Project Number: 96-CJ3

Fourth Year Progress Report to Various California Tree and Vine Commodity Groups

by
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UC Riverside

November 1, 1996

For this year's report I will identify specific alternatives and their potential to replace methyl bromide. The support of California Almond Board is particularly appreciated.

This report has three parts. First we describe the limitations and attributes of five biocide treatments that can in some situations replace MB. In most respects these five treatments are more expensive or more cumbersome to the grower than MB, but not always. In the second portion of this report we discuss some of the "softer" treatments and treatment strategies that are possible for the commodities of walnut, stone fruits, almonds, and grape. These strategies are based on our improved understanding of the replant problem and our finding of practical solutions to individual components of the replant problem. The packaging of these "softer" treatments in the correct combination will be the focus of our work in 1997. Examples of "softer" treatments are included in the three attached two-page reports. The third portion of this report identifies future steps to acceptance or nonacceptance of MB alternatives. By late-summer 1997 there must become available the funds to initiate commercial evaluations among the various commodity groups in various counties. Interested farm advisors or individuals will want to test portions or the packages we have reported herein. We are committed to facilitating those efforts but such projects should be spearheaded by individuals other than myself.

A. Five Alternatives Involving Biocides

Alternative #1 – Telone with MIT Drench

The closest we have to a general MB alternative is alternative #1: Pull, rip, 35 gallons/acre Telone shanked at 18 inch depth to dry soil with portable sprinkler lines already in place on the field. After the shanking attach delivery lines to the existing lateral lines and from days two through six after treatment deliver intermittently 2 inches water containing 250 ppm MIT (~30 gallons/acre Vapam). This Telone with MIT drench treatment will perform equivalent with MB in most vineyard and orchard settings at $720/acre (includes $100/acre for sprinkler rental). There will be no need for a one full year fallowing period but trees and vines always grow better if a year of fallowing is included. Use of this treatment should enable an increase in the total acreage we are able to treat with Telone/township. The currently missing data for this treatment include: 1) Volatilization monitoring; 2) Best timing for delivery of the 2 inches water in different soil textures; and 3) Efficacy in commercial settings. This treatment will cost one third more than the nontarped MB treatments but one third less than the MB tarped treatments. It will be less useful than MB in cooler, wetter soils. Like MB this treatment will not control some aspects of the replant problem, oak root fungus below 5 feet or verticillium. This treatment will have some advantages over MB, including weed control, and these benefits will be learned during commercial evaluations.

Alternative #1a – MB Deep Injection with MIT Drench

It should be noted that shanking 225 lb/acre MB at 24 to 30 inches instead of the Telone and then drenching with MIT could greatly reduce MB volatilization as well.

Alternative #2 – 500 ppm MIT Drench Plus One Year Fallow

There is a second alternative that also will provide general cleanup for replanting, but only usable in very coarse-textured soils. Alternative #2 is as follows: Pull, rip, resettle, drench 500 ppm MIT (200 gallons/acre Vapam) in 6 inches water then clean fallow for one full year before replanting. This treatment is only for coarse-textured deep soils that take 6 inches water in 8 hours or less. Water delivery may be by sprinkler or a portable soil drenching device. If the soil will infiltrate 6 inches water in less than 3 hours a flat flood basin method is also an acceptable delivery method. The cost is $700 to $1,000/acre plus one full year of land idling after treatment. This treatment will kill old tree roots at least 4 feet deep and with the waiting time root lesion nematode control is comparable to that of MB. This treatment rate is double that currently registered for Vapam. A change in the labeling is underway.

For orchard settings where growers are able to use resistant rootstocks to control all the main soil pests present, the stripped MB treatment has been adequate at $280/acre nontarped, with no more than one year of land fallowing. The general methods listed previously can replace these MB strip treatments but not with the simplicity of MB. The 500 ppm MIT can be delivered via a low-volume irrigation system. With drippers an 8 hour irrigation containing 500 ppm MIT can wet a continuous 4 foot strip down the treated row. Pulling each drip line a few feet at 4 hours may be necessary. This treatment with water delivered to 5 foot depth can give nematode protection for the first full year with a purchase of 25 to 40 gallons Vapam/planted acre. Unfortunately, tree and vine replants do not grow well unless there is a one year waiting time or NRPS soil (= virgin soil) of ½ yard per tree site is placed at each tree site prior to replanting. At-planting micronutrients are also very important following 500 ppm MIT.

