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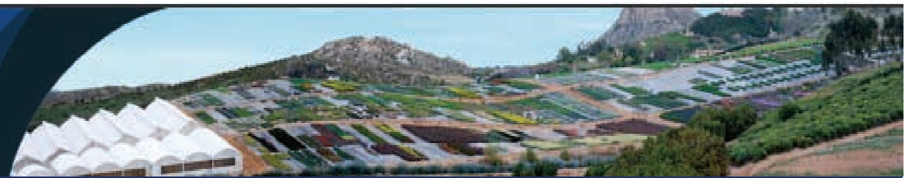

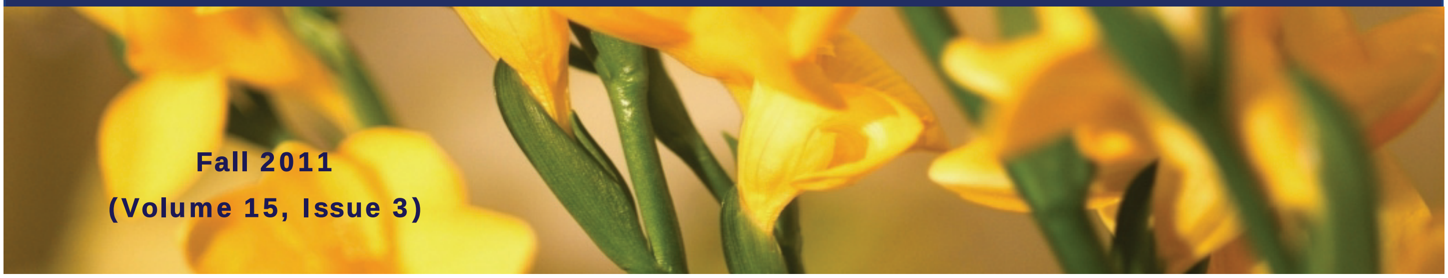

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EDITOR'S NOTE

The focus of this issue is managing insects and other pests in greenhouses and nurseries, especially invasive exotic pest species. Two invasive moth species are discussed in the feature articles: Jim Bethke writes about the European pepper moth and Steve Tjosvold discusses insecticides for controlling light brown apple moth. In a new column, "Disease Focus," Deborah Mathews describes insects to watch for that can vector plant viruses. In the regional reports, Jim Bethke (San Diego) discusses palm weevils and reniform nematodes, Steve Tjosvold (Santa Cruz/Monterey) writes about sudden oak death and Julie Newman (Ventura/Santa Barbara) describes how growers can mitigate pesticide runoff while managing invasive pests. Another new column is "Gleanings from Meetings" in which we highlight past UCNFA educational meetings. Finally, included in this issue is an article on the use of filter strips ("Get Cultured").

Julie Newman
Co-Editor

EUROPEAN PEPPER MOTH: A NEW INVASIVE MOTH THREATENS CALIFORNIA AGRICULTURE

by James A. Bethke and Bryan Vander Mey

California growers should be on the lookout for a new exotic pest, the European pepper moth (EPM). Many people won't think much of this insect because it's just another moth, but if ignored, it could become a serious pest on certain ornamental and agricultural crops. It has been a consistent pest of greenhouse crops in Europe, but has not been as destructive in field-grown crops. EPM, *Duponchelia fovealis* Zeller (Lepidoptera: Pyralidae), originates in the Mediterranean area and the Canary Islands, and also has been known to occur in Africa and Asia Minor where it is a significant pest of agricultural crops including peppers, squash, tomatoes and corn. The Animal Plant Health Inspection Service (APHIS) of the USDA originally considered this moth an actionable pest because initially it was not known to occur in the United States and because it is a serious agricultural pest.

The moth was first identified in California in 2005 and was originally assigned an "A" rating, which meant that when found, there would have to be action taken to eliminate the risk of spreading the insect. Since 2010, the insect has been found widespread in San Diego County and has been detected elsewhere in the state, as well as numerous other states, so a move to reduce the severity of the rating is in progress. Regardless of the rating, concern from ornamental and vegetable plant producers is leading to the formation of a USDA APHIS Technical Working Group to study ways of reducing the impact that this pest may have on U.S. agriculture.

The caterpillars are difficult to detect because they typically feed at soil level around the crown of the plant and sometimes burrow into stems. Prolifer-

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ation of the population can occur without notice. You should be aware of the potential this pest has to do serious crop damage and watch for it.

One of our biggest worries during the last poinsettia season was that poinsettias are on the host list. Unfortunately, we have observed larvae girdling poinsettia and causing significant damage on some growers' crops. That means that everyone growing poinsettias this coming season should be looking for this moth and should consider initiating a preventative program or there may be unintended consequences.

We will do our best herein to educate you about this insect so that when you see it you will not be surprised and hopefully will have some management solutions. We are studying the life history and control for this pest and plan to have more results relatively soon.

Invasion History

EPM was first detected in this country in 2005 as live larvae in a shipment of begonias from San Diego County. It was thought to be eradicated, but a detection in Canada in April of 2010 was traced back to ornamental plant production in San Diego County. Following action by regulators and treatment applications by the grower and on the surrounding landscape by a commercial applicator, further surveys of the property could not detect any more moths or larvae. Unfortunately, a second detection occurred in July 2010, and a trace-back led to the same area of San Diego County but to a different grower. This detection triggered an extensive trace forward survey to determine the extent of the invasion in California and other states. During the months of September and October 2010, APHIS and state departments of Agriculture confirmed the presence of *Duponchelia fovealis* in portions of 13 additional states including Alabama, Arizona, Colorado, Florida, Georgia, Mississippi, New York, North Carolina, Oklahoma, Oregon, South Carolina, Texas and Washington. Survey data to date confirmed the presence of EPM in 16 counties in California.

The detection in July 2010 in San Diego County was very extensive at one production facility and caused the County Agriculture Commissioner's office to put a hold on all plants throughout the facility. At a great cost to the company, it took approximately two weeks of intensive treatment applications and the destruction of mature plants in order to release portions of the crops for sale and distribution. Younger plants were treated preventatively. In all likelihood, growers of EPM host plants here in the county will have to monitor for the time being and treat preventatively to remain moth-free (see host plants below).

Life History

There is little scientific literature from which to develop a life history. Much of what is known is anecdotal observations from lepidopterists and official records from invaded countries in Europe.

Development from egg to adult is as long as 47 days at 68ºF, but will be much shorter in our warmer climates and especially in greenhouses. The adult (fig. 1A) life span is from 1 to 2 weeks, and a female can lay up to 200 eggs, singly or in small batches. Eggs are small (0.5 x 0.7 millimeters), whitish to green in color and darken to a reddish color as they age (fig. 1B). The adult forewings are gray to brown with distinctive markings and a wingspan of .75 to .83 inches (19 to 21 millimeters). The lowest lines on the outer wing have a tooth-like notch facing backward. Males have a longer, more slender abdomen than females. Larvae are creamy white to brown with a dark head capsule (fig. 1C) and lines of distinct dark spots along the abdomen. Larvae mature in about 4 weeks.

