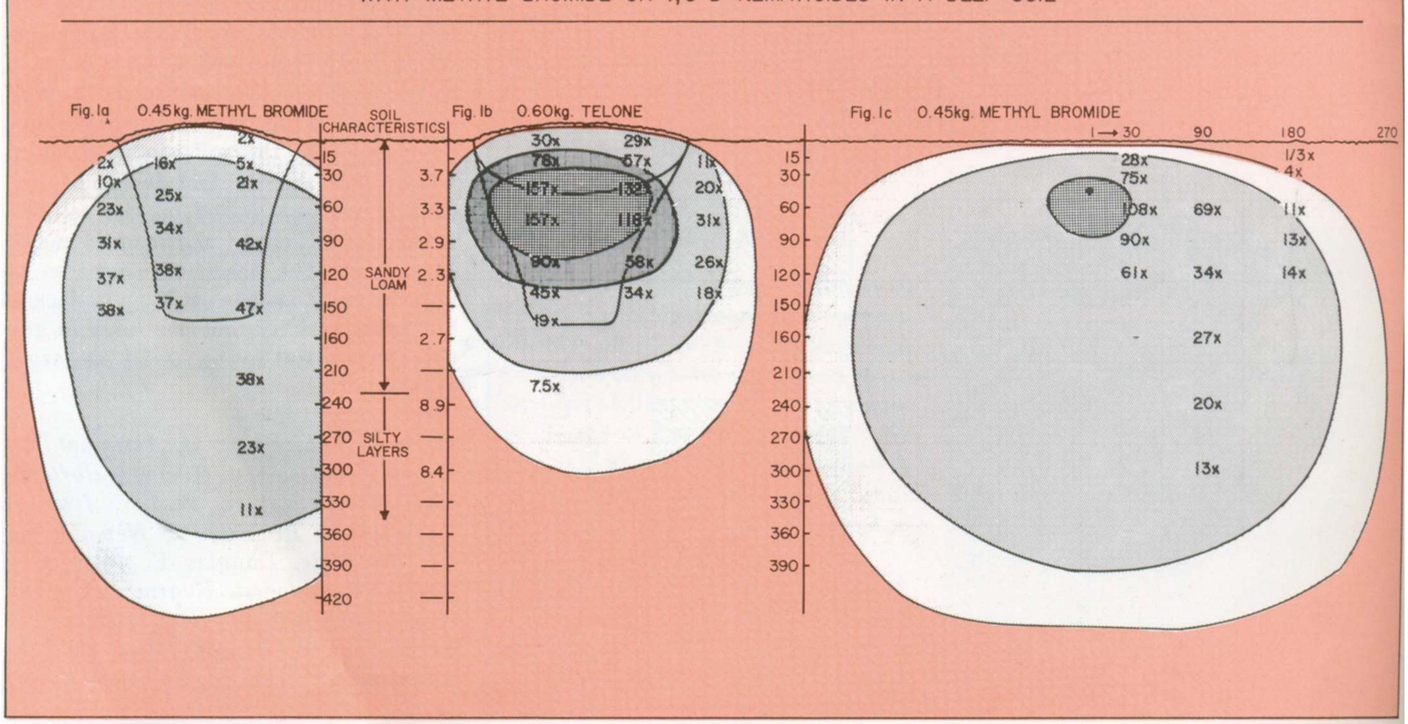
Extrapolating from work at UC Riverside, 99.9 percent control of oak root fungus, *Armillaria mellea* (Vahl) Quel within infected citrus roots (3.5 cm in diameter) at temperatures above 15°C would require 5.1 times the nematoxic level.

With these toxicity levels in mind we set out to compare the effects of the two chemicals following spot treatments.

Field experiments

On October 16, 1973 at the Kearney Horticultural Station, Parlier, California, we treated the soil in a field that had been cleared of existing trees and prepared for replanting. Three treatments involved preplant soil preparation utilizing a tractor-mounted backhoe. Holes approximately 12 cubic meters in volume were dug at individual tree sites. Upon reaching the 165 cm (5½ foot) depth the backhoe operator used his digging bucket to cave in the soil from the side walls of the hole. At this time the hole had been filled to approximately 45cm (18 inches).

