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James J. Stapleton, Charles G. Summers, Beth L. Teviotdale Editors

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ARTICLES

EFFECTS OF NITROGEN FERTILIZATION IN STONE FRUITS ON INSECT PESTS AND FRUIT SIZE AND QUALITY

K M Daane, R S. Johnson, J. W. Dlott, G. Y Yokota, and T J. Michailides. U. C. Kearney Agricultural Center

Introduction

Agricultural researchers have been assigned the long-term task of developing sustainable programs to reduce grower dependence on fuel inputs (e.g. fertilizers, herbicides, pesticides). In stone fruits, fuel inputs begin with chemical fertilizers to increase fruit yield and size (4), and pesticides to control insect, mite, microbial, and weed pests (1). For proper plant growth the macronutrients nitrogen, phosphorus, potassium, calcium, magnesium, and sulfur are required. The balance of macronutrients is controlled by the addition of fertilizers, most commonly nitrogen, typically applied in a mix with potassium and phosphorous. Market value for peaches and nectarines is based largely on fruit color, size, and weight. Growers often use fertilizers to increase profits; however, to get maximal fruit size, growers may add too much nitrogen, the excess (e.g. that not needed for increase fruit size and yield) either increases shoot growth or remains in the soil as a contaminant.

Beyond the effect on fruit size, excess nitrogen may have deleterious effects on susceptibility of trees to attack by pathogens and arthropod pests. In 1990, we

University of California and the United States Department of Agriculture cooperating

Cooperative Extension • Agricultural Experiment Station • Statewide IPM Project

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observed that peach twig borer (PTB), *Anarsia lineatella* Zeller, and oriental fruit moth (OFM), *Grapholita molesta* (Busck), preferred young, vigorously growing peach and nectarine shoots. Not surprisingly, orchards with high nitrogen fertilization had more shoot growth and our observations indicated that more and better feeding sites allowed for a greater number of moth pests. Similarly, recent work indicated that lower incidence of brown rot, *Monilinia fructicola (G.* Wint.) Honey, is correlated to lower levels of nitrogen fertilization and that there is a natural resistance to infections by the brown rot fungi of nectarine fruits collected from underfertilized trees (5). The above observations led to a cooperative study investigating the effects of nitrogen fertilization on orchard pests and diseases and on fruit quality, size, and yield. Here we present initial results which correlate nitrogen fertilization and tree growth to infestation levels of PTB and OFM. While insect pest management is emphasized, some results from the other disciplines will be mentioned, and we plan to present that information in greater detail in future issues of the Kearney Plant Protection Quarterly.

Materials and Methods

In 1983, a nitrogen (N) fertilization rate experiment was initiated in a block of Fantasia nectarines at the Kearney Agricultural Center. Five fertilization treatments were established, organized in a randomized block design with three replicates each and five trees per replicate. The treatments were: (1) no fertilizer (2) 100 lbs N/acre/year, (3) 175 lbs N/acre/year, (4) 250 lbs N/acre/year, and (5) 325 lbs N/acre/year. This block has been maintained since 1983.

To determine N levels, 100 mid-shoot leaves located on the periphery of the canopy in well-exposed locations were sampled in each block. Only healthy leaves free from defects, blemishes, mites, etc. were sampled. These leaves were washed with a very weak soap solution, triple rinsed with distilled water, dried in an oven at about 65'C, and sent to a laboratory for determination of total N. At harvest, fruit yield and size were measured for each tree in each replicate.

To determine the effect of nitrogen levels on fruit damage by insect pests approximately 50,000 fruit were examined in 1991 for damage from OFM, PTB, omnivorous leafroller (OLR), codling moth, San Jose scale, thrips, and katydid in the five nitrogen treatments. All fruit with damage from lepidopteran pests were dissected and moth larvae found were reared to adults or to the emergence of parasitoids, on an artificial diet. This year we are also investigating shoot strikes, shoot host site condition, and insect (PTB and OFM) biology in each of the treatment blocks.

Results from the experimental nectarine block were compared to data collected in commercial orchards between 1989 and 1992. In these studies the number and location of PTB, OFM, and OLR strikes in growing shoots was examined. Mass collections of larvae and pupae also were made from tips, fruit, and cardboard bands secured around tree branches. OFM, PTB, and OLR were reared on an artificial diet and parasites emerging from this material were identified and their impact on pest mortality determined.

Data were analyzed with ANOVA using SAS and SYSTAT statistics. If the F statistic was significant, mean separation was done using Duncan's Multiple Range Test (fruit size and yield) or Tukey's HSD Multiple Comparison (insect pest damage).

