UNIVERSITY OF CALIFORNIA COOPERATIVE EXTENSION

Kearney Plant Protection Group

PLANT PROTECTION QUARTERLY

October 1995 **Volume 5, Number 4**

James J. Stapleton, Charles G. Summers, Beth L. Teviotdale, Peter B. Goodell, Timothy S. Prather
Editors

IN THIS ISSUE

EXPANDED SUMMARIES

1995 ANNUAL INTERNATIONAL RESEARCH CONFERENCE ON METHYL BROMIDE ALTERNATIVES AND EMISSIONS REDUCTION, November 6-8, 1995, San Diego, CA

Mitigating the Volatilization Associated with Telone.
Michael V. McKenry and Tom Buzo, U. C. Kearney Ag Center

In 1972 this author reported the volatilized amount following a 280 kg/ha shankless, 30 cm deep injection of 1,3-Dichloropropene (1,3-D) in a drying soil to be 2% of the applied. Using shanks the volatilized amount could reach as much as 20% depending on the attention given to filling and compacting of soil behind the delivery shanks (1). Eighty-five percent of the volatilization occurred between day 1 and day 5 with the peak amount on day 3. Excessive volatilization and the subsequent 1990 suspension of 1,3-D use in California prompted the development of new shank delivery designs, maximum treatment rates of 135 kg/ha, and higher soil moisture content at the time of treatment (2). As a consequence, 1,3-D is now permitted for selective use in California. Unfortunately, in old vineyard and orchard sites treatment rates of 400 kg/ha applied to a dried soil are required to kill remnant roots down to 1.5 m depth and provide control of

This material is based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project section 3(d), Integrated Pest Management

endoparasitic nematodes to 99.5% of the nontreated as much as two years after treatment (3).

There are at least three approaches that may be used to mitigate 1,3-D volatilization at these higher treatment rates. Sealing the field surface with a poly film tarpaulin doubles the treatment cost but also presents special exposure problems during tarpaulin removal. A second approach involves delivery of 1,3-D at 75 cm depth instead of the usual 30-45 cm depth. With shank traces properly filled and compacted there would be less of the 1,3-D and it would not reach the field surface for 48 hr (1). The use of moveable sprinklers utilized intermittently to produce a surface seal between 36 and 120 hr after treatment should be evaluated.

A third approach, and the one we have studied most, involves drenching of the field with 15 cm-ha water containing 366 kg/ha emulsified 1,3-D uniformly injected into it (3). Two years after making such a treatment it is now apparent that each of seven selected tree and vine crops planted 6 mo after treatment has grown comparable to that achieved following shanked methyl bromide or 1,3-D. Control of root lesion nematode, *Pratylenchus vulnus* and citrus nematode, *Tylenchulus semipenetrans*, one year after treatment was 99.5% of the nontreated.

In two separate drench sites we also monitored 1,3-D volatilization. Both sites involved a dripper emitter located at each 30 cm interval across the field, but in one site they laid on the field surface and in the other they were buried 30 cm deep. Unfortunately, the water infiltration rate for this soil was closer to 15 cm in 10 hr rather than the preferred 15 cm in 8 hr or less. Puddling occurred in the buried-emitter site as well as the on-surface site. Two weeks of continuous air monitoring from a point 15 cm above the field surface revealed that two-thirds of the volatilization from the surface drip occurred in the 12 hr period during application. Volatilization from the buried drip was half of that from the surface drip with peak volatilization occurring in the 12 hr period just after application. These data suggest that by drenching 1,3-D one can reduce volatilization as it becomes locked into the soil profile with water. A reusable poly film tarpaulin may need to become a component of the drenching device when broadcast treatments are made in soils with slower water infiltration.

A fourth approach with 1,3-D is now apparent. Emulsified 1,3-D delivered via existing low-volume irrigation systems can provide kill of tree and vine roots before removal of the planting. Minimal 1,3-D volatilization would occur because 1) less 1,3-D would be used per hectare and 2) puddling of water in that area can be kept to a minimum. Strip treatments such as this would only be applicable where resistance to soil pests is also available.