Alternative #3 – 250 ppm Telone EC Drench

Emulsified Telone at 250 ppm could be used instead of Vapam and the waiting period of one winter is adequate. Unfortunately Telone EC is not yet registered for California and could not be applied by basin or sprinkler but only by drip and there will most likely need to be a tarp over the top of any broadcast applications through drip.

There are also many field settings having no endoparasitic nematodes or having the replant problem only. In such settings Alternatives #4 and #5 can be comparable to MB treatments.

Alternative #4 – 250 ppm MIT Drench

For soils that take 6 inches water in 8 hours or less, that have ring nematode or dagger nematode or no live roots below 2½ foot soil depth or there is resistance to the endoparasitic nematodes in the crop to be planted, this drenching can be as effective as methyl bromide. The waiting time after treatment can be one summer month to four winter months. Drenches such as this can also be made into backhoed sites where they can be useful for creating a biological vacuum which is then filled with beneficials. This treatment is already registered and the cost is $300 to $700/acre including any backhoe costs.

Alternative #5 – 300 gallons/acre Enzone Drench

Drenches with Enzone also have utility. Enzone is an even poorer root penetrant and root killer than 250 ppm MIT. Grapes have grown especially well when planted only 21 days after a summer treatment with Enzone. However, winter treatments followed in 45 days with a planting of peach were disastrous. At $6.00/gallon of product, Enzone at these treatment rates could reach as high as $2,000/acre. This alternative will not be acceptable unless there is a price reduction.

B. Softer Treatment Strategies

The preceding information provides a status report for treatments and products currently available or very close to being available for growers' fields. Back at the research bench we have another list of potential alternatives for orchard and vineyard replanting and this list involves the putting together of treatments having useful performance characteristics but against only one or two components of the replant problem. Some of these packages are now being taken to the field. We don't yet refer to these as alternatives. They are not going to have the general value as listed above but some of the packages might be very good for specific crop situations. The individual components of the replant puzzle include: 1) Kill the old roots; 2) Cleanse the surface 5 feet of soil or at least render it anti-nematodal; and 3) provide the "increased growth response" (IGR) associated with fumigation. Below are examples of these packages for individual commodities.

Walnut

Harvest, irrigate, cut trunks and apply 50 ml Garlon 3A + 25 ml diesel oil by low-mist spray or paintbrush to the exposed cambial region. Remove stumps and roots next spring, rip and level, backhoe new planting sites, and drench each by tank or low-volume irrigation with a biocide (e.g. 250 ppm MIT). Into the sunken planting sites 30 days later we add ½ yard NRPS (= virgin soil). Next spring (~18 months after tree cutting) we plant trees with a complete micronutrient solution. We have now carried out each of the individual steps in this package and new trees are expected to grow better than they do after MB. We know also that without the MIT biocide step new trees have only 1.4 root lesion nematode/g root by the first fall compared to 15/g root for more conventional nontreated settings. We are expecting the complete package to give us two years of nematode relief and a filled biological vacuum. Our job would actually be completed if there were a rootstock with resistance to root lesion nematode in walnut. This package treatment is ready for field testing at commercial sites.

Stone Fruits and Almond

Our only successful root kill by systemic herbicides on *Prunus* spp. has been with a foliar spray of 2% Roundup by August 1. Unlike walnut roots, the killed peach roots do not rot, leaving a refuge site for root lesion nematode eggs for at least two full years later. For sites without an endoparasitic nematode this treatment plus 18 months fallow is adequate to give first-year trees equivalent to those treated by MB. To provide nematode protection we are currently delivering biocide at planting sites and then 30 days later adding NRPS (= virgin soil) where the new trees are to be planted and at planting we use a micronutrient solution.

Since only 32% of almonds and 50% of stone fruit growers have root lesion nematode this treatment has potential. The herbicide cost is about $250/acre and the backhoe plus virgin soil cost is unknown until we learn how much NRPS soil to add to each site. There will be one full year of fallowing with this method. In a field setting with the USDA we tried a trunk application of systemic herbicides and 60 days later were able to show good reductions of root knot nematode on 20-year-old Lovell rootstock but no visual symptoms of dead roots.

