

**Project No. 93-CJ1 - Alternatives and Improvements to Soil Fumigation with
Methyl Bromide**

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Cooperating Personnel: None.

- Objectives:**
1. Field test various methods of soil sterilization in an effort to replace soil fumigants. Examples include use of a soil drenching device, use of the existing dripper system to deliver Vapam, Furfural, Urea, or Telone. Use of winter and summer rotation crops plus root-killing techniques.
 2. Reduce volatilization percentage of Telone and MB using new application procedures.

Results:

This project is currently being funded by 8 California commodity groups. This generic report will encompass studies on a wide variety of crops. All eight commodities have in common the presence of old woody roots and various soil pests within the surface five feet of soil. Findings for one crop will have varying degrees of application to other crops. All the work is conducted in fields or has a focus towards field implementation.

High Pressure Steam: Steam at 1200°F and 130 psi was injected into a sand soil and heat movement monitored. Temperatures of 140°F were not detected beyond 6 inches, even when the injection port was stationary for several minutes. Treatments resulted in the formation of "bricks" directly out from each port but little lateral movement of the heat. I do not visualize any adequate delivery methods short of bringing the soil up into an oven and then replacing it back into the field.

Hot Air Injections: Compressed air at 60 psi was passed over a 220°F electric heating element in a gravelly, sand soil. Twenty minutes were required for the heat to transfer 6" below the injection point.

Hot Water Delivery: Water at 190°F when poured into core holes on 6" centers will eventually deliver 140°F to the center of the undisturbed soil. These were July treatments with the soil already at 80°F. This approach is non-feasible.

Soil Solarization: Into an old vineyard site peaches were replanted on Lovell and a 6-ft wide black-tarp mulch remained in place for two years around the tree trunks (Duncan et al, J. of Nematol. 24(45):681-687). The habitat created was a uniform moisture regime and high heat which proved deleterious to citrus nematode and root lesion nematode within the old grape roots but root knot nematode flourished within six inches beneath the tarp on the new Lovell roots.

Deeper Placement and Reduced Rates of MB: An injection of 200 lb/ac MB at 36" depth was followed in 10 days by flipping over the top 12 inches of soil and re-treating at 100 lb MB at 20" depth. Control of nematodes was excellent and weed control was very good. Roots of old peaches and plums were killed throughout the surface 5 ft of soil. Treatments such as this at even lower rates should be monitored for total MB off-gassing. Such treatments are efficacious for tree and vine growers, although some loss of weed control should be expected.

Strip Treatments with Telone: In mid-September Salinas Valley vegetable growers began limited use of Telone at treatment rates of 120 lb/ac (= 12 gallons/ac). Walnut, almond, and peach growers could use 120 lb/ac if applied deeper and concentrated into strips of 1/3 or 1/4 the field surface area. If one replants with rootstocks resistant to the dominant soil pest, such treatments would be highly beneficial.

Portable Soil Drenching (PSDD): We now have a number of small PSDD units and one large enough to treat 0.6 acres at one time. Using Metham Sodium as our model biocide we achieve nematode control very close to that of tarped MB with weed control slightly better. It remains to be seen when and if such units ever become commercially available but there have been two major spin-offs. 1) For research purposes we are now aware that there can be a mycorrhizal-like deficiency associated with Vapam treatments and, 2) For growers already having established low-volume irrigation equipment there will be some opportunity to modify that equipment and treat existing vines and tree rows using the recipes we are developing. Also, there is an incentive now for growers to put in their low-volume irrigation devices well before replanting as a means of delivering Metham Sodium (= Vapam) pre-plant. At 654 lb/MS/surface acre one can kill old tree roots 4 feet deep and nematodes 5 feet deep in the treated area. At 327 lb MS nematodes can be controlled 4-5 ft deep with root kill limited to the top 2 feet. We are now beginning field evaluations of such treatments down tree and vine rows to determine the necessary width of a treated row.

PSDD Treatments Other Than MS: Work is underway with treatments of Clorox, chlorine dioxide, urea, plant extracts, and Telone through the PSDD. Each appears to have some value but not against old tree roots. These treatments are being evaluated on soils where old trees were treated with glyphosate 60 days before their removal.

Systemic Herbicides to Kill Roots: After a summer of testing various treatment methods, two acres of 15-yr old plums on peach and plum rootstocks were treated 2 times in 24 hr with a 1% foliar application of Round-up. After 1 year the root death was 80%, 70%, 40% and 30% for NemaGuard, Lovell, Myrobalan 29C, and Marianna 2624, respectively. Garlon herbicide, another systemic brush killer, is now being painted onto vine trunks.

Rotation Crops: One aspect of soil fumigation that will be most difficult to replace is the growers' ability to remove a perennial, fumigate and replant a perennial the very next spring. By realizing there will probably be at least a year of down-time it is important to know which rotation crop is best for which situations and are they better than fallowing. Alongside our field tests we are evaluating specific nematode reducing capabilities of Sudan grass, barley, and Cahaba white vetch in rotation. These and other potential rotation crops are ones for which we already have good indications of their nematode-reducing potential.

Flooding: 15-yr-old peaches and plums were removed and the soil flooded for 40 days and nights (= 16 ac ft of water). The goal was to kill old roots. Roots became slightly browner but did not die. Nematode counts 9 months later indicate absolutely no value for flooding. It did turn out that the flooded trials (4 reps) were the only sites where Malva did not occur the following spring.

To this date I have only seen one Federal source of funds for this type of work and we probably will not see any funding until October, 1994. Growers need to know that it will require millions of dollars and many scientist hours to replace MB and Telone.