Literature Cited

1. McKenry, M.V. 1972. The Behavior of Pesticides Containing 1,3-dichloropropene and 1,2-dibromoethane in Soils. Nematology Dept. UC Riverside Ph.D. Thesis, 110 pp.
2. Melichar, M.W. and D.M. Roby. 1994. Telone Soil fumigants – Regulatory Status Report. J. of Nematology 126:559.
3. McKenry, M., T. Buzo, J. Kretsch, S. Kaku, E. Otomo, R. Ashcroft, A. Lange, and K. Kelley. 1994. Soil Fumigants Provide Multiple Benefits; Alternatives Give Mixed Results. California Agriculture Vol. 48:3, pp. 22-28.

Key Points

1. Deep placement of 1,3-D and strip drenching of 1,3-D via existing drip systems should be field tested.
2. Drenching a soil with 1,3-D alters the timing of the peak volatilization event.
3. Drenched 1,3-D EC provides nematode control and kill of remnant roots comparable to shanked 1,3-D.

Implications

1. Treatment rates higher than those currently allowed in California are needed for orchard and vineyard sites. Drenching via drippers offers an opportunity to reduce 1,3-D volatilization.

First-year Evaluation of Tree and Vine Growth and Nematode Development Following 17 Pre-plant Treatments. *Michael McKenry, Tom Buzo, and Stephanie Kaku, U. C. Kearney Ag Center*

In a two hectare plum replant site three separate experiments were conducted. On half the site trees were removed, soil was ripped to 0.7 m depth and a dual application of 366 kg/ha methyl bromide (MB) was compared to 40 days flooding or a 732 kg/ha drench of methyl iso-thiocyanate (MIT). The plot was split with rootings of Nemaguard Peach, Black Walnut, Dr. Huey Rose, Marianna 2624 Plum, and Teleki 5C Grape either replanted in 6 mo. or after 18 mo. of crop rotation involving Barley, Sorghum x Sudan and Cahaba White Vetch.

On the adjacent one hectare the existing plum trees received a foliar spray of 2% glyphosate 60 days before

their removal. The field was then planted to barley. After discing under the barley, ripping to 1.3 m and resettling the soil, treatments were drenched into the surface 1.6 m of soil profile. To this half the field all trees and vines were replanted a full 18 mo. after tree removal. Six months after the glyphosate treatment there was 80% kill of old Nemaguard roots and 40% kill of old plum roots. Populations of *Pratylenchus vulnus* nematode were still present within the root systems two full years after the glyphosate treatment. Populations of *Tylenchulus semipenetrans* nematode also remained alive around the plum roots two years after the glyphosate.

Each October after replanting the growth of five reps of each of five plant cultivars was destructively sampled. Plant growth was compared to the nontreated that were replanted 6 mo. after tree removal. For example, several treatments produced plants that were 7 to 11 times larger than the nontreated. The multiple for plant growth improvement was averaged across the five plant cultivars to provide a single value which depicts relative plant growth.

Four treatments provided nematode control one year after treatment that was 99% of the nontreated. These four treatments also provided plant growth 7.0 to 8.5 times better than the nontreated that was planted 6 mo. after tree removal. The four comparable treatments included: 1) MB at 366 kg/ha followed by an 18 mo. crop rotation; 2) MIT at 732 kg/ha followed by 18 mo. crop rotation; 3) Glyphosate-treated site followed by a drench of emulsified 1,3-D at 366 kg/ha and 4) MB at 366 kg/ha replanted after 6 mo.

A fifth treatment, glyphosate followed by acrolein drench at 366 kg/ha gave plant growth of 8.3 times the nontreated but after one year the nematode control averaged only 50% among the three most susceptible hosts.

Three treatments that provided plant growth comparable to the above-mentioned but provided no long-lasting nematode relief included: 6) 40 days flooding then 13 mo. sorghum x Sudan and vetch; 7) glyphosate followed by MIT drench at 366 kg/ha and 8) glyphosate followed by 18 mo. fallow.