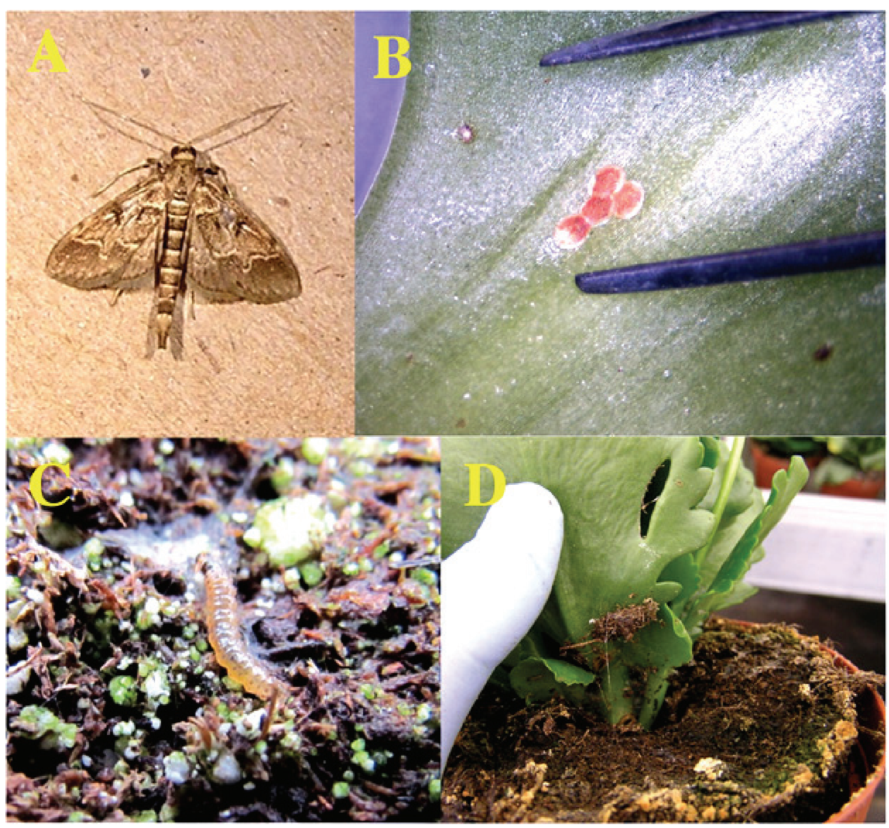

Fig. 1. European pepper moth (EPM) adult male (A), eggs (B), larva (C) and pupa (D). Photos by J.A. Bethke and B. Vander Mey.

Mature larvae pupate inside a cocoon composed of webbing and soil particles (fig. 1D). The cocoon is usually attached to the undersides of leaves or the edge of the pot, and larvae take about 1 to 2 weeks to hatch. The number of generations per year is variable but is certain to be multiple generations in Southern California, where multiple year-round generations in greenhouse production is likely. We have started a colony in our greenhouse and have found the generations to be synchronous at this point, which may be an advantage for the timing of applications.

Damage

EPM causes severe damage to main stems, lower leaves and tissues that are adjacent to the potting soil. The larvae tend to create webbed tunnels and protective coverings, and often feed below the soil line in soft plant media. Girdling damage can be seen on poinsettia (fig. 2A), begonia (fig. 2B), kalanchoe (fig. 2C) and pepper (fig. 2D).

Host Plants

The host list is comprised of plants in about 38 plant families and include field-grown vegetables and ornamentals, greenhouse-grown ornamentals and herbs, and tree and vine hosts. A summary of ornamental host plants from the literature include alternanthera, daisy (*Bellis* spp.), cineraria, gerbera, impatiens, begonia, elderberry, goosefoot, kalanchoe, azalea, croton, poinsettia, geranium (*Pelargonium* spp.), lisianthus, lilyturf, cuphia, coleus, mint, mallow (*Malva* spp.), calathea, oxalis, loosestrife, limonium, cyclamen, portulaca, ranunculus, rose, bouvardia, heuchera, waterhyssop (*Bacopa* spp.), pepper (*Capsicum* spp.) and elm. Summaries of agricultural plants that are attacked include celery, peppers, cucumbers, tomatoes, maize, pomegranate and certain herbs. In San Diego County, confirmed host plants include begonia, echeveria, gerbera and several varieties of kalanchoe and poinsettia. I anticipate that the EPM host list will grow.

Control

Control measures for adults include conventional registered pesticides applied where the adult will come into contact with them. In addition, aerosols or fogs applied in protected culture just before adults begin to fly at night will be effective. In general, the adults are relatively easy to kill.

In contrast, the larvae are very difficult to contact with pesticides, and stomach poisons do not always reach the feeding site. Therefore, some of the more effective compounds against this pest will not be as effective as one would expect. A preventative treatment of Bt or spinosad on smaller plants and cuttings will kill early instar larvae as they hatch and begin to feed, but the pesticide has to be applied at the feeding site. Pyrethroids are also a good

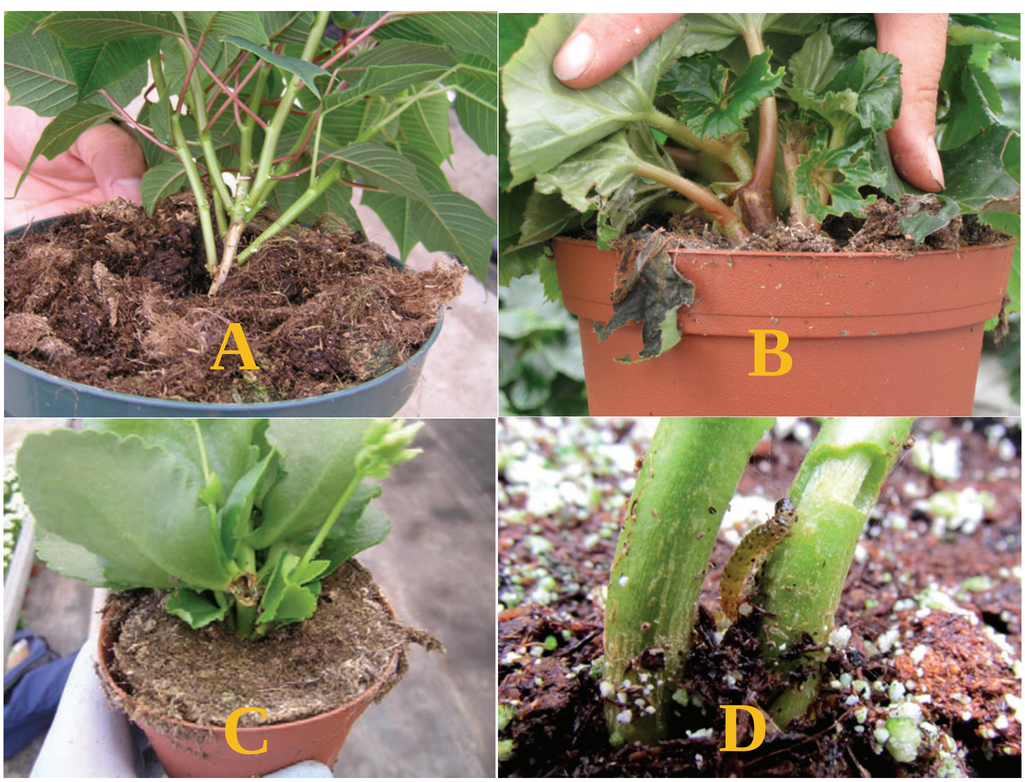

Fig. 2. Girdling damage by European pepper moth (EPM) larvae on poinsettia (A), begonia (B), kalanchoe (C) and pepper (D). Photos by J.A. Bethke and B. Vander Mey.

choice for larval control, but may need to be synergized. An additional aid to effective treatment applications would be to trim off the leaves that lie on the soil surface: there will be less shelter for larvae and better pesticide coverage.

When larvae are more mature they are much more difficult to control because of the protection offered by webbing as described above. Therefore, knowing when a new generation begins will be an important factor in control. In addition, we observed larvae taking refuge deeper in the soil alongside the main stem. Preventative treatments of granular insecticides may protect plants from this type of infestation, but for best control, persistent applications of effective products using a heavy application or large droplet size and a directed spray may be necessary.

