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

Michael V. McKenry

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 effective control of deep-living soil pests is diminished. In overly wet soils (-0.6 bars), there is poor toxicant movement; in overly dry soils (-15. bars), there is excessive toxicant adsorption. Fumigation of moist soils (-0.6 to 1.0 bars) results in acceptable toxicant movement if the soil is of a uniform profile (no wet or restrictive layers). Fumigation of dry soils (-1.0 to -15. bars) provides optimum toxicant movement, especially in finer textured soils and those with restrictive layers.

However, there are some problems created if certain soils are tilled with a dry surface. Movement of chiseling equipment across a dry field surface tends to result in the development of large soil aggregates. Such clods need to be destroyed to provide a smooth field surface, often requiring a light sprinkling. Application of a continuous tarp to a dry, dusty field surface results in poor adhesion of the glue to the tarp.

This chart does not apply to the control of soil organisms that require high moisture levels to insure an active target pest (i.e., weed seeds). Target pests need to be metabolically active for these alkyl halide pesticides to be effective.

A second exception involves non-tarped applications of fumigants. Typically, the zone of the soil profile which receives lowest dosages following non-tarped fumigation is the surface 6 cm of soil. For "easy to control pests" (E) dosages of 1x are attainable in the surface to 6 cm of soil as the chart adequately indicates. However, dosages of 1,3-D and EDB in excess of 100 µg per ml for one day (3x) are not often attained in the surface to 6 cm of soil water even at highest application rates.

Generally for the 1,3-D and EDB fumigants the dosages are reduced by one-half as one moves one-half the distance from the 15 cm depth to the field surface. For example, after application of 500 lb per acre 1,3-D to a sandy loam soil, we commonly find daily dosages of 500 per ml (16x) at the 15 cm depth. At the cm depth the dosage is approximate one-half (8x), 4x at the 4 cm depth and at the 2 cm depth. With these figures mind one begins to realize the importan of a smooth, flat, clod-free soil surfa devoid of large-sized roots.

This chart may have to be modifie as researchers learn more about soil o ganisms and their interactions. In add tion more information is needed concer ing the economic threshold level various soil pests and the protection tim needed to provide economic responses fo specific crops. Studied carefully this char will provide pest control operators an advisors with an insight as to the rela tive importance that various soil factor play in affecting soil fumigations.

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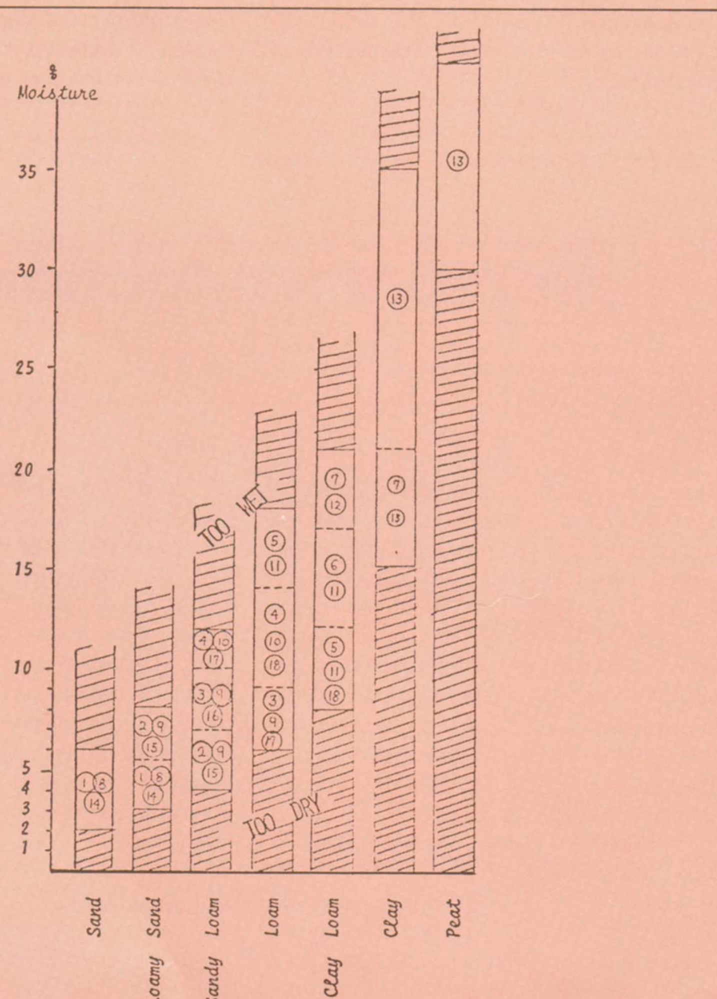
Suggested broadcast, preplant application rates to provide lethal dosages to soil pests at the 75 or 150cm depths.



APPLICATION SPECIFICATIONS:

- Remove old roots especially from surface 15cm of field.
- Depth of application from 15-35cm to soils not in excess of 2% fresh organic matter.
- No major restrictive layers present in soil profile.
- No rain in excess of 25mm within 5 days subsequent to application.
- Adequately sealed soil surface.
- Temperature of soil determined at 30 cm depth.

1,3-D NEMATICIDES (92% 1,3-D)

	°C	E*	M**
1.	5-25	50-100 lb/Ac	400 lb/Ac
2.	5-25	75-125	400
3.	10-25	100-150	500
4.	10-25	125-175	500
5.	15-20	150-200	600
6.	15-20	200-250	700
7.	15-20	250-300	800

TARPED METHYL BROMIDE (98% ai) (+)

	°C	M	D***
8.	5-25	200 lb/Ac	400 lb/Ac
9.	5-25	250	400
10.	5-25	300	500
11.	5-25	350	600
12.	10-20	400	700
13.	10-20	500	800

ETHYLENE DIBROMIDE (65% ai)

	°C	E
14.	15-30	40 lb/Ac
15.	15-30	50
16.	15-30	75
17.	15-30	100
18.	15-30	150

*E = Delivers 30 $\mu g\ ml^{-1}$ day to the soil water films throughout the surface 75 cm of soil for easy to control soil pests. Providing a dosage of 1x

**M = Delivers 200 $\mu g\ ml^{-1}$ day to the soil water films throughout the surface 150 cm of soil for moderately difficult to control pests. Provides 10x methyl bromide - 7x 1,3-D - 5x EDB.

***D = Delivers 1000 $\mu g\ ml^{-1}$ day to the soil water films throughout the surface 150 cm of soil for difficult to control pests. Provides 50x methyl bromide - 33x 1,3-D - 25x EDB.

(+) Additional chloropicrin may be present.