Replanting 3 m away from the old tree row provided 2.6 times more growth in the first year but no nematode relief. Flooding for 40 days and planting within two months did not provide kill of remnant roots or nematode reductions and plant growth was only 1.4 times the nontreated.

Fallowing or crop rotation for 18 mo. greatly improved growth of replants but didn't provide adequate nematode relief against endoparasitic nematodes which remained in roots.

A drench of urea gave 95% nematode relief in soil but didn't reduce populations of endoparasitic nematodes within roots. A drench of marigold tea plus urea followed in one month by 1 ha-m irrigation gave control of soil-dwelling nematodes without creating a biological vacuum. Plant growth of 4.6 times the nontreated indicated, however, that a phytotoxic residue remained in the soil. A drench with 366 kg/ha chlorine gave surprising benefit to the growth of peach but nematode control in soil and in remnant roots was inadequate. Drenches are very useful in sites where 15 cm water can be delivered within 8 hr. These drenches were each delivered throughout the surface 1.7 m of soil using a portable soil drenching device.

Key Points

1. MIT liberators are mediocre in performance against old peach roots.
2. Trees and vines do not grow well after 200 gpa Vapam – wait one year.
3. Crop rotations do not reduce nematode populations within remnant roots.
4. Roundup killed old roots of peach but not endoparasitic nematodes within.
5. Flooding 40 days did not kill remnant roots of Prunus.
6. Replanting 10 ft. away from the old tree row improved growth of replants but only for the first year.

Implications

1. For Vapam to perform like MB or 1,3-D there will need to be a 12 to 18 mo. waiting period after a high treatment dose.
2. The nonchemical approaches improved growth of replants when they also included an 18 mo. waiting period. They did not reduce nematode counts within remnant roots.
3. Drenching of biocides can be accomplished by a variety of methods if the soil will take the water fast enough.

Biofumigation and Solarization for Soil Disinfestation. *James J. Stapleton, UC Kearney Ag Center*

Solarization is used commercially in California, primarily in the interior valleys where air temperatures are very high during summer and/or land is out of production (creating a window of opportunity to use solarization between crops).

Currently, most growers in California using solarization are those having some aversion to synthetic chemical disinfestants, either because of their close proximity to urban areas or because they are growing "organic" produce. A number of conventional farming operations are routinely solarizing in order to have a basis of knowledge so they could switch practices, if necessary, and maintain a predictable soil disinfestation program.

In many cases, solarization can be economically aided by integrating the treatment with other disinfestation methods. Numerous previous studies have shown that solarization may be productively combined with chemical and biological control methods. There is considerable interest in combining solarization with organic soil amendments to achieve biofumigation. This integrated method has been shown to be of value in both open field disinfestation and in preparation of containerized planting mixes. For example, In vitro amendment of soil with cruciferous plants including black mustard, bok choy, broccoli, cabbage, cauliflower, and black radish reduced germination of *Pythium ultimum* by 52-91% and of *Sclerotium rolfsii* by 2-65% ($P<0.05$) over the nontreated control after 7 days in incubated soil. Addition of a sublethal, diurnal heating regime (38 C maximum/27 C minimum) to the 7 day incubation period reduced germination of *P. ultimum* and of *S. rolfsii* by 97-100% and 87-100%, respectively.

Reference

Stapleton, J.J., and DeVay, J.E. 1995. Soil solarization: A natural mechanism of integrated pest management. Pages 309-322 in: Novel Approaches to Integrated Pest Management, R. Reuveni, editor. Lewis Publishers, Boca Raton.

It is a Long Road from the Finding of a New Rootstock to the Replacement of a Soil Fumigant. *M. V. McKenry and J. O. Kretsch, U.C. Kearney Ag Center*

Culminating eight years of small plot evaluations we recently reported the finding of three grape rootstocks with “broad nematode resistance.” Our first four years were spent identifying the nematode susceptibilities of existing rootstocks (see Table 1). Meanwhile, Dave Ramming of the USDA Plant Breeding Station in Fresno, CA was in possession of more than 500 mature vines that had been collected over decades and occasionally submitted to various screenings. Knowing our specific needs, we set out to find sources of resistance to three very aggressive Meloidogyne populations. Our definition for resistance is a lack or near lack of reproduction by the nematode on the cultivar over a two-year period. Thirteen of the USDA cultivars met our objective so we looked further to identify, one species at a time, the breadth of their resistance to each of the other common nematode species on grape in California.