Monitoring

Monitoring techniques with documented efficacy include the use of a pheromone in Delta traps, funnel traps and water traps. Pheromone lures for EPM are available from Koppert, Biobest and Syngenta. We have observed large numbers of EPM caught in water traps in Southern California (a good description of the water trapping techniques used in the Netherlands can be downloaded using this url: documents.plant.wur.nl/wurglas/C_bestwatertrap.pdf). In addition, it appears that the EPM is attracted to the light brown apple moth pheromone lures as well.

Control Trials

We conducted two greenhouse trials on infested potted plants from cooperating growers.

The first trial was on a group of greenhouse-grown kalanchoe plants (*Kalanchoe* spp.). The plants were mature and flowering, and the vast majority of the plants contained larvae or evidence of an infestation. They were potted in Latvian peat in 4-inch pots. We treated the plants with several insecticides that we thought might help in an eradication effort (see Table 1) at the highest recommended rates on the label. The majority of the larvae were in late stages, and we observed that about 2% of the plants contained pupae. Very few plants contained more than one larva. The larvae were exceptionally well protected under leaves, in webbing and between leaf and soil surfaces. Therefore, pesticide contact with larvae was difficult. Foliar applications were made using a backpack sprayer and a large droplet size, and we made an effort to get the soil surface and main stem wet with the treatment application.
We assessed the presence of active larvae per plant at 24 and 72 hours after application. We selected 60 plants as a pre-treatment count and a different set of 60 plants for each of the two post-treatment assessments. The percent reduction in the number of larvae per treatment was determined (Table 1). Bifenthrin, acephate, and bifenthrin+acephate tank mix caused a 50 to 75% reduction in the mean number of live larvae per treatment.

Table 1. Efficacy of selected insecticides applied to European pepper moth-infested kalanchoe in 4-inch pots. Sixty new pots were selected for each assessment, and the percentage of pots with live infestations of caterpillars was recorded.

Treatment Application	Pre-treatment live/60 plts (%)	24hour post-trt (%)	72 hour post-trt (%)	% Reduction 72hrs
Bifenthrin	8 (13.3)	2 (3.3)	4 (6.7)	50.0
Bifenthrin+Orthene	10 (16.7)	5 (8.3)	3 (5.0)	70.0
Emamectin	7 (11.7)	7 (11.7)	4 (6.7)	42.9
Lambda-cyhalothrin	8 (13.3)	7 (11.7)	7 (11.7)	12.5
Chlorantraniliprole	7 (11.7)	9 (15.0)	5 (8.3)	28.6
Spinosad	7 (11.7)	5 (8.3)	6 (10.0)	14.3
Orthene	8 (13.3)	5 (8.3)	4 (6.7)	50.0
UTC	9 (15.0)	6 (10.0)	12 (20.0)	-33.3

Percent reductions are the percent of change from the pretreatment count. Larger numbers are better.
Negative numbers indicate an increase in the number of plants infested from the pre-treatment count.
Products and rates tested are for experimental purposes only and may not be registered for use.
It is your responsibility to make sure you are using registered products and rates for control purposes.

The second trial was conducted on heavily infested potted verbena in an outdoor nursery environment. The caterpillars were not evident at first, but when the pots were turned over, we detected numerous larvae infesting the roots that protruded from the drainage holes in the bottom of the containers. We wanted to make sure the pesticide would contact the pest, so we tried two methods of application with selected pesticides (Table 2): some applications were made using a backpack sprayer, and some plants were drenched from above. Both methods are difficult and costly, but when faced with the Nursery Clean Stock Program and potential shut down, any control method may be of benefit.

Mortality was observed for three days after treatment applications. Acephate performed well as both a spray and a drench against this pest. Other products did not cause significant mortality compared to the control under the conditions of this trial.

Conclusion

EPM is a new pest of potentially great significance in California and elsewhere. It has proven to be a significant pest in Europe, especially in greenhouse ornamental and vegetable production. It will benefit you to be aware of the biology and control of this pest, and it will certainly pay to be on the lookout for it. Acephate was an effective treatment for controlling larvae in two preliminary trials. Currently, we are conducting both lab and greenhouse trials using selected pesticides on early instar larvae from colonies that we have initiated. Stay tuned for these results.

James Bethke is Farm Advisor for Nurseries and Floriculture and Bryan Vander Mey is Staff Research Associate, UC Cooperative Extension, San Diego County.

Table 2. Efficacy of selected pesticides against European pepper moth (EPM) on potted verbena. Spray applications were made by turning the pots on their sides and applying the pesticides to the caterpillar on the roots and bottoms of the pots. Drench applications were made using label instructions for application to a 6-inch pot. Numbers are the average number of live larvae per pot.

Treatment/Formulation	Rate/100 gal	Application Method	Nov. 16 Pre-Treatment	Nov. 17	Nov. 18	Nov. 19
Acephate TT&O	8 oz	Drench	4.0a	2.8ab	0.8b	0.7cd
Bifenthrin Pro	23.85 oz	Drench	4.0a	3.8a	3.5a	3.2a
Dinotefuran 20SG	15.5 oz	Drench	4.0a	2.3ab	2.2a	2.2abc
Emamectin + Dyne-amic	4.8 oz + 80 oz	Spray	4.0a	2.8ab	2.7a	1.8abc
Acephate	8 oz	Spray	4.0a	1.7b	1.2b	0.3d
Bifenthrin (8.8%) + Abamectin (1.3%)	21 oz	Spray	4.2a	2.3ab	2.0ab	1.5bcd
Check	***	Spray	4.2a	4.2a	3.7a	3.2ab

Means followed by different letters are significantly different, LSD ($p=0.05$).

FIELD EVALUATION OF INSECTICIDES TO CONTROL LIGHT BROWN APPLE MOTH

by Steve Tjosvold and Neal Murray

Introduction and Goals

The light brown apple moth (LBAM) is an important quarantined pest in California, currently detected in 16 counties with a wide host range of native, ornamental and crop hosts (fig. 1). The quarantine has greatly affected the ornamental nursery stock industry along the central coast and other areas where LBAM is established in native and ornamental vegetation surrounding the nurseries where it is left unmanaged. This makes it difficult to keep LBAM from migrating into nurseries and re-infesting the production areas even with judicious control efforts. Regular official inspections occur at nurseries shipping nursery stock outside of the regulated areas. If LBAM is found in a nursery, insecticide treatments are usually required until LBAM is no longer found with follow-up inspections. (See link below for the CDFA official regulatory manual.) The larvae of this moth species, *Epiphyas postvittana,* are often difficult to distinguish morphologically from many other similar tortricid larvae that occur in ornamental crops, and therefore insecticides are often used proactively against any suspect larvae found by nursery staff or pest management scouts.

Fig. 1. LBAM female adult and egg mass. Photo S. Tjosvold.

Experiments at the South Australia Research and Development Institute (SARDI) screened insecticides, including horticultural oils for ovicidal activity against LBAM, using dip bioassays of exposed egg masses. Likewise, at the USDA Otis Lab (Buzzards Bay, MA), several insecticides targeting LBAM larval stages were screened in a laboratory environment. This information has been used by the California Department of Food and Agriculture (CDFA) to establish an official list of approved insecticide treatments for agricultural operations when required (see link below). Nursery operators usually choose to minimize the time lag between treatment and re-inspection so that the quarantined plants can be released for sale as quickly as possible. Usually the grower's preferred treatment has been the officially designated "ovicidal" treatment containing one active product that targets larvae and a horticultural oil that targets eggs. So far there have been no studies to evaluate the efficacy of these insecticides and the prudence of combining the products in the field. Moreover, growers need to know how long these insecticides remain effective in the field so they can use good judgment as to how often spray treatments need to be applied. Since nurseries can often be re-infested by migrating moths, an important management strategy might be to target oviposition (egg laying), egg eclosion (egg hatch) and the development of the brood to the next generation.