Results and Discussion

The 1991 harvest data indicated that total yields and fruit weights were comparable to industry standards for the Fantasia variety. Fertilization rates between 100 and 325 lbs N/acre/year resulted in no differences in either total yield or fruit weights (Table 1). Only the unfertilized treatment significantly reduced yields. Fruit weights were quite variable among the treatments and showed no significant differences. However, much of this variability was due to differences in fruit load. When fruit load effect was accounted for, the unfertilized treatments showed a significantly smaller fruit weight (Table 1). The data support the conclusion that fertilization rates greater than 100 lbs N/acre/year do not increase yields or fruit size in Fantasia nectarine.

Nitrogen fertilization rates had a significant effect on fruit quality and maturity as measured by percent red color (Table 1). The lower rates of N induce more red coloration on the fruit and thus improve quality. Percent soluble solids and firmness also were evaluated at each harvest but showed no significant differences. However, mean firmness did increase from the low to the high N treatments and this parameter will be evaluated more closely during the

Table 1. Response of Fantasia nectarines to 9 years of nitrogen fertilization (1983-1991): Yield, fruit quality and vegetative growth parameters.

	Treatment (lbs N/acre/year)				
Parameter	0	100	175	250	325
Yield (kg/tree)	132.2b	207.2a	193.6a	222.1a	197.9a
Weight (g)	146.5	160.4	171.9	159.7	167.3
Weight (g)[1]	130.5b	165.8a	167.9a	169.4a	166.8a
Soluble Solids	11.7	11.2	10.8	10.5	11.0
Firmness Obs)	10.4	10.7	11.0	11.9	11.8
Red Color (%)	92.0	80.3b	71.6bc	68.5c	69.9c
Vegetative Growth(kg/tree)[2]	1.6c	7.2b	8.9b	14.3a	10.5b

1 Fruit weight adjusted to equal fruit load.

2 Vegetative growth measured by Topper. Different letters in the same row indicate significant differences (Duncan's Multiple Range Test, p=0.05).

Vegetative growth, as measured by topping weights, was significantly different, increasing from the low to the high N rates with the exception of the highest rate (325 lbs N), which fell below the 250 lbs N treatment (Table 1). The reduced vegetative growth in the 325 lbs N treatment may be an indication of negative effects of long term, over-fertilization. Further studies will be conducted to determine the cause of reduced vegetative growth in an over fertilized system. In summary, the 100 lbs N/acre/year rate produced yields and fruit sizes equivalent to higher fertilization rates with better fruit quality and no nutrient imbalances. Data on N effects on nectarine fruit size, color and yield and on tree health will be presented in greater detail in later publications. However, it is important to provide some information here to help weigh the importance of reduced N as an IPM tool for insect suppression.

Levels of fruit damage by key lepidopteran pests were significantly different among some of the N treatments. Figure 1 shows increasing worm damage (damage caused by PTB, OLR, and OFM were combined) with increasing N fertilization levels. The change in moth damage to fruits, in this study, is an indication of pest density in the tree and, more importantly, shows a preference for fruit from higher N fertilization levels.

(Figure not available)

Figure 1. Data from an experimental Fantasia nectarine block with five levels of nitrogen shows increasing fruit damage with increasing nitrogen (worm damage caused by peach twig borer, omnivorous leafroller, and oriental fruit moth is combined). Different letters above each bar indicate significant differences (Tukey's HSD Multiple Comparison, p=0.05).

Hypothesis: Effects of Nitrogen on Host Plant Quality

We believe that the difference in pest densities in the different N treatments resulted from changes in host plant characteristics, such as number and temporal availability of growing shoots, and to alterations of microclimate (see Table 1, topping weights). Such host plant quality changes may have direct effects on the pest survival, fecundity, or dispersal. For example, increased shoot growth results in greater canopy size and this correlates to lower temperatures (Daane, unpublished data), which may affect insect survival. The shoot physiology also changes as does the availability of fresh shoots late in the season. Lowering nitrogen levels reduces the number of available pest host sites, therefore lowering late season moth densities. The effect of early or "in season" topping to remove host sites along with the moth pests has the same results (Dick Rice, personal communication.).