Table 1. Susceptibility or resistance of various grape cultivars to various nematode populations.

	Populations of *Meloidogyne* spp.									*Xiphinema* spp.				
Rootstock	Mi	Mj	Mm	Ma pt H	Ma pt F	Mc-L	Mc-D	Pv [1]	Ts [2]	Xi	Xa	Xc-1	Xc-2	Cx [3]
Ramsey	R	R	R	HS	HS	S	R	R	S	9	71	-	-	100
Freedom	R	R	R	HS	HS	R	S	SS	S	2	10	S	-	50
Dog Ridge	R	R	R	HS	HS	-	-	S	S	24	15	-	-	123
1613C	R	R	MR	HS	HS	S	S	SS	S	7	72	-	-	164
Harmony	MR	R	R	HS	HS	S	S	SS	S	24	52	-	-	35
Teleki 5C	SS	MR	S	HS	HS	-	-	S	S	9	72	-	-	65
Oppenheim-4	SS	MR	S	S	-	-	-	S	S	6	43	-	-	65
Schwarz.	S	MR	S	HS	HS	-	-	SS	S	5	13	-	-	42
039-16	S	S	HS	S	S	-	-	S	S	2	5	S	-	-
99R	HS	S	S	S	-	-	-	S	SS	54	28	-	-	71
3309C	HS	S	HS	HS	HS	-	-	SS	S	20	44	-	-	136
Thomp. S.	S	S	HS	HS	S	S	HS	S	S	100	100	100	-	100
Flame S.	S	S	HS	S	S	S	S	S	S	154	32	-	-	185
Rubired	S	S	S	S	-	-	R	S	SS	365	51	-	-	59
K51-32	R	SS	S	S	-	-	-	R	S	2	52	-	-	272
Grenache	-	-	-	-	-	-	-	-	-	-	-	-	-	251
USDA Selections														
6-19B	R	R	R	SS	-	R	MR	R	R	15	2	1	30	12
10-17A	R	R	R	R	-	R	R	R	R	2	-	1	16	24
10-23B	R	R	R	R	-	R	R	R	R	5	-	1	7	19
Ramsey x Schwarzmann Selections														
RS-9	R	R	R	R	R	R	R	-	-	-	-	-	-	-
RS-3	R	R	R	SS	-	-	-	-	-	-	-	-	-	-

Resistant	R = <0.2 nematodes/gr root	
Moderate resistance	MR = 0.21 to 0.6 nematodes/gr root	- = no data
Slightly susceptible	SS = 0.61 to 3.0 nematodes/gr root	
Susceptible	S - 3.1 to 180 nematodes/gr root	
Highly susceptible	HS = 180+ nematodes/gr root	

For ectoparasites population buildup is expressed as a percentage of that level built up on Thompson Seedless. Levels of 100 are normal, levels of 10 or less indicate resistance.

[1]*Pratylenchus vulnus*, [2]*Tylenchulus semipenetrans*, [3]*Criconemella xenoplax*

The notion that these three rootstocks or any others will replace methyl bromide is premature. First, methyl bromide solves the replant problem by killing nematodes and most everything else in soil. Although these rootstocks do not permit nematode reproduction they may not stop nematode feeding. Since remnant grape roots can survive in soil as much as a decade after vine removal, there can be an abundant supply of nematodes and viruses in the proximity of newly planted grape roots.