The goal of this experiment was to determine the efficacy and residual action of many of the approved treatments and other new insecticides in preventing or retarding oviposition, egg development, egg hatch, and larva and pupa development in field conditions. Ultimately these experiments will aid in the development of an insecticide treatment strategy, with rotating chemical classes, to manage LBAM and prevent insecticide resistance in nurseries. This trial is being repeated in the summer of 2011 to strengthen our findings.

Materials and Methods

Plant Material. Pacific wax myrtle (*Myrica californica*) in 1-gallon pots were obtained from a commercial nursery in Watsonville, California. (In Santa Cruz County, Pacific wax myrtle is a common host of LBAM in the landscape.) Plants received no pesticides at least two months before the experiment began, and no supplemental fertilizer during the experiment. The plants were moved into quarantine field cages covered with 32 x 32 mesh Lumite Saran insect screen at a secure-access facility in Watsonville, California. Plants were pinched to create uniform plants and stimulate branching supportive of LBAM larval development, and held for 2 weeks before treatments. Temperature data was recorded inside one caged plant and degree day accumulation was calculated using a LBAM developmental model and temperature thresholds to help assess the development of the insects and time the treatments, moth infestations and evaluations in this experiment.

Insecticide Treatments. Treatments included many of those from the CDFA officially approved insecticide treatments, which represent a wide range of chemical classes with different modes of action. Several of the commonly used treatments by growers — spinosad, *Bacillus thuringiensis* (Bt) and methoxyfenozide — were applied alone, or combined with horticultural oil. All products were registered for ornamental nursery stock except emmamectin benzoate (registered for vegetables), chlorantraniliprole (registered for turf and landscape) and indoxacarb (registered for turf and landscape) (see Table 1). To insure thorough coverage of all treatments, a non-ionic surfactant (modified vegetable oil and organosilicone blend at 3 pints per 100 gallons) was added to all insecticides and the control, and all were applied at 200 gallons per acre (see Table 1).

Pre-oviposition bioassay. To access the treatments' residual efficacy, insecticide treatments were applied on August 24, 2010. Each treated plant was subsequently infested with 20 female and 20 male moths that were recently hatched, obtained from the LBAM colony at the USDA LBAM Project in Moss Landing, California. Plants were infested by enclosing each one in a 19 inch x 28 inch (48 centimeter x 71 centimeter) insect rearing bag (BugDorm by Megaview Science Co., Taiwan) made of white nylon netting (104 x 94 mesh) to securely contain all life stages on each plant. Plant blocks were infested at 4 successive days after treatment (DAT) with insecticides: 1 DAT, 7 DAT, 14 DAT, and 21 DAT (respectively: Aug. 25, 2010; Aug. 31, 2010; Sept.8, 2010, Sept.14, 2010).

Post-oviposition bioassay. To access the treatments' efficacy when applied to recently laid egg masses, the insecticide treatments were applied after 10 days (225 degree

Table 1. Insectide Treatments and Rates

Active ingredient	Formulation	Rate product / 100 gal.
Bt *(Bacillus thuringiensis)* ssp. *kurstaki*	54% DF	16 oz.
Bt ssp. *kurstaki* + horticultural oil		16 oz. + 1 gal.
spinosad	11.6 % SC	12 fl. oz.
spinosad + horticultural oil		12 fl. oz. + 1 gal.
methoxyfenozide	22.6 % F	8 fl. oz.
methoxyfenozide + horticultural oil		8 fl. oz. + 1 gal.
horticultural oil (petroleum oil)	98%	1 gal.
lambda-cyhalothrin	9.7 % GC	5 fl. oz.
emmamectin benzoate	5% Powder	4.8 oz.
chlorantraniliprole	18.4% SC	4 fl. oz.
indoxacarb	30% WDG	2.5 oz.
diflubenzuron	40.4 % SC	4 fl. oz.
Untreated Check		

days accumulated, on October 1, 2010) when most egg masses were laid and adults had died. Plants were infested with fertile moths on Aug. 21, 2010 as described above and treated 10 days later.

Evaluation of egg laying and eclosion. Approximately 3 weeks after each moth infestation (455 to 543 degree days), when all eggs had apparently hatched, the total number of egg masses per plant in the pre-oviposition bioassay were counted for 5 minutes by 2 persons (each counting one half of the plant). Then up to 3 leaves were randomly selected and pulled from each plant and examined with the aid of a stereo microscope to evaluate the number of eggs per egg mass, proportion of eggs that had successfully eclosed, and whether the eggs were laid on the bottom or top of the leaf.

Evaluation of survival from egg mass to larvae, pupae, or adults. For both pre- and post-oviposition bioassays, the brood developed very slowly in the field (over winter) for approximately 217 days (2750 to 2850 degree days) until most individuals had reached the adult stage. At this time, the total number of healthy life stages (larvae, pupae and adults) were counted on each plant.

Results and Discussion

Total larvae life stage survival. A random sample of all blocks and treatments in both bioassays indicated that all larvae were in late stages of development: 2.4% were 4th instar and 97.6 % were 5th or 6^{th} instars.

Pre-oviposition bioassay. The overall average of eggs deposited on plants was 20.8 egg masses per plant. However, the average deposited at the 14 DAT (11.8 egg masses per plant) was significantly lower than the other dates. This is probably due to the particularly hot weather that occurred during oviposition which probably affected egg laying.

Of the leaves that were randomly sampled to evaluate egg eclosion and egg deposition location, the overall average number of eggs per egg mass for all treatments was 18. 6 on the bottom (B) of the leaves and 9.6 on the top (T) of the leaves, a 1.9 : 1 ratio (B/T). In contrast, the average number of eggs per egg mass for the control plants were 16.3 on the bottom of the leaves and 20.0 on the top of the leaves, a 0.8 : 1 ratio (B/T). The literature indicates the propensity of moths to deposit eggs on the top of the leaves as illustrated here in the control plants, but with the insecticides applied in greater concentration on the top of leaves, the moths preferred to deposit eggs on the bottom of the leaves.

The number of eggs deposited per plant was significantly lower in only the lambda-cyhalothrin treatment (1.4 egg masses per plant). Of those eggs that were deposited in that treatment, the average proportion of egg eclosion was also lower (data not shown).

The total surviving life stages were statistically lower (greater efficacy) for the *Bacillus thuringiensis* treatment when compared to the control treatment for up to 1 week after the treatment, but not for 2 or 3 weeks, which indicates a fairly short residual activity. The spinosad treatment showed significant efficacy as compared to the control for up to 2 weeks, but not for 3 weeks. The methoxyfenozide treatment showed significant efficacy as compared to the control for at least 3 weeks. In general, when horticultural oil was added to these treatments, efficacy was not improved, and in some cases, although not significant, was less efficacious. Horticultural oil (alone) showed inconsistent results on survival as compared to the control. Its uncertain activity could not be explained by repellency since egg number and egg number per mass were no different than the control. The lambda-cyhalothrin and emmamectin benzoate treatments showed significant efficacy for at least 3 weeks. The chlorantraniliprole treatment showed significant efficacy for 2 weeks but not for 3 weeks. The indoxacarb treatment showed significant activity for 1 week, but not longer. The diflubenzuron treatment in general showed no significant efficacy on total surviving life stages as well as on the other egg parameters that were evaluated (see fig. 2).