Supporting Evidence

This hypothesis is supported by related work by Daane et al. (3) that examined PTB and OFM population dynamics in orchards with varying cultural practices and levels of insecticide use. The studies included numerous orchards, both with sustainable and conventional management practices, that had low OFM and PTB populations. Data collected demonstrated that orchards without insecticide applications or pheromone dispensers (OFM only) had PTB and/or OFM infestations. However, there was no significant difference in the percent parasitism of PTB and OFM between organic and non-organic orchards. From these data we conclude that between-orchard differences in pest densities cannot be accounted for solely by the activity of PTB and OFM parasites. Empirical evidence collected from organic and conventional orchards indicated that orchards with poor shoot growth generally had low pest densities, while orchards with excessive shoot growth generally had high densities of PTB or OFM. Numerous published studies have demonstrated that N can have an effect on insect populations (6). For example, lowering N levels increased resistance in corn to the European corn borer, *Ostrinia nubilalis* (Hübner) (2).

One important component of the insect/host plant relationship is the suitability of the host site. New shoots provide excellent feeding sites for both PTB and OFM larvae, but as the shoots harden off they are !less suitable, and finally unsuitable, for the developing larvae. With reduced nitrogen there is a corresponding reduction in shoot growth, especially after harvest (Yaffa Grossman, personal communication). Pest populations have fewer host sites and therefore, we believe, increased mortality from abiotic factors such as desiccation from high temperatures and/or biotic factors such as generalist predators. Figure 2A shows the percent infested shoots in the upper and lower tree canopy sections in an over-fertilized orchard. After harvest, new shoot growth continues in the upper canopy, where there was a corresponding increase in percent infested shoots. The increase in PTB and OFM populations in August and September represented an increase in overwintering populations which may damage the next season's crop. These data support the hypothesis that insect survival is closely tied to host plant physiology. Notice in the bottom graph (Figure 2B) the reduction in percent strikes in the upper canopy. This may be due to the gap between PTB and OFM generations occurring in May, but it also relates well to the period of time when fruit is maturing and moth pests may preferentially attack fruit in over-fertilized trees, as indicated in the nitrogen trial.

(Figure not available)

Figure 2: A) Percent infested shoots (M and OFM strikes) in the upper and lower canopy sections of an over fertilized peach orchard shows an increase in strike numbers in the upper canopy, corresponding to new shoot growth in the upper canopy. Asterisks under each sample date indicate significant differences between upper and lower canopy sections (Tukey's HSD Multiple Comparison, P=0.05). B) The lower graph shows a decrease in the proportion of strikes in the upper canopy which corresponds to the period of maturing fruit. Pest insects may preferentially feed on fruit at this time, returning to new growing shoots after harvest.

Conclusion

Work must be completed on pest biology, developmental time, survival, and fecundity on trees with varying nitrogen levels. Studies on many of the above mentioned factors are currently underway. Future work in the Fantasia block will more closely examine the suitability of plant host sites as they effect PTB and OFM populations, with respect to varying nitrogen concentrations. The interactions of San Jose scale, katydids, and thrips with N levels also will be examined.

This work has implications for field pest management decisions, which will be effected as growers reduce N fertilization. However, immediate effects may not be apparent as each orchard ecosystem will offer different levels of pest problems as well as varying N concentrations naturally present in the trees and soil. The interaction between orchard fertilization and pest control has a natural extension into cover crop management. We speculate that good productivity and fruit quality can be maintained at moderately low N rates, which may be supplied by leguminous cover crops which will, in turn, increase the number of general insect predators.

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INTRODUCING TIMOTHY S. PRATHER, THE NEW AREA IPM ADVISOR VEGETATION MANAGEMENT

Peter Goodell, U. C Kearney Agricultural Center

The Statewide IPM Project and South Central Region for Cooperative Extension are pleased to announce that Timothy S. Prather has accepted the position of Area IPM Advisor/Vegetation Management and is currently on the job at Kearney Ag. Center. Mr. Prather is finishing his doctorate at the University of Idaho in the

Plant Science Division. His dissertation topic involves integrated control of the weed *Chondrilla juncea*, using plant competition and weedparasitic arthropods. He completed his M.S. at the same institution in plant science examining the interference between yellow starthistle and pubescent wheatgrass in an effort to establish forages that can out-compete yellow star thistle.

Mr. Prather comes with good quantitative and statistical skills, as well as with competence in the emerging field of geographical information systems. He has taught weed science laboratory sections and has several publications to his credit, including two cooperative extension bulletins.

The Area IPM Advisor/Weed Science position will be a challenge and will offer unique opportunities to facilitate interdisciplinary research. This position will complete the four-member IPM team located at Kearney Ag Center and provide needed expertise in the area of vegetation management.