To answer the question of how well these potential rootstocks replace soil fumigation, at least three additional screenings are needed. First, using four or five different replant soils, how well do the rootstocks grow compared to nonreplant or fumigated soil? This test is now underway. Second, do these rootstocks tolerate nematode feeding? Tolerant rootstocks are the ones that grow as well in the presence of nematode feeding as in their absence. Freedom and Ramsey grape rootstocks, for example, actually grow significantly better (35%+) in the presence of limited nematode feeding. By contrast, cultivars of *V. vinifera* commonly grow significantly less (12-50%) in their first year of exposure to nematode feeding. The third screening should be across a variety of common soil pests including Phylloxera *Daktalosphaeria vitifoliae*, Phytophthora spp. and *Armillaria mellea* as well as their performance in droughty soils, calcareous soils, shallow soils, etc. It has been our experience that field-level rootstock trials can go

on in abundance for decades and provide only partial answers to specific soil and pest questions. We need to be more efficient at learning the limitations of rootstocks.

If there is inadequate resistance or tolerance by the rootstock to the replant problem, growers will continue to need either strip or spot treatments of soil fumigant before planting. Or, with broad nematode resistance planted to primarily nematode problem sites we may be able to use "softer" pre-plant treatments. For example, growers with an existing dripper system may be able to apply products at biocidal rates to mitigate some of the replant problem and then rely on broad nematode resistance for the lifetime of the vineyard. One point to be remembered is that resistance to nematodes is a helpful tool once the vineyard is established but there are no examples of it being useful in solving replant problems where vineyards or orchards are removed one year and replanted the next. The second point is that there are no universally acceptable rootstocks, whereas soil fumigants have a history of very broad acceptance among a range of high-value crops.

Key Points

1. Among *Vitis* spp. it is possible to find "broad nematode resistance."
2. Resistance to nematodes does not also provide protection against the replant problem and other pests.

Implications

1. Relative to soil pests, rootstocks offer specific pest protection whereas soil fumigants offer broad protection.
2. There will continue to be a need for strip or spot treatments of fumigant unless new rootstocks are also successfully screened against the replant problem and other soil pests.

Evidence for the Development of a "Biological Vacuum" in Soil Following Pre-plant Soil Fumigations or Drenches. *Michael McKenry, Stephanie Kaku, and Rulon Ashcroft, U.C. Kearney Ag Center*

Soil sterilization reduces soil microbe populations that are beneficial as well as those that are detrimental to plant growth. Following soil fumigation, plant parasitic nematode species can be reduced to nondetectable levels (1). Subsequently-planted trees or vines respond favorably to the treatment for at least these reasons: 1) The lack of soil pests, 2) The lack of microbes not usually considered as pests or disease incitants, and 3) These plants also exhibit an "increased growth response" (IGR) due to changes in nutrient availability (2). Participants in soil fumigations have occasionally observed a fourth phenomenon in that the first microbes that are reintroduced into fumigated soil develop greater abundance than if they were introduced into nonfumigated soil. These organisms appear to be filling a "biological vacuum" but since the treated vines or trees also grow many times faster than the nontreated it has been difficult to quantify the impact of a biological vacuum. In a separate paper at this conference an example involving Vapam was presented illustrating the importance of remnant roots as a protective habitat for endoparasitic nematodes and the ability of those nematodes to rebuild quickly within treated soil. In conducting those same experiments we inadvertently observed a "biological vacuum" effect in more quantifiable terms.

Six months before various tree and vine crops were replanted a variety of "softer" soil drench treatments were compared. Nematodes in the field included *Pratylenchus vulnus*, *Tylenchulus semipenetrans*, and *Paratylenchus hamatus*. The latter nematode is usually an ectoparasite but in a few crops including Dr. Huey Rose this nematode occurs as an endoparasite. In fact, the bareroot roses we planted to the field were contaminated with a low population level of *P. hamatus* at planting. A drench treatment of 366 kg/ha 1,3-D resulted in no plant parasitic nematodes on six of seven hosts. Six months after planting, however, a population of *P. hamatus* was present at threefold the level present in the nontreated sites when planted to rose. By contrast, the nontreated sites had *P. hamatus*, *P. vulnus*, and *T. semipenetrans* across all seven crops. This threefold population increase over the nontreated also occurred after drenches of Vapam and Acrolein (see Table 1). By contrast, treatments of marigold tea plus urea resulted in *P. hamatus* populations on rose very similar to those of the nontreated, and very similar to those on the other crops planted. In this experiment the marigold and urea treatment provided tree and vine growth at slightly less than those treated with Acrolein, 1,3-D or Vapam. For tree and vine crops the existence of a biological vacuum carries two significant impacts. First, we should be learning how to add back or stimulate beneficial organisms after soil treatment. Secondly, treatments that might miss specific life stages of soil pests need to be evaluated for at least two growing years after treatment. The MIT and Acrolein treatments, for example, can be expected to result in very high populations of *P. vulnus* in the second year.