Post-oviposition bioassay. The total surviving life stages were statistically lower for all treatments except diflubenzuron. As with the pre-oviposition bioassay, there was no improvement of adding horticultural oil to the *Bacillus thuringiensis*, spinosad, or the methoxyfenozide treatment, although horticultural oil alone was somewhat effective (see fig. 3).

Conclusions

The data shows that several insecticides can target egg-laying adults and subsequent development of the brood. These include several of the commonly used insecticides *Bacillus thuringiensis* and spinosad. The efficacy and longevity of methoxyfenozide was even better. Contrary to the recommendations of the officially approved list, adding horticultural oil did not improve control or longevity of *Bacillus thuringiensis*, spinosad, or methoxyfenozide. Lambda-cyhalothrin was highly effective and long lasting, affecting egg laying of adults by some mechanism, either by killing adults or inhibiting egg laying. This phenomenon will be investigated in the next experiment. There were also other effective and relatively long lasting treatments, including chlorantraniliprole and indoxcarb, newly registered turf and landscape insecticides, and em-

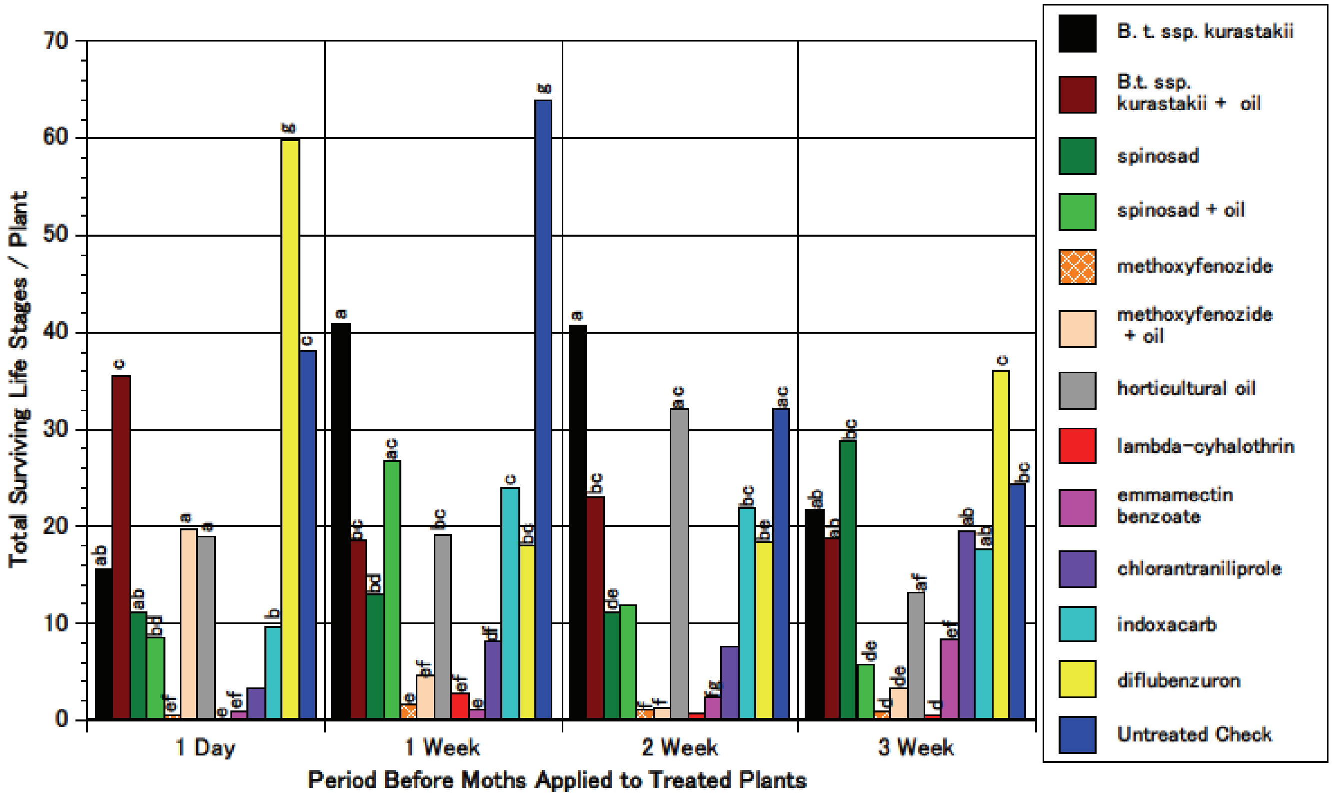

Fig. 2 Effect of insecticides applied before moth infestation (egg deposition) on the total surviving life stages

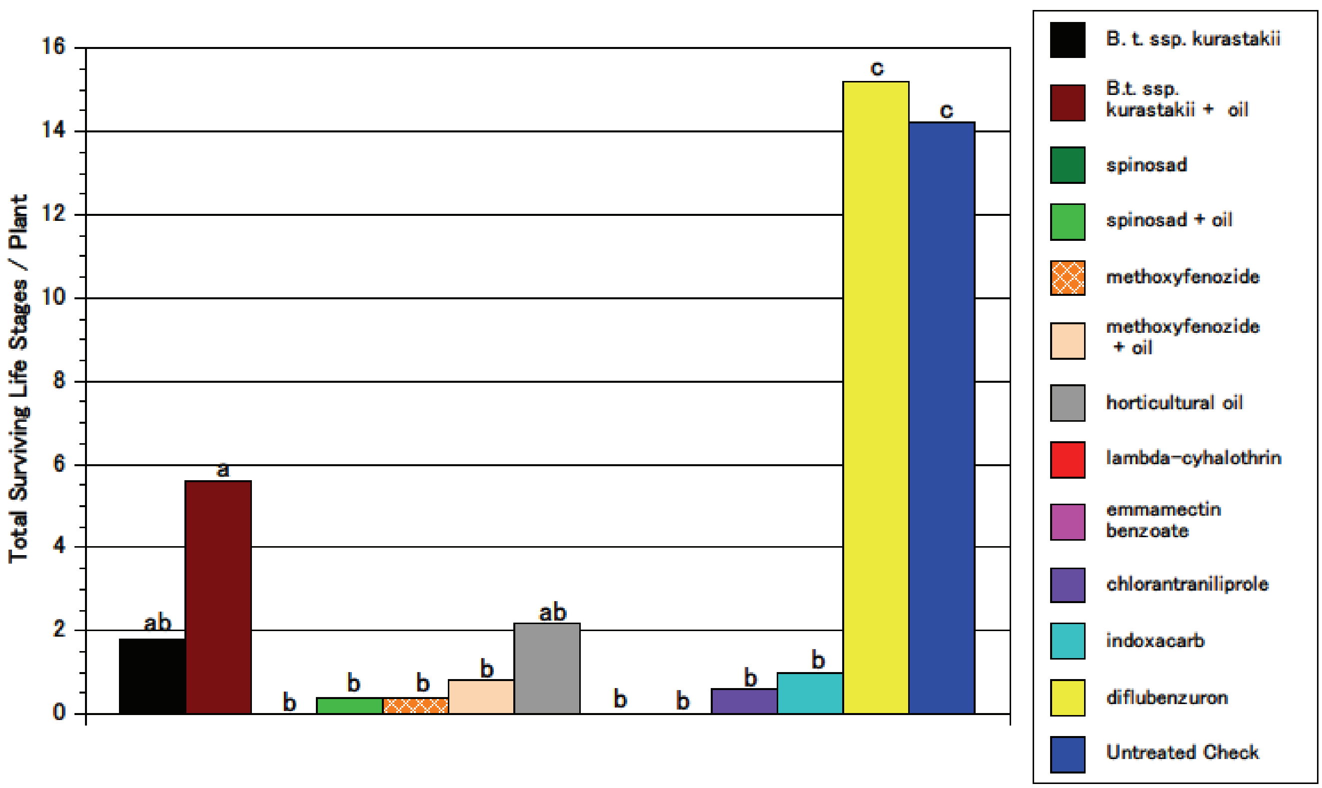

Fig. 3. Effect of insecticides applied after moth infestation (egg deposition) on total surviving life stages

mamectin benzoate, which will be registered in the near future. Our data or specific experimental conditions cannot explain the apparent ineffectiveness of diflubenzuron.