Tim will spend the first part of his appointment in learning the system, getting to know the players, familiarizing himself with the weed and vegetation management experts in the state, and getting to know the major problems. He will be traveling through counties and to the campuses to accomplish this. Please take the opportunity to introduce yourself and spend a few minutes discussing key weed issues with Tim.

RESEARCH SUMMARIES

Establishment of Orchards with Black Polyethylene Film Mulching: Effect on Soilborne Nematode and Fungal Pathogens, Water Conservation, and Tree Growth

R A. Duncan, J. J. Stapleton, and M V McKenry U. C Kearney Agricultural Center

Placement of a 3 m-wide, black, polyethylene film mulch down rows of first-leaf peach *(Prunus persica* 'Red Haven' on 'Lovell' rootstock) and almond (*Prunus dulcis* 'Nonpareil' on 'Lovell') trees in the San Joaquin Valley of California resulted in irrigation water conservation of 75% (Fig. 1), higher soil temperature in the surface 30 cm, a tendency toward greater root mass, elimination of weeds, and a greater abundance of *Meloidogyne incognita* J2 in soil but reduced root galling when compared to the nonmulched control. Population levels of *Pratylenchus hexincisus,* a nematode found within tree roots, were reduced by mulching, as were those of *Tylenchulus semipenetrans,* which survived on old grape roots remaining from a previously planted vineyard, and *Paratrichodorus minor,* which probably fed on roots of various weed species growing in the nonmulched soil. Populations of *Pythium ultimum* were not significantly changed, probably also due to the biological refuge of the old grape roots and moderate soil heating level. Trunk diameters of peach trees were increased by mulching, but those of almond trees were reduced by the treatment. Leaf petiole analysis indicated that concentrations of mineral nutrients were inconsistent, except for a significant increase in Ca in both tree species.

Reference: Duncan, R. A., Stapleton, J. J., and McKenry, M. V. 1992. Supplement to the Journal of Nematology: in press.

(Figure not available)

Fig. 1. Soil moisture depletion dynamics in the surface 60 cm of root zone of mulched and nonmulched peach and almond trees. Light arrows indicate irrigations of nonmulched trees; heavy arrows indicate irrigations of mulched trees.

Establishment of Apricot and Almond Trees Using Soil Mulching with Transparent (Solarization) an Black Polyethylene Film: Effects on Verticillium Wilt and Tree Health

J. J. Stapleton, E. J. Paplomatas, R. J. Wakeman, and J. E. DeVay, U.C. Kearney Agricultural Center and U.C. Davis

First-leaf apricot (*Prunus armeniaca*) and almond (*P. dulcis)* trees were planted in soil infested with *Verticillium dahliae* and mulched with transparent or black polyethylene film, or not mulched. During the 19 wk mulching treatment, summer soil temperatures reached 46, 41, and 33°C at 18 cm depth; and 41, 37, and 32°C at 30 cm depth under clear film, black film, and no film, respectively. Trees mulched from the time of planting with transparent polyethylene (solarization) did not survive or grow as well as those mulched with black film or not mulched. Incidence of foliar symptoms due to Verticillium wilt was reduced 86-100% in both apricot and almond trees by black, as well as transparent film mulch the following season (Fig. 1). Incidence of vascular discoloration symptoms of trunks and primary scaffolds due to Verticillium wilt was similarly reduced by both mulches. Mulching with black polyethylene film gave better overall results than solarization with transparent film, since the intermediate soil temperatures produced did not chronically harm trees as judged by tree survival and annual growth of trunk diameter, yet the prolonged period of soil heating provided control of Verticillium wilt equivalent to that of solarization with transparent polyethylene. These studies also provided further evidence that in-season mulching can be used to conserve water during establishment of new orchards or replant trees in warm, and climates.

Reference: Stapleton, J. J., Paplomatas, E. J., Wakeman, R. J., and DeVay, J. E. 1992. Plant Pathology: in press.