Grapes

We have experimented for three years with 2,4-D, Roundup, and Garlon and there are no systemic herbicides able to kill grape roots at this time. There needs to be more work in this area, but as it stands we are forced to use MIT or Telone EC as our root killing agent. Own-rooted grapes do not experience the replant problem as badly as the tree crops but some of the popular rootstocks such as Teleki 5C are more sensitive to the replant problem than the own-rooted.

C. Future Studies on MB Alternatives

Over the last four years we have attempted to identify the best treatments for commercial testing. Many of my ideas and the ideas of others have fallen flat in experimental settings. Cover crops, plant extracts or teas, flooding, steam, solarization, urea drenches, planting off the old row, and others have been interesting and partially effective but exhibited too many limitations based on today's available technologies. The alternatives and potential alternatives we have identified must now receive commercial evaluation if they are to become a reality. I will encourage farm advisors and others to initiate such tests but they will need financial support.

This generic research program will wind down in the winter of 1997. After that date I too will begin commercial evaluations, especially for specific commodity groups. Such projects will not be as generic as this one has needed to be. It is clear that one way to recommend treatments other than MB is to fully characterize the field setting. In other words, there are places where we will not replace MB and other places where we can. Another major objective of mine for this last year of study is the writing of a manual that describes our current knowledge about the replant problem and its control.

Growth Benefit Of Adding "Virgin Soil" When Replanting An Orchard

by
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Virgin soil, or a better term "non replant problem soil" (NRPS), is a soil that has not supported a perennial crop for 10 to 15 or more years and does not harbor soil pests or chemical residues that might limit the growth of subsequent perennial crops. Replant problem soil (RPS), by contrast, is the soil that can be collected from anywhere near the roots of established trees or vines and when as little as 2 or 3 pounds is added to a young tree or vine at planting the first year plant growth is markedly reduced even when no known soil pests are present.

For the field tests reported here NRPS was collected from the center of an 80-foot-wide zone located between an old orchard and an old vineyard. This NRPS zone had received occasional tillage but had not supported perennial plants for 15 years. The NRPS was collected by the use of a Vermeer Tree Spade that dug a hole 50 inches square at the surface and tapering down to a point 36 inches in depth. This ½ yard volume of soil was transported to the orchard and inserted into a tree site where the same equipment had previously dug a hole. On April 12, 1996 almond trees on nemaguard rootstock were planted into sites having complete NRPS, complete RPS, ½ yard NRPS surrounded by RPS, and ½ yard RPS surrounded by NRPS. For comparison two additional treatments included RPS but were backhoed before planting and RPS backhoed and treated with 1 lb/tree site of methyl bromide (MB).

Four weeks after replanting the NRPS soil supported almond/nemaguard trees with two times more top growth than those trees planted into replant soil (RPS). At 8 weeks after replanting the trees replanted to NRPS or ½ yard NRPS were similar in size and four times larger than those of any other treatment. By mid-July or 12 weeks after replanting those trees planted into ½ yard NRPS began to slow their growth as their roots invaded the surrounding RPS soil. Also the trees in MB treated sites were by this time half the size of the NRPS trees although they were much more rank in appearance and slightly yellower. By mid-September the trees growing in RPS or backhoed RPS were beginning to grow well so that by mid-October they appeared to have grown past the replant problem. Trees planted in complete NRPS never slowed their growth while trees planted to ½ yard NRPS had not yet resumed their growth by mid-October. The final 1996 trunk circumferences for each treatment are detailed in Table 1. This site was selected because it contained the replant problem without pathogenic nematodes present. These data show that methyl bromide does not solve the complete replant problem.

In this orchard site that did not have a nematode component, the replant problem still occurred. I refer to this major and most visible component of the replant problem as the rejection component. The new trees had overcome the rejection phenomena six warm months after they encountered it. We know that the rejection phenomena can be transported by physically transporting RPS but within soil it does not appear to be mobile. Rather, it is an entity that the roots can encounter and then adjust to. This rejection phenomena can slow even the most vigorous of root systems. This field trial will continue for two more years.

Table 1. First-year growth of almond/nemaguard replanted 4 months following removal of an almond/nemaguard orchard that did not have a nematode problem.