For nursery stock producers, *Bacillus thuringiensis* and methoxyfenozide would provide the most selective control of the current registered insecticides in this study since they are active specifically on Lepidoptera larvae. This may be important in some production systems because field monitoring studies using sentinel LBAM eggs have revealed that at least two naturally occurring species of the *Trichogramma* wasp (*T. platneri* and *T. fasciatum*) in California have an active role in parasitizing LBAM eggs within infested coastal areas. In addition, *T. platneri* (fig. 4) is being reared on a large scale and is being tested for efficacy as augmentative releases in the landscape and commercial nurseries, and might be used in the future as part of an integrated management program.

Fig. 4. Augmentative releases of *Trichogramma platneri* (shown parasitizing a moth egg) in landscapes and commercial nurseries are being evaluated as part of an integrated approach for the control of light brown apple moth. Photo by Jack Kelly Clark. Source: UC Statewide IPM Project.

Steve Tjosvold is Environmental Horticulture Farm Advisor and Neal Murray is Staff Research Associate, UC Cooperative Extension, Santa Cruz County. ***The authors thank Dr. Greg Simmons (USDA, Moss Landing, CA.) and his staff for their valued input into this project and their assistance in providing LBAM moths. Also, thanks to Dr. Scott Myers (USCA, Otis Lab, Buzzards Bay, MA.) for helpful suggestions on experimental protocol and the selection of treatments.***

References

LBAM CDFA approved Insecticide list: http://phpps.cdfa.ca.gov/PE/InteriorExclusion/PDF/LBAMApprovedTreatments.pdf).

LBAM Regulatory Procedure Manual: http://phpps.cdfa.ca.gov/lbam/LBAMtoc.pdf

GET CULTURED: Drainage channels and vegetated filter strips in nurseries. Part II

by Don Merhaut and Lea Corkidi

Vegetated and non-vegetated drainage channels can be used to remediate the negative environmental effects of storm water and irrigation water runoff that may occur from agricultural production. In the previous newsletter, we addressed important considerations for the construction of non-vegetated drainage channels. This article focuses on vegetated filter strips, one of the available Best Management Practices to improve the quality of runoff water.

Filter strips are bands of vegetation intentionally planted between agricultural production areas and waterways to intercept sediment and absorb pesticides and nutrients. As runoff water moves across the vegetated strips, the water is filtered by physical, biological and chemical processes (fig. 1). Roots and rhizomes obstruct flow, facilitate sedimentation and provide surface area for microbial activity. Nutrients and pesticides are taken up by plant root systems, decomposed by microorganisms or adsorbed into soil particles.

Fig. 1. Filter strips can be used in the nursery to protect nearby waterways. As runoff water flows across the vegetated strip, the water is filtered by physical, biological and chemical processes. The filter strip in this photo was established at Tree of Life Nursery in San Juan Capistrano, California.

Different studies have compared vegetated and non-vegetated systems for wastewater treatment and have emphasized the key role of plants in pollutant removal. Plants are known to influence the removal of pollutants either directly through assimilation or indirectly through their influence on microbial activity. However, the effectiveness of vegetative filter strips depends on many factors, such as slope, runoff flow, climate, soils, plant size and vegetation cover, and plant species. There are a few key considerations when planning and establishing a filter strip: (1) site selection, (2) filter strip design, (3) plant selection, (4) plant establishment practices, and (5) maintenance.

Site Selection

It is ideal to select a site that already is conducive to channeling runoff; otherwise, site preparation such as grading and addition of soil amendments may be required. Filter strips should be planted on gently sloping sites so that water flows slowly through the filter strip to allow optimum absorption of nutrients and pesticides before the water flows out of the filter strip. Slopes that are too steep are subject to erosion; slopes that are too flat will result in standing water that will be low in oxygen, causing odors and accumulation of organic matter. Existing natural habitat and endangered species also need to be considered when selecting the site.

Filter Strip Design

Many factors must be considered in developing a good filter strip design. One of the most important factors is the size of the filter strip, which should accommodate the normal flows of nursery runoff and runoff from storm events. When designing a filter strip, it is best to consult a licensed engineer or the Natural Resources Conservation Service (NRCS). Filter strips need to be designed and constructed to comply with all federal, state, and local laws and regulations.

Plant Selection

A large number of species can be suitable for filter strips, including trees, shrubs, and cool season and warm season grasses as well as herbaceous rhizomatous perennials. It is important to select plants that withstand the particular characteristics of the area (e.g., plant hardiness, heat tolerance) because the nutrient removal efficiency varies in different environmental conditions. Site conditions that may need to be considered include soil type, depth to water table and seasonal rainfall (especially if supplemental irrigation is not planned for dry seasons), and conditions of standing water and low root aeration.

Plant qualities that have been considered important to improve the efficiency of nutrient removal include large biomass and tolerance to salt, drought and flooding. High transpiration rates and ability to enhance microbial populations are also important.

Wetland plant species have widely been included for waste water treatment because of their abilities to accumulate nitrogen and phosphorus. Many of these species tolerate different periods of soil inundation but can also survive the summer drought, which are common conditions experienced in filter strips in Southern California. Different species of cattails (*Typha* spp.) and bulrushes (*Schoenoplectus* spp.) (fig. 2), rushes (*Juncus* spp.) (fig. 3), sedges (*Carex* spp.), and grasses and other herbaceous perennials have been used as water purifying plants. Some species of these plants are known to remove nutrients and bacteria and accumulate heavy metals.

However, the rate of nutrient uptake varies widely among different species, depending on the plant growth rate and nutrient concentration in plant tissue. Plant growth during seasonal storms is important in the uptake of pollutants generated during these events. Plants that grow rapidly are easier to establish and can take up more nutrients from runoff, but pruning, mowing and other maintenance issues associated with rapid growth need to be considered. In addition, when plants are mowed or pruned severely, the water and nutrient uptake capacity is reduced until new vegetative growth is established.

When filter strips are used in natural areas, as is common in agriculture, it is preferable to use native plant species that blend with existing vegetation. Table 1 includes a list of California native plants that could be suitable for vegetated filter strips. The incorporation of local native species also provides a sustainable habitat for native wildlife.

Plant Establishment Practices

Planting should be timed so filter strips are established prior to expected runoff. The use of mulch or straw dikes may be necessary to protect vegetation until it is established. In addition, continuous protection from vehicular traffic is critical. Supplemental irrigation may initially be needed to promote seed germination and vegetation establishment. When seeds are used, environmental conditions that support seed germination requirements are critical, as unfavorable temperature may reduce germination percentage; stands produced by transplanting may be more uniform than seeded buffers. Weed control during establishment is also important and requires more labor for seeded buffers.

Maintenance

After the filter strip is established, on-going maintenance is necessary to sustain function and effectiveness. Filter strips should be inspected regularly, especially after

Fig. 2. Vegetated filter strip with different species of bulrushes (*Schoenoplectus* spp.) and cattails (*Typha* spp.) at Tree of Life Nursery in San Juan Capistrano, California. Establishing and maintaining a diverse plant community allows a more complete use of resources.