Literature Cited

1. California Agriculture. 1994. Vol. 38(3), pp. 22-28.
2. Phytopathology. 1979. Vol. 69(8), pp. 793-797.

Table 1. Plant biomass and nematode populations one full year after planting *P. hamatus* contaminated roses into infested soil that had received three conventional biocides compared to a "softer" treatment of marigold tea plus urea.

Soil Treatment	Plant Growth (g/plant)	Nematodes/250 cm^2 soil	
		P. Hamatus	*P. vulnus*
1,3-D	1185 ns	742 a	0 a
MIT	1108	802 a	227 a
Acrolein	1068	743 a	81 a
Marigold Tea Plus Urea	779	243 b	295 a
Nontreated Control	969	204 b	1292 b

Variance of the means was analyzed and subjected to a T test. Means in each column followed by a different letter are significantly different from each other ($P < 0.05$).

Key Points

1. Following the use of biocides a biological vacuum is created. However, a drench of marigold plus urea did not create such a vacuum.

Implications

1. We should learn how to use a biological vacuum to advantage when adding biocontrol agents to treated soils.
2. Biocide treatments that miss a life stage or refuge site of the pest can result in greater abundance of the pest.

ABSTRACTS

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, Pittsburgh, PA, August, 1995

Thinned Infected Stone Fruit as an Inoculum Source of *Monilinia fructicola* in California. *B. A. Holtz, R. Kölliker, and T. J. Michailides, U. C. Davis/Kearney Ag Center*

Immature Fantasia nectarines were found infected and sporulating with *Monilinia fructicola* conidia after they were thinned from trees and left on the ground. Experiments were conducted to determine whether the placement of thinned fruit in irrigation trenches would enhance its decomposition and reduce this source of brown rot inoculum. Of an average of 1,200 thinned fruits per tree, 36.2% showed *M. fructicola* sporulation one month after thinning. There was significantly less ($P < 0.05$) sporulation on thinned fruit in the irrigation trenches when compared to fruit on the dry berms. There was also significantly ($P < 0.05$) less conidia per infected fruit, and the % germination was also less. Latent infections of thinned fruits were determined after sterilizing (0.08% NaOCl, 1.6% EtOH, 0.05% Tween 20, 4 min), freezing (-23 C, 15 h), and incubating the fruit for 7 days (21 C, 10 h light, > 97% RH), and were positively correlated ($r^2 = 0.97$) with percent brown rot at harvest. Mummified thinned fruits, which had survived on the berms for over 3 months, were collected and incubated in moist sand (> 95% RH) in the dark for 8 wk at 2 C, and then for 2 wk at 15 C with a 12 h photoperiod. Apothecia were produced from 1% of these thinned fruit. These results suggest that infected thinned fruit can provide both primary (ascospores) and secondary (conidia) inoculum.

The Relationship of Shell Discoloration to Fungal Decay for Pistachio Nuts. *D. A. Doster and T. J. Michailides, U. C. Kearney Ag Center*

Although only a small percentage of pistachio nuts in commercial orchards have both hull and shell split, these nuts ("early splits") are the major source of fungal-decayed kernels. Fortunately, such nuts frequently have discolored shells which could assist in removal during processing. Nuts that split their hulls earlier in the season had more shell discoloration than nuts that split later. For example, 67% of the nuts that had hulls split before 12 August had extensive shell discoloration (>10% shell surface) compared to only 13% of the nuts that split after 26 August. Discoloration along the suture where the shell splits was a common characteristic for early splits. Pistachio nuts were obtained from two processors, separated according to the shell appearance, and evaluated for kernel quality. Nuts in the following four categories frequently had fungal-decayed kernels: oily shell, crinkled shell, extensive dark brown shell discoloration, and limited (<11%) dark brown shell discoloration along the suture. However, nuts with limited dark brown discoloration (none along the suture) or with yellow shell discoloration almost never had fungal-decayed kernels. Therefore, the processors need to remove only those nuts with certain types of shell discoloration.

Using Subsurface Drip Irrigation to Reduce Alternaria Late Blight of Pistachio Caused by *Alternaria alternata*. *T. J. Michailides, D. P. Morgan, and David A. Goldhamer, U.C. Kearney Ag Center*

The effects of subsurface (75 cm deep) drip and flood irrigations on Alternaria late blight of pistachio were compared using a randomized complete-block design with five replications of 12 rows (800 m long) of trees. Subsurface drip irrigation resulted in significantly lower incidence and severity of infected leaves by *A. alternata*. For instance, by commercial harvest time only 11% of the leaves in the drip-irrigated blocks were infected while 54% of those in the flood-irrigated blocks. Furthermore, subsurface irrigation reduced the incidence of infected fruit to 22% while 51% of the fruit from trees irrigated by flooding were infected. However, subsurface drip irrigation resulted in ten times more Aspergillus fruit blight (1.3%) than flood irrigation. *A. alternata*, other filamentous fungal, and yeast propagules on leaves and fruits were not affected by the irrigation type. Subsurface drip irrigation resulted in shorter periods of dew, lower relative humidities, and higher temperatures, which can explain the differences in disease levels between the two irrigation systems. In addition, subsurface drip irrigation substantially improved nut quality (more shell splitting and less shell stain and fewer blank nuts) without lowering yield.

Residual Effects of Treatment on Control of Olive Leaf Spot Caused by *Spilocea Oleaginea*. *B.L. Teviotdale and G.S. Sibbett, U. C. Kearney Ag. Center and UCCE Tulare County*

Olive trees treated annually in two consecutive winters with one or two applications of copper fungicide were left untreated the immediate following winter, then treated the next winter with one application of Bordeaux mixture. Percent healthy and diseased leaves among ten adjacent leaf pairs were evaluated on 20 randomly selected shoots each May. In a second experiment, cupric hydroxide was applied once in November or January or in both November and January on annual or biennial schedules for three years. All trees were treated the following two winters with cupric hydroxide. In May of the first three years, percent healthy and diseased leaves were determined among ten adjacent pairs of leaves on ten shoots which were selected on each tree before treatments were made. Similar measurements were made for ten pairs of leaves on 20 randomly selected shoots on each tree the last two years. In both orchards, following similar treatment after experiments ended, treatment effects were measurable.

Spectral and Temperature Modifying Properties of Reflectorized Spray Mulch and its Role in Management of Aphid-transmitted Virus Diseases of Melons.
J. J. Stapleton and C. G. Summers, UC Kearney Ag Center

Reflectorized (silver) spray mulch can effectively deter aphid vectors from alighting on cucurbitaceous plants. In addition, the mulch usually has an unrelated, beneficial effect on plant growth. Mulch raised root zone soil temperatures 1-3 C at 6-8 cm depth, but did not affect canopy temperature. Silver mulch increased upwardly reflected light, particularly shortwave radiation, over that of bare soil. Spectral characteristics closely mimicked those of ambient, incoming radiation. Increased light intensity over that of bare soil ranged from nearly 7-fold at 330 nm (ultraviolet) to 35% at 1050 nm (near infrared). Reflectorized spray mulch delayed onset of WaMV, CMV, and ZuYMV symptoms in 'Primo F1' cantaloupe melon ca. 6 weeks under conditions of high disease pressure. Silver mulches covering 25%, 50%, 75%, and 100% of bed width increased marketable yield 9.5-, 12.5-, 13.9-, and 15.4-fold, respectively, over plants grown in bare soil.