Treatment	Trunk Circumference (cm)
Complete NRPS (= virgin soil)	3.62 a
½ yard NRPS surrounded by RPS	3.54 a
RPS backhoed + 1 lb MB	2.98 b
RPS nontreated	2.41 c
½ yard RPS surrounded by NRPS	2.35 c
RPS backhoed only	2.27 c

Numbers followed by the same letter are not significantly different from one another ($P = 0.01$). RPS is replant soil.

This work partially funded by the California Almond Board, California Cling Peach Board, California Tree Fruit Agreement, and a cooperative agreement with the USDA.

Nutritional Deficiencies as a Component of the Peach Replant Problem

by
Michael V. McKenry and Tom Buzo

A benefit associated with soil fumigation is the increased growth response (IGR) it provides to the planting that follows. IGRs are demonstrated by their occurrence in the absence of known soil problems and they appear to be a result of improved nitrogen availability or status. In this work we set out to identify alternative methods for providing an IGR, but instead we learned that subtle nutritional deficiencies are a common occurrence when peaches or walnuts are replanted.

In a peach replant site infested with *Pratylenchus vulnus* three preplant soil treatments were imposed in the fall with replanting the next spring. Treatments included: 1) A solution of Vapam® at 500 ppm (mg/l) MIT delivered in an 8 hr irrigation using a drip line with 2 l/hr emitters spaced 0.6 m apart; 2) Methyl bromide (MB) applied by injecting 1.12 kg/ha at 0.6 m depth every 3.3 m in distance; and 3) Nontreated check. There were four replicates of each treatment randomly placed down the old tree rows with 30 trees/row spaced 1.3 m apart. Tree rows were 6.6 m apart. Six sub-treatments having the possibility to promote an IGR were then randomly applied to each of five adjacent trees down each row. Enzone® was applied to planting sites 45 days before planting by digging a 0.5 m by 0.6 m deep hole caving in the side walls and then drenching 40 l water containing 1000 ppm CS_2. Other sub-treatments were made on the day of planting and they included: New Era Compost® mixed into planting hole at 0.18 kg/site; 0.36 kg/site steer manure sprayed with 92 ml/site Hinder®; an ammonium soap; Hinder® sprayed alone; complete fertilizer consisting of NPK + Super Micro®, and a nontreated comparison. The fertilizer treatment consisted of solubilizing 100 g 15-15-15 fertilizer into 8 l water adding 8.3 ml Super Micro® to it and drenching it to the selected tree sites. Once planted the dripper tube was also used to deliver monthly fertilizations of 11 kg/ha nitrogen in the form of calcium nitrate to all plants.

Within four weeks of treatment the Enzone® treated trees appeared to be negatively impacted. At six weeks the treatment of NPK + Super Micro® yielded the best appearing trees. At 12 weeks after planting the MB treated trees were visibly better than the more chlorotic and stunted Vapam or nontreated check comparisons. The compost treatment did not appear beneficial until 20 to 25 weeks after planting. In the fall all trees were cut to ground level and weighed. Soil samples were collected, and *P. vulnus* extracted by sieve-misting and then counted.

Results are depicted in Table 1. The strip treatments of MB or MIT gave one year of nematode protection. The NPK + Super Micro® treatment was highly beneficial to plant growth regardless of preplant treatment. In this experiment even the nonfumigated trees benefited from NPK + Super Micro®. In other experiments the fertilizer treatment appears to be of benefit even when trees are planted into nonreplant sites and it is as beneficial to walnut trees as to peach but applications need to be made before mid summer of the first year. The cost of NPK + Super Micro® is 6¢/tree and it corrects a nutritional need experienced by young trees. Its benefit may not be a result of the replant problem. It is not the IGR response we were searching for and it is not nematicidal. However, the benefit it provides is even greater than that from the IGR and any experimentation with MB alternatives for tree and vine crops should include the use of complete fertilizers. Conventional wisdom of fertilizing first-year trees with only a nitrogen source appears to be in error.

This work partially supported by Cling Peach Board, California Almond Board, California Tree Fruit Agreement, and California Table Grape Commission.

Table 1. First-year growth of peach replants and buildup of *P. vulnus* following three preplant treatments and six planting site treatments.