Fig. 3. Rushes (Juncus spp.) are commonly used in filter strips. This photo shows *Juncus acutus* at Tree of Life Nursery in San Juan Capistrano, California. Image by Mike Evans.

Table 1. California Native Plants for Vegetated Filter Strips

Family	Scientific Name Common Name	Size	Flowering Season	Plant General Characteristics[1]
Cyperaceae (Sedge Family)	*Carex obnupta* Slough Sedge	2-5 ft. tall	Spring	Grass-like perennial. Salinity tolerant.
	Carex pansa California Meadow Sedge	6-8 in. tall x 3 ft. wide	Spring	Grass-like, low creeping perennial. Tolerates foot traffic.
	Carex praegracilis Clustered Field Sedge	1 ft tall x spreading	Spring/Summer	Clumping grass-like perennial. Grows in alkaline places.
	Carex senta Swamp Sedge/Rough Sedge	1-3 ft tall x 3 ft. wide	Spring	Low clumping, grass-like perennial. Tolerates alkaline soil and foot traffic. Stress deciduous.
	Carex spissa San Diego Sedge	5 ft. tall x 3-4 ft. wide	Winter/Spring	Large clumping, grass-like perennial.
	Carex tumulicola Berkeley Sedge/Foothill Sedge	10 in. tall x 3 ft. wide	Spring	Low clumping, arching, grass-like perennial. Drought tolerant, survives foot traffic.
	Eleocharis macrostachya Spike Rush	3 ft tall x 2 ft wide	Spring	Low evergreen herbaceous perennial.
	Eleocharis montevidensis Sand Spikerush	1-2 ft tall x 2-3 ft wide	Summer	Spreading herbaceous perennial. Tolerates heavy clay soils.
	Schoenoplectus[2] *americanus* American Bulrush	1-4 ft tall x 2-5 ft wide	Spring	Erect herbaceous perennial.
	Schoenoplectus[2] *maritimus* Alkali Bulrush	1-4.5 ft tall x spreading	Spring/Summer	Grass-like perennial. Can grow submerged in water. Winter dormant.
	Juncus mexicanus Mexican Rush	2 ft tall x spreading	Spring	Upright spreading rush.
	Juncus patens Common Rush/California Grey Rush	2 ft tall x spreading	Summer	Evergreen perennial rush with upright to slightly arching stems. Prefers moist places but tolerates drought once established. Dormant without summer irrigation.
	Juncus xiphioides Irisleaf Rush	1 ft tall x spreading	Summer	Low spreading, evergreen rush.

Table 1. California Native Plants for Vegetated Filter Strips, Continued

Family	Scientific Name Common Name	Size	Flowering Season	Plant General Characteristics[1]
Onagraceae (Evening Primrose Family)	*Oenothera elata* ssp. *hookeri* Marsh Evening Primrose	1-4 ft. tall x 1-2 ft. wide	Spring/Summer	Herbaceous erect perennial. Large yellow flowers with 4 petals attract moth pollinators.
Poaceae (Grass Family)	*Elymus Trachycaulus* Slender wheatgrass	2-21/2 ft tall	Spring	Erect, cool season perennial bunchgrass.
	Hordeum brachyantherum Meadow Barley/California Barley	6 in. to 2 ft tall	Late Spring/Early Summer	Cool season, perennial bunchgrass.
	Leymus triticoides Creeping wildrye	2-3 ft. tall x spreading	Summer	Perennial grass, drought tolerant. Tolerates foot traffic.
	Muhlenbergia rigens Deergrass	2-4 ft. tall x 4 ft. wide	Summer	Perennial warm season bunchgrass. Tolerates periodic flooding and drought once established.
	Sporobolus airoides Alkali Sacaton	2-3 ft tall	Summer	Perennial warm season grass.
Scrophulariaceae	*Mimulus guttatus* Golden Monkey flower	2 ft tall x spreading	Spring/Summer	Annual or perennial herb with yellow flowers spotted with red dots, deciduous.
Typhaceae	*Typha spp.* Cattail	10 ft tall x spreading	Spring	Upright, spreading, herbaceous perennial. Winter dormant. Excellent for erosion control.

[1]Plant characteristics from Theodore Payne Foundation: http://www.theodorepayne.org, Calflora: http://www.calflora.org

[2]*Schoenoplectus* spp. are also known as *Scirpus* spp.

storm events, and damaged areas immediately repaired. Periodically remove sediment before seasonal rains: trapped sediment changes the shape of the filter strip, and may cause runoff to flow parallel to the strip rather than across it.

Filter strips also require management of pests such as weeds, insects and vertebrates. Insect pests in buffers that can move into production areas may require treatment. If the buffer has areas of standing water, mosquitoes need to be controlled due to diseases that they vector. If chemical treatments are necessary to control pests, such treatments should be selected considering potential risks to adjacent aquatic ecosystems.

Depending on the plant material, mowing and pruning may be necessary. The frequency of this task will also depend on the nutrient content and volume of runoff water being passed through the filter strip. Mowing must be conducted to avoid peak nesting seasons and reduced winter cover for wildlife.

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DISEASE FOCUS: Insect-transmitted plant virus diseases

by Deborah M. Mathews

This new column in the UCNFA newsletter will focus on various aspects of plant diseases, including new disease reports, emerging threats to the ornamental industry, as well as control and management strategies. In the next UCNFA issue, I will be discussing new diseases to watch out for and the return of some old pathogen problems. But in keeping with the insect theme, this issue will focus on virus diseases that are transmitted by insect pests.

There are many reasons to control insect populations in plant production facilities, not only to prevent damage from the insects themselves, but also to avoid subsequent infection by viruses. Further, although this article focuses on insect-transmitted virus diseases, there have been several reports of viable spores of fungal and oomycete plant pathogens (e.g., *Fusarium, Verticillium, Thielaviopsis, Pythium* and *Phytophthora*) being ingested and moved by such insects as shore flies and fungus gnats, common greenhouse invaders.

Thrips Transmission

Two of the most common virus diseases facing greenhouse operations today are members of a virus family collectively called the tospoviruses: impatiens necrotic spot virus (INSV) and tomato spotted wilt virus (TSWV). INSV is more prevalent in ornamentals (fig.1), while TSWV is more often found in vegetable crops. However, both viruses can infect hundreds of different plant species, and plants with mixed infections of both viruses are not uncommon.

Fig. 1. Viral lesions caused by impatiens necrotic spot virus on snapdragon seedlings. Photo by S. Tjosvold.

These tospoviruses are moved by vegetative propagation of plants and can be mechanically transmitted, but by far the most important mode of transmission is by thrips. The prevalence of western flower thrips, *Frankliniella occidentalis*, in California has helped lead to an increase in the incidence of these viruses. The insect vector-virus relationship is quite complex in that only the juvenile larval stages of thrips can **acquire** the viruses (the first instar is primarily responsible, the second instar acquires rather inefficiently). Juvenile larval stages that acquire the disease must then undergo their non-feeding pupal stages and emerge as adults before they can **transmit** the viruses to new plants. The entire progression takes about 1 to 2 weeks from egg to adult, depending on temperature. Once acquired in this manner, the adults can transmit the viruses for the rest of their live span (about 30 to 35 days), although adults do not pass the virus through to their eggs. Interestingly, adults that have not acquired the virus that feed on infected plants cannot transmit the viruses to new plants, even though the virus may be detected within the insects themselves.