Table 1. Influence of polyethylene film mulching on numbers of *Verticillium dahliae* in soil and incidence of Verticillium wilt symptoms in second-leaf apricot and almond trees (Five Points, CA, 1990-91)[a]

Host Species; Soil Mulch Treatment b	*V. dahliae* propagules per g soil c	Incidence Verticillium Wilt (%)		
			Vascular discoloration	
		Foliar Symptoms	Primary Scaffolds	Trunks
Apricot d				
Clear	1.5 a	0 a	25 a	45 a
Black	1.8 ab	0 a	6 a	34 a
Control	4.5 b	36 b	92 b	96 b
Almond c				
Clear	0.8 a	ND f	ND	ND
Black	0.6 a	7 a	10 a	18 a
Control	3.4 b	50 b	68 b	73 b

[a] Mulches applied 14 days after trees were planted (March 1990). In each column, data values followed by different letters are different at P<0.05 according to Duncan's Multiple Range Test.
[b] Mulches removed after 19 weeks (August 1990).
[c] Soil sampled in 0-23 cm depth range after mulch removal (August 1990)
[d] 'Patterson' apricot on apricot rootstock.
[e] 'Carmel' almond on 'Nemaguard' peach rootstock.
[f] No data given due to single surviving tree.

ABSTRACTS

THE AMERICAN PHYTOPATHOLOGICAL SOCIETY, Portland, OR, August 1992

Cruciferous amendments, chitin, and Paecilomyc lilacinus reduce pgl2ulations of *Verticillium dahliae* in soil

D. P. Morgan and T J Michailides U. C Kearney Agricultural Center

Amendments of dried cabbage, broccoli, or chitin at a concentration of 1% w/w reduced the number of viable microsclerotia of *Verticillium dahliae* up to 100% after incubation of naturally infested soils in sealed bottles for 15 days. In addition, a 68% reduction of V *dahliae* microsclerotia occurred after amending 3 x 10^6 conidia of *Paecilomyces lilacinus* per g of soil. All of these experiments included soils at field capacity (-35 kPa) and soils were incubated at temperatures ranging from 10-30 C. Increasing soil incubation temperatures decreased the time needed to achieve LD_{50} for the cabbage-, broccoli-, and chitin-amended soils. However, when *P. lilacinus* was added to the soils, levels of viable microsclerotia of *V. dahliae* were reduced more at 10 C (68% reduction) than at 30 C (23% reduction). Cruciferous amendments, chitin, and *P. lilacinus* could perhaps be used in controlling crops.

Virulence of Isolates of *Fusarium* spp. Causing Endosepsis in Both Cultivated and Wild Caprifigs_in California

K V Subbarao and T. J. Michailides U. C Kearney Agricultural Center

A total of 62 isolates of *Fusarium* collected from both cultivated and wild caprifigs in most fig production areas of California included one isolate of *F. episphaeria*, seven of *F. solani*, and 54 of *F. moniliforme*. These isolates were compared for growth rate, sporulation, temperature optima, and virulence. Virulence was tested by placing 5 μl of a 10^6 conidia/ml suspension of each isolate on a wound made on the surface of caprifigs and incubating at 25^{o}C. Lesion sizes were recorded after 5 days incubation. Growth rates of isolates within species differed significantly and sporulation correlated highly with growth rate. The majority of the isolates had a temperature optimum of 25^{o}C. *F episphaeria* was moderately virulent; *F. solani* isolates were either virulent or highly virulent; and *F. moniliforme* isolates showed greater variation for virulence. About ll% of the isolates were avirulent, 67% were either weakly or moderately virulent, and 22% were virulent to highly virulent. *F. moniliforme* isolates from wild caprifigs were significantly more virulent than those from cultivated caprifigs but no such differentiation occurred with *F. solani*. Infusion of *F. moniliforme* from wild caprifigs may cause significant long-term problems for the fig industry.

Effect of Irrigation Cut-Off Date on Hull Rot of Almond

B. L. Teviotdale, U C Kearney Agricultural Center

Hull rot, caused by *Rhizopus stolonifer*, results in leaf and shoot death (strikes) without damaging the edible nutmeat. The influence of deficit irrigation practices on hull rot was studied using groups of trees whose seasonal irrigation was terminated at eight weekly intervals before harvest. The incidence of natural infection increased as irrigation cessation was delayed. Fruit in the latest five irrigation cut-off treatments were inoculated at four weekly intervals during hull split with 0.1 ml of 10^3, 10^4, and 10^5 conidia/ml suspension of *P. stolonifer*. Fruit having small, medium, and large hull splits or loosely or firmly attached hulls were inoculated with 0.1 ml of the 10^4 conidia/ml suspension. Percent infected hulls increased with increased numbers of irrigations but was not affected by inoculum concentration or inoculation date. Percent strikes was positively correlated with deferral of irrigation cut-off date, unaffected by inoculum concentration and least at the latest inoculation date. Fruit with small- and medium- split hulls had greater percent infected hulls and strikes than hulls with large splits. Percent strikes, but not percent infected hulls, was greater when fruit with firmly than loosely attached hulls were inoculated.