TREATMENT					
Preplant	At Planting Site	Growth in kg/tree		*Pratylenchus vulnus* / 250 cm³ Soil Sample	
MB	NPK + Super Micro®	2.24	a	0.25	c
MIT	NPK + Super Micro®	1.82	a b	23.	c
MB	Compost	1.75	a b c	66.	b c
Nontreated	NPK + Super Micro®	1.64	b c d	316.	c
MB	Hinder®	1.54	b c d e	0.5	c
MB	Enzone®	1.42	b c d e f	0	c
MB	Nontreated	1.25	c d e f	0	c
MB	Manure + Hinder®	1.24	c d e f	0.25	c
MIT	Compost	1.20	c d e f	2.	c
Nontreated	Compost	1.17	d e f	688.	a
Nontreated	Hinder®	1.13	d e f	335.	a b c
MIT	Hinder®	1.05	e f	1.	c
Nontreated	Nontreated	1.03	e f	450.	a b c
MIT	Enzone®	1.02	e f	0.4	c
MIT	Nontreated	0.99	e f	18.	c
MIT	Manure + Hinder®	0.98	e f	432.	a b c
Nontreated	Manure + Hinder®	0.95	f	552.	a b
Nontreated	Enzone®	0.93	f	88.	b c

Note: Values followed by a different letter are significantly different at P = 0.05

A Novel Approach to Provide Partial Relief from the Walnut Replant Problem

by
Michael V. McKenry and Tom Buzo

Remnants of woody roots and associated rhizosphere microbes can survive a number of years after tree or vine trunks have been removed. Live roots of *Prunus* spp. may survive for two years, *Juglans* spp. for more than three years and *Vitis* spp. for more than eight years. Soil fumigations involving methyl bromide or 1,3-dichloropropene have historically provided a method for complete and quick kill of remnant roots within the surface 1.5 to 2 m depth. Kill of these roots results in rhizosphere changes that provide partial relief from the replant problem. In a recent study foliar-applied glyphosate herbicide resulted in 85 to 95% root kill to a peach orchard six months after treatment. Unfortunately, the eggs of *Pratylenchus vulnus* survived within killed roots for two years after treatment.

Two hundred trees of the two major walnut rootstocks, *J. hindsii* and *J. hindsii* x *J. regia*, were planted in 1989 in a 0.5 acre planting site near Parlier, CA. In October 1994 each of five trees of each rootstock received a 10 g ai herbicide treatment applied either to the foliage or to the cut trunk surface. Over the next year above- and below-ground assessments of tree viability were made. Foliar sprays of Envy®, Garlon® or Roundup® were compared with trunk-paint treatments with or without the addition of diesel oil. Trunk applications involved chain saw removal of the 10 to 25 cm diameter trunks followed by the forming of a concave surface on the cut trunk. Into each newly-formed trunk cup was painted 10 g ai of each herbicide with or without a smaller quantity of diesel oil. One year after treatment a backhoe was used to visually rate root viability down to 2 m depth. At that time roots were collected, rinsed free of soil and the *P. vulnus* were mist-extracted from a known root mass and counted.

Foliar applications of the herbicides were generally ineffective as indicated by new growth above ground and the abundance of live roots present one year later (see Table 1). However, there was also a significant reduction in the count of *P. vulnus* from roots of trees receiving some of the foliar herbicides.

Applications of the herbicides to cut trunks provided greater root destruction, and in many cases no regrowth aboveground the following year. The addition of diesel oil to the painting solution improved root kill. The rootstock choice did not influence root kill so the data sets in Table 1 are compiled across the two rootstocks. Root kill of 97% plus reductions in the *P. vulnus* populations by 98% resulted from a trunk treatment of Garlon 3A® plus diesel oil. Unlike our previous work with peach, the roots of *Juglans* spp. degenerate into a moistened, sloughing surface when killed by systemic herbicides. The leaking of tannins and phenolic compounds throughout the root cortex is likely important in the reduction in *P. vulnus* populations surviving there. Ninety-eight percent reductions in *P. vulnus* will not protect the new trees beyond one year so an additional soil treatment will need to be coupled into the replanting strategy.

This work partially supported by California Walnut Board.

Table 1. Root viability and *Pratylenchus vulnus* populations in walnut roots one year after various systemic herbicide treatments.