Therefore, virus management depends greatly on thrips management: if thrips reproduction can be prevented, juveniles will not be available for virus acquisition, and viruliferous adults (those able to transmit the virus) will not be produced. Fine mesh screening for thrips exclusion on greenhouse vents and other openings can prevent thrips that have obtained INSV and/or TSWV from weeds or field crops outside from entering the facility and inoculating plants. A good scouting and trapping routine for thrips detection (fig. 2) and chemical application and rotation schedules for thrips control round out an integrated management program. There are easy-to-use “dipstick” type detection systems (fig. 3) available for INSV and TSWV that take only 5 to 10 minutes to get a result (e.g., Immunostrips from Agdia Inc., Elkhart, IN). If these viruses are an ongoing problem in your facility, you may consider adding this type of early detection system so infected plants may be identified and discarded before virus spread can occur.

Fig. 2. A monitoring program for tospoviruses should include a petunia indicator plant (shown in a self-watering pot on a blue plate with nonsticky blue cards to attract thrips). Petunia indicator plants show distinctive local lesions when infective thrips feed on them. These plants do not support thrips development and seldom become systemically infected. Photo by Jack Kelly Clark.

Fig. 3. Test strip from a kit for detecting viruses in plants. A positive result on a strip specific for tomato spotted wilt virus is shown. Photo by Jack Kelly Clark.

Aphid Transmission

Aphids are able to transmit over 300 plant viruses including cucumber mosaic virus (CMV) and about 100 different members of the potato virus Y group, known generically as potyviruses. CMV can infect over 900 plant species, while most potyviruses have more limited host ranges. Usually the aphids are able to transmit these viruses almost immediately after feeding on infected plants, but unlike the tospovirus/thrips relationship described above, they lose the ability to transmit the virus after just a few minutes or hours and must reacquire virus particles to continue to transmit them. Tobacco mosaic virus (TMV) is not classically vectored by any insect through feeding. However, it has been shown that this readily mechanically transmissible virus can be transmitted by aphids that walk on infected leaves and pick up virus particles on their legs, then fly to new plants and move around on the foliage, thus inoculating these plants with TMV. Outbreaks of large numbers of aphids are somewhat rare inside greenhouses, but field crops or outdoor nursery crops face more of a threat from viruses transmitted by aphids.

Whitefly Transmission

Whiteflies are also very efficient vectors of about 115 plant viruses. Common vectors are greenhouse whitefly (*Trialeurodes vaporariorum*) and silverleaf whitefly (*Bemisia argentifolii* [=*Bemisia tabaci* B-biotype]). Fortunately, most of these viruses affect mainly vegetable crops, but as it becomes more common to grow tomatoes and peppers alongside ornamental plants, we may start to see more problems in our industry. Whitefly transmission varies with the insect species and the virus, but generally they are able to acquire the virus at the nymph and adult stages in as little as an hour, and then they can transmit the virus for days or weeks. As with thrips, the increase in pest infestations and the development of pesticide-resistant populations in recent years has made the role of whiteflies in virus transmission more important.

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GLEANINGS FROM MEETINGS

ABCs of Fertilizer and Irrigation Management

by Don Merhaut

Forty-six floriculture and nursery growers and allied industry representatives attended the UCNFA ABCs of Fertilizer and Irrigation Management and Best Management Practices (BMPs) meeting in Azusa, California on June 23, 2011. Colorama Wholesale Nursery hosted the meeting and provided use of their facilities. The program was presented by Drs. Lea Corkidi and Maria de la Fuente. There were four sections to the program: (1) a summary of fertilizer BMPs and the Ag Waiver Program, (2) a review of plant physiological concepts that directly impact a plant's ability to absorb and translocate nutrients, (3) an overview of essential plant nutrients — their role in plant functions and the fertilizer products available to provide these nutrients, and (4) irrigation and water recycling practices that mitigate nutrient and pesticide runoff.

The morning program concerned fertilizer BMPs. During this time, a training was provided on fertilizer bag labeling — how to calculate actual nitrogen, phosphorus and potassium. In addition, topics that were discussed included the pros and cons of different fertilizer compounds, what chemical and environmental factors influence the longevity of fertilizer release, and BMPs related to the use of granular and polymer coated fertilizers.

After the fertilizer BMP portion of the program was completed, lunch was graciously hosted by Everris NA, Inc., makers of Osmocote® and Peters® fertilizers. After the lunch, Nursery Manager Bill Le Valley led a tour demonstrating various technologies used by Colorama to mitigate nutrient, pesticide and sediment runoff. These processes included flood irrigation, fog irrigation and water recycling. Karen Stringer of Everris Inc. then demonstrated the use of different Osmocote® controlled release fertilizers (fig. 1), including a new product called Osmocote™ Pro with Fusion Technology,™ a controlled release fertilizer with an adhesive-type coating that makes the fertilizer prills "sticky," so that they don't fall out of the container if the container is knocked over.

After the tour, participants returned to the meeting room where Dr. Maria de la Fuente explained key concepts regarding the chemical and physical properties of media that would aid in the mitigation of nutrient and pesticide runoff from production (fig. 2). The last section of the workshop focused on irrigation and water management BMPs that mitigate nutrient and pesticide runoff, highlighting the demonstrations seen during the tour.

Fig. 1. Karen Stringer of Everris Inc. demonstrating the proper use of different controlled release fertilizers.

Fig. 2. Dr. Maria de la Fuente explaining concepts of irrigation technology to growers.

ABCs of Fertilizer and Irrigation Management is a UCNFA workshop that has been presented in three locations in California: Ventura, Azusa and Vista. In keeping with our objective of reaching Hispanic audiences who make up a large part of the ornamental production industry, the meeting has been presented in Spanish in all three locations. UCNFA is hoping to have another ABCs of Fertilizer and Irrigation Management workshop in 2011 or 2012, possibly in the Central Valley. Stay tuned.

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GLEANINGS FROM MEETINGS, Continued

Is Nursery Insurance Practical to Manage Risk in Your Business?

by Trent Teegerstrom and Ursula K. Schuch

In Cooperation with University of Arizona extension specialists Trent Teegerstrom and Ursula Schuch, UCNFA provided a risk management workshop for greenhouse and nursery managers last May in Carpinteria. One of the topics was nursery crop insurance programs in California. In response to requests from workshop participants for more risk management information, Trent and Ursula provide a detailed article on crop insurance programs below. For more information, look for the next UCNFA risk management meeting to be scheduled in Watsonville in 2012.

Nursery insurance is one of many tools to manage risks in a production system that deals with perishable products that are exposed to the hazards of inclement weather, outbreaks of pests and diseases, and various market forces to name a few. Climate extremes including unseasonable or extreme high or low temperatures, severe rainfall, hail, flooding, drought and wildfires have occurred more frequently in recent years. Pests and diseases challenge plant health, but can also limit or prevent marketing of plants or can require costly treatments before shipping products to customers. Nursery insurance can protect against some of these risks and offset potential losses. Nursery insurance underwritten by the Federal Risk Management Agency subsidizes the premiums.

There are two types of federal insurance products available for nursery and floriculture products in California. Both cover growing products but one uses an approach based on whole-operation revenue (Adjusted Gross Revenue or AGR) and the other uses an inventory-value approach (nursery crop insurance). Table 1 lists a few characteristics of the two types of insurance. Both products can work together or independently (http://www.rma.usda.gov).

Nursery Crop Insurance

Nursery crop insurance is available to operators of nurseries that meet certain criteria. These include that the operation receives more than 50% of the income from wholesale marketing of nursery plants, and that plants are on the eligible plant list and are grown in appropriate medium. Operations must meet all requirements for insurability and the nursery must be inspected and approved as acceptable before insurance coverage begins. Both field and container-grown plants are eligible for insurance, but a few exceptions include plants grown for Christmas trees, stock plants and plants harvested for cut foliage. Containers with different species, cultivars, varieties, or genera