Relative Susceptibility of Four Table Grape Varieties to Fungal Components of the Summer Bunch Rot Complex in the San Joaquin Valley

H. Yunis, R. A. Duncan, and J. J. Stapleton, *U. C Kearney Agricultural Center*

Four table grape varieties (Cardinal, Emperor, Flame, and Thompson) were tested for susceptibility to five fungi (*Botrytis, Aspergillus, Alternaria, Penicillium*, and *Cladosporium* spp.) associated with the summer bunch rot complex in the San Joaquin Valley. Significant differences in susceptibility among varieties were observed, as were differences in pathogenicity of the fungi. Flame was the most susceptible variety, while Emperor was the most resistant. All fungi colonized wounded berries, but only *Botrytis* and *Alternaria* were able to infect nonwounded berries when inoculum was suspended in water. Suspension of spores in grape juice increased infectivity.

Effect of Organic Amendments and Solarization on Pathogen Control, Rhizosphere Microbiology, Plant Growth, and Volatiles in Soil

A. Gamliel and J. J. Stapleton, U. C Kearney Agricultural Center

Field solarization of composted chicken manure-amended soil gave better control of *Meloidogyne incognita* and *Pythium ultimum* and higher lettuce yield than either treatment alone. Numbers of pathogens, as well as of total fungi, were significantly lower in the rhizosphere of lettuce plants grown in chicken manure-amended, solarized soils. In contrast, population densities of fluorescent pseudomonads and *Bacillus* spp. were higher in plants grown in solarized soil, whether amended or not. When studied in vitro, numbers of *P. ultimum* in soil amended with composted chicken manure or dried cabbage were further reduced by heating, even at sublethal temperatures. Changes in volatile evolution in heated, amended soil may be related to increased biocidal activity.

ASEV 1992 ANNUAL MEETING, Reno, Nevada, June 1992.

Specific Nematode Feeding, Sites Within Vitis Rootstocks

Michael V McKenry, U. C Kearney Agricultural Center

Roots of most *Vitis vinifera* cultivars are fed upon, penetrated, and supportive of numerous and diverse nematode species. Rootstocks containing *V. champini* parentage provide few feeding or penetration sites on their young roots, although one *Meloidogyne* pathotype does circumvent this resistance and causes heavy galling. Rootstocks with *V. riparia* parentage are able to limit population development by endo and ectoparasitic nematodes to the youngest roots. Parentage with *V. rupestris* appears to limit nematode feeding to epidermal layers of the root but does not exclude feeding on older roots. None of the eighteen rootstocks tested was immune to nematode feeding or penetration. Reproduction by ectoparasitic nematodes was limited most by VR-039-16, Freedom, and Schwarzmann rootstocks.

Nematodes may be useful laboratory probes for indicating the site(s) of phylloxera, *Daktalosphaira vitifoliae*, resistance. It is speculated that *Vitis* rootstocks with broadest nematode resistance may also be resistant to phylloxera. Further, rootstocks having only tolerance to phylloxera will host one or more nematode species.

WORKSHOP ON MATING DISRUPTION IN ORCHARDS AND VINEYARDS, Istituto Agrario of S. Michele all'Adige, Trento, Italy, Aug-Sept, 1992

Mating Disruption of Peach Twig Borer, *Anarsia lineatella* Zeller: Progress and Problems

R. E. Rice, U. C. Kearney Agricultural Center

Field trials for efficacy of mating disruption of the peach twig borer, *Anarsia lineatella* (PTB), have been conducted in the San Joaquin Valley of California since 1989. Trials have been variously placed in orchards of 0.5 to 2.0 ha in nectarines, peaches, apricots, prunes, and almonds. Pheromone dispensers were manufactured by AgriSense, Inc., Fresno, CA; BASF, Ludwigshafen, Germany; and Consep Membranes, Bend, OR. Dispenser design and load rates have varied with each manufacturer, but pheromone in all disruption dispensers have been a two-isomer blend of E5-10 Ac (85%) and E5-10 OH (15%). Re-examination of pheromone components produced by virgin female PTB (Dr. Jocelyn Millar, University of California, Riverside) has shown that the original identifications by Roelofs in 1975 are essentially correct; the few very minor components identified by Millar in 1991 add no significant improvement to pheromone trap catches. Field longevities of the various pheromone dispensers under central California weather conditions have ranged from approximately 50 days to 75 days regardless of load rate. Control of PTB in the various host crops through mating disruption has generally been good, with early season cultivars showing the least damage compared to untreated checks, while mid- and late-season maturing cultivars experience increasingly heavy damage, some unacceptably high. Acceptable long-term control of PTB by mating disruption will probably require at least two applications of pheromone per season.