Foliar Applications	Surviving Tree Tops	Surviving Roots	Surviving *P. vulnus*/g root
Nontreated	100 %	99.5 a	258 a
3% Envy®	100	86 a b	10 b c
3% Garlon®	Trunks only	72 b	54 b c
3% Roundup®	100 %	87 a b	34 a b c
Applications to Cut Trunk	(Trunk Cup Method using 10 g ai herbicide)		
Nontreated		100 a	150 a b c
22 ml Envy®		85 a b	150 a b
27 ml Garlon®		30 c	0 c
27 ml Roundup®		95 a	9 b c
22 ml Envy® + 11 ml diesel		35 c	1.5 c
27 ml Garlon® + 13.5 ml diesel		3 d	3 c
27 ml Roundup® + 13.5 ml diesel		72 b	27 b c

Note: Values followed by a different letter are significantly different ($P = 0.05$) based on ANOVA and Duncan's Multiple Range Test.

Workgroup/Department California Almond Board

University of California
Division of Agricultural Sciences

Project Plan/Research Grant Proposal

Project Year 1997 **Anticipated Duration of Project** final year

Project Leader Michael V. McKenry **Location** Kearney Agricultural Center

Cooperating Personnel

Project Title Alternatives and improvements to soil fumigation with methyl bromide

Keywords Telone, Vapam, rotation crops, replant problems, nematodes

Commodity(s) Trees, vines **Relevant AES/CE Project No.** 4166H

Problem and Its Significance:

Methyl bromide is the last pre-plant soil fumigant which, when properly applied, kills roots and soil microbes throughout the surface 5 ft of soil. The current estimate is that 20 to 70% of the applied product is volatilized from the soil surface. Polyethylene tarps slow the volatilization rate but not the overall amount. In 1987 I published an article indicating there would be a 25% reduction in efficiency of tree and vine production if the soil fumigants are lost. Nematode resistant rootstocks are not a replacement for pre-plant treatments but are more accurately a replacement for post-plant nematicides. The current alternative to soil fumigation is 4 years of fallowing, a very expensive option. The need for a replacement is critical.

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.

Plans and Procedures:

There are at least 3 different situations a grower faces which we will be studying: 1) sites with soil pests present but no large woody roots present (this is the area we are studying for the nursery industry); 2) sites with woody roots and soil pests present but rootstocks are available to control the major soil pests; 3) number 2 above but with no resistant rootstocks available.

Specific procedures and methods to evaluate for 1997:

1. Backhoe site treatments continued.
   a) MB by existing low volume irrigation.
   b) 1,3-D EC by existing low volume irrigation.
   c) 210° F water.
   d) 210° F water plus nematode repellents sprayed to side walls.
   e) Filling the biological vacuum.
   f) Virgin soil added back; how much?
2. Field evaluations of treatment packages initiated:
   a) Walnut replants.
   b) Stone fruit and almond replants.
   c) Grape replants using nematode resistance and MIT or Telone via existing drip system.

(continued on reverse)

BUDGET REQUEST **Budget Year:** 1997-98

Funding Source California Almond Board

Salaries and Benefits			
Postdocs/RAs			
SRAs	SRA III		$6,500
Lab/Field Assistance			
Subtotal		Sub 2	$6,500
Employee benefits		Sub 6	$3,500
		TOTAL	$10,000
Supplies and Expenses		Sub 3	
Equipment		Sub 4	
Travel		Sub 5	
		TOTAL	**$10,000**

Department account number 5-440355

Plans and Procedures (continued from front)

3. Can a non replant problem soil (= virgin soil) be made?
4. For Prunus spp. can trunk applied systemic herbicides be as effective as foliar applied?
5. Continue search for a systemic herbicide that kills grape roots.
6. Field evaluation of additional chemical treatments:
   a) Methyl iodide.
   b) Picric acid plus calcium hypochlorite.
   c) 1,3-D shanked plus shallow drench of MIT.
   d) Enzone drench.
   e) Oxycom drench.
   f) Precursor to acrolein.
   g) Urea drench, then barley.
   h) Fosthiazate systemic nematicide applied to Prunus trunks.

	Originator's Signature [signature]		Date Nov. 26, 1996
COOPERATIVE EXTENSION	County Director		Date
	Program Director		Date
AGRICULTURAL EXPERIMENT STATION	Department Chair	[signature]	Date Nov-27/96
LIAISON OFFICER			Date