For one of the treatments we applied one pint (0.60 kg) of Telone (42 percent cis-1,3-D and 36 percent trans-1,3-D) using a spraying device to spread the



PEST CONTROL PATTERN EXPECTED FOLLOWING FUMIGATION OF INDIVIDUAL TREE SITES WITH METHYL BROMIDE OR 1,3-D NEMATICIDES IN A DEEP SOIL chemical onto the soil surface in the hole. The hole was immediately filled with the remaining soil. A second treatment involved the release of a 1-pound can (0.45 kg) of methyl bromide at the 45 cm depth in a previously filled backhoe site. Additional treatments involved the use of either the backhoe or methyl bromide individually.

Gas sampling probes had been placed into the sites prior to fumigation. Concentrations of each pesticide were periodically monitored at various soil depths for a period of 1 month after which nematoxic concentrations could no longer be detected. Diffuse silt layers were present in the orchard below the 240 cm depth. Soil moisture was dry, being less than 4 percent in the surface 180 cm and less than 9 percent in the deep silt layers. Temperature of this Hanford sandy loam soil was 17°C.

Results

Figure 1 shows the distribution of nematoxic levels as a result of the fumigations. Movement of pesticides was unrestricted throughout the backhoe areas. Although methyl bromide did penetrate to greater depths than 1,3-D, the movement of pesticides was adequate and perhaps excessive in all cases. Methyl bromide dosages were noticeably lower at the field surface in comparison to the 1,3-D nematicides. Methyl bromide in the non-backhoed areas moved at higher concentrations and to greater distances than in the backhoed areas. At distances in excess of 90 to 120 cm (3 to 4 feet) away from the point of application nematoxic dosages were not achieved at the field surface of non-backhoed areas.

During the spring of 1974 peaches on Nemaguard rootstock were planted. Irrigation of the orchard resulted in additional soil settling at most of the backhoed sites, and the submersion of many trees.

Trunks of surviving trees were measured in the second and third years of growth. The table indicates the average trunk circumference for each of the treatments. The various treatments provided significantly improved growth during the first 2 years only. Trees on treated sites grew significantly more than did trees on untreated sites in this root knot (*Meloidogyne* spp.) and Pin nematode (*Paratylenchus hamatus*) infested soil. Soil sampling in the second year revealed the presence of numerous Pin nematode adjacent to all tree roots, irrespective of treatment.

The cost of planting site fumigations is 1/6 to 1/2 that of a commercial broadcast fumigation.

Additional experiments

Using similar application techniques, we then conducted experiments to determine the optimum placement depth for methyl bromide in non-backhoed, moist to dry, sandy loam soils. Comparative experiments at placements of 90, 45, and 15 cm, or at 15 cm with a tarp, revealed that 45 cm provided optimum fumigant movement. The presence of a tarp (3.6 m^2) provided nematoxic dosages at all positions just beneath the tarp.

The soil subsidence problem is significant, aside from the loss of trees. Subsided areas should not be refilled with nematode infested soil. Extra soil should be placed on the surface of the backhoed area prior to the fumigation. Removing additional surface soil from the tree sites just before planting is a more practical approach than making soil additions at planting time.

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Selection of preplant fumigation

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Application rates of methyl bromide, 1,3-Dichloropropene, and ethylene dibromide which have been used in California for 30 years as preplant soil fumigants, are well established. Field monitoring of these fumigants has revealed certain characteristics of each fumigant: those characteristics are greatly influenced by soil conditions. In order to show the relative importance of each of the soil factors we have developed a chart which reveals the quantity of chemical to apply for a given field situation.

This chart is based on pesticide monitoring data obtained from numerous field- and simulated field-fumigations. It is also based on laboratory data which indicate the dosage of each toxicant necessary to be lethal to specific pest populations. This chart may or may not correlate with current label recommendations and it should not be considered as a suggested usage by the University of California. It was designed to demonstrate the relative impact of various soil conditions on the delivery of fumigant throughout the soil profile. Hopefully, after studying this chart pest control applicators will better understand the value of exerting greater control over soil conditions at the time of application.

Field situations and pest problems vary. Most field soils are not of uniform measure or texture throughout the soil profile. This chart applies directly to those which are uniform and serves as a guide for treating less uniform soil profiles. The chart demonstrates the difficulty of satisfactorily controlling pests by fumigation of fine-textured soils which characteristically hold higher moisture.

Determination of conditions prevailing in a field and preparation for fumigation require considerable forethought. Consideration at planting time is too late. This chart takes into consideration the relative importance of soil texture, moisture, temperature, organic matter content, depth of the pest in soil, and the pest's inherent tolerance level to three soil fumigants.

Soil moisture

In general, our suggested fumigation range is between -0.6 and -15. bars soil moisture tension. Outside that range