UC-IPM NOTES

SUMMARY OF THE NATIONAL IPM FORUM, Washington D.C. June 17-19, 1992

Peter Goode1l, U. C. Kearney Agricultural Center

This well-attended forum was sponsored by USDA and the EPA. Participants included the nation's leading authorities in IPM research, adoption, and implementation and were charged with assessing the current status of IPM and determining its best future course. The purpose of the forum was best described by the organizers:

> The forum will provide a cooperative setting for all participants in the agricultural system to come together and to chart the future of IPM. In particular, participants will be tasked with identifying the best methods for overcoming current impediments to the broad scale adoption of IPM in American agriculture.
>
> For the purposes of the Forum, IPM is defined as a pest population management system that anticipates and prevents pests from reaching damaging levels by using all suitable tactics including natural enemies pest resistant plants, cultural management and the judicious use of pesticides leading to an economically sound and environmentally safe agriculture for the United States.

For several years prior to this gathering, other groups were meeting to prepare reports on the status of IPM in four major commodity areas; soybean/corn, cotton, tree fruits, and vegetables. This report has been published as *Food, Crop Pests, and the Environment* edited by F.G. Zalom and W.E. Fry, APS Press, 1992. The commodity teams were made up of a cross section of practitioners, industry representatives, growers, environmentalists, scientists, and Federal and State agency personnel. The major function of these groups was to identify constraints to the implementation in commercial agriculture.

The constraints listed by the commodity teams were divided into four areas: regulatory, institutional, research/extension, and policy. Participants were invited to become involved in one of the groups and were provided summaries of the constraints and suggested resolutions. Discussion papers listing all constraints and resolutions were made available to participants for examination.

The bulk of the meeting was spent in amending, deleting, and editing these constraints and resolutions. A total of 60 constraints and over 140 resolutions to these constraints were compiled. The entire Forum voted on the top ten constraints and suggested resolutions. The following were the top ten constraints:

1. Lack of a national commitment to IPM.

2. Insufficient funding and support fort IPM implementation, demonstration, and fundamental infrastructure.

3. Lack of funding and support for long-term, interdisciplinary extension/education.

4. The EPA regulatory process is burdensome, expensive, time-consuming, and unclear.

5. Lack of funding for applied research, regulatory personnel to expedite product registration, and education/promotion for growers.

6. Shortage of independent, trained IPM practitioners.

7. Inability of current USDA and EPA structure to efficiently address cross-cutting agricultural and environmental concerns.

8. Insufficient education of the public about IPM and its benefits.

9. Agricultural policies were developed without considering IPM.

10. Lack of common and specific goals for IPM.

These 10 constraints were given consideration by a diverse group including food processor representatives, agrichemical representatives, regulatory and enforcement agencies, scientists, extension personnel, growers and private IPM practitioners from across the nation. The debate was well 'facilitated, fairly conducted, and in a spirit of cooperation.

The next step will be to summarize and formulate a position paper to provide guidance to policy makers and administrators. Before the conclusion of the Forum, USDA (with 13 agencies dealing with IPM) and the EPA had already pledged to work more closely together. The Forum provided an excellent opportunity to establish a benchmark of our current understanding of IPM and its status in agriculture.

HANDS-ON TRAINING FOR PESTICIDE APPLICATORS

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An innovative format for pesticide applicator workshops was developed by the Statewide IPM Project and tested in the southern California area during September 1990, and was repeated in northern California this past May. Workshops were held in Chico on May 6; Arbuckle on May 12; Davis on May 14; and Yuba City on May 28, and involved training 75 instructors who in turn trained over 600 pesticide applicators. Two-hundred, thirty-five of these applicators received their training entirely in Spanish, while 34 applicators received training in the Punjabi language. Workshops previously held in Escondido, Chino, and Oxnard during 1990 involved 79 instructors and provided training to 1,180 applicators, 438 of these applicators received their training in Spanish.

The idea for this type of workshop stemmed from the challenge of providing quality, up-to-date training to pesticide applicators in California. The large numbers of applicators and potential applicators, the size and diversity of the state, and the many state and federal laws and regulations that affect pesticide use (including a new regulation mandating continuing education for certified applicators) contributes to the current difficulty of designing suitable and meaningful programs.

<u>THE PROBLEMS</u>: Programs designed to train large numbers of pesticide applicators require time, expertise, and participation by University of California advisors and specialists, regulatory agency representatives, and industry personnel. Compared with the demand, there are limited numbers of people who have the expertise or available time to provide this type of training. Few, if any, of the people presently involved are willing to commit additional time to participate in more programs. Since many more programs are needed to accommodate the increased demand for training, there is a significant shortage of instructors.

In addition, many of the skills that pesticide applicators need to learn are difficult to present to large groups; thorough understanding of the technical aspects of pesticide application and safety generally requires hands-on involvement. For instance, attempts have been made at some large meetings to train participants in the concepts of equipment calibration. Even when the audience is broken out into groups of 50 to 100, only a few people have the opportunity to handle equipment and participate in the exercises that demonstrate the effect of nozzle placement or changes of pressure.

<u>ASPECTS OF THE WORKSHOP</u>: A workgroup consisting of UC farm advisors and specialists along with industry representatives participated with UC Statewide IPM Project in developing this hands-on program. The workgroup identified 7 topics to be presented at the workshops. Topics were interrelated and followed the sequence of steps an applicator must take to plan, perform, and complete any pesticide application. This sequence was designed to follow a typical work day in the life of a person who applies pesticides. Each 50-minute topic involved hands-on experience with equipment, protective clothing, and other materials used to perform applications.

Since many of the non-certified pesticide applicators in California are Hispanics, the hands-on training workshops had both Spanish and English sections. For the Spanish sections, all written training materials were translated into Spanish. Instructors fluent in Spanish were selected and trained to present each of the 7 topics. The Yuba City workshop was conducted entirely in the Punjabi language to accommodate the large number of Punjab workers in that area. Training materials for this workshop were translated into Punjabi and Punjab instructors participated in extensive training to prepare them for the workshop

Logistics: Applicators attending the workshop were assigned to small groups consisting of no more than 15 individuals. Each group remained together throughout the day and rotated through the 7 different stations corresponding to each topic. Presentations for each topic were given simultaneously by three or four instructors (depending on the location); each instructor presented the same topic to 7 groups throughout the day. In order to prevent confusion, color coding was used to identify instructors, topics, and the small groups. At the completion of the day, each participant received a certificate of training.

Applicators who attended the workshop were given a pair of safety glasses and a pair of nitrile gloves when they first arrived; they took these items home with them. Instructors asked the participants to wear these protective devices during the day whenever they were participating in a hands-on activity that, in actual practice, would require use of this equipment. Other personal protective clothing and equipment such as coveralls, goggles, and respirators was available at training stations whenever their use in actual practice would be appropriate.

For each topic, a lesson plan, handout materials, and visual aids were specially developed. Props, such as protective clothing, eye wash stations, chemical containers, sprayers, nozzles, spill cleanup kits, and other materials were purchased or borrowed from suppliers. Several sets of all equipment, lesson plans, handouts, and visuals for each topic were assembled to be used at each site by different instructors. Upon the completion of the workshops, these materials were placed in the local Cooperative Extension offices so they can be borrowed by the instructors for their own use in other training programs.

Resource Personnel: Workgroup members identified several outstanding people to be resources for developing topics and participating in training the instructors. Most of these resource people are individuals who have given many presentations in traditional applicator workshops and training sessions over the past several years. The knowledge and expertise of these resource people was much better utilized in this manner and instructors greatly benefited from the opportunity to work closely with these experts.

Instructors: Instructors were recruited by workgroup members (local Cooperative Extension advisors). People selected were experienced local individuals who work with pesticides or have responsibilities for supervising pesticide applicators. Most came from private industry and included owners, supervisors, or managers of farms, commercial nurseries, or landscape maintenance businesses. Others were employees of municipal agencies such as the Department of Transportation, local school districts, state and county parks, and cemeteries. Instructors participated in an extensive training prior to the workshop; they also participated in a "dress-rehearsal" for the workshop to help them fine tune their teaching skills.

Instructors benefited from this program by: (1) learning important presentation skills; (2) learning needed pesticide safety and application information from recognized University, regulatory, and industry experts; (3) gaining experience as an instructor; and (4) by having an opportunity to interact with their peers. These benefits provided instructors with the expertise to participate in other workshops and training programs, thus increasing the numbers of people in the state with applicator training expertise. All participating instructors can freely borrow any of the props and visual aids from local Cooperative Extension offices for use in their own training programs. A considerable amount of training material relating to all of the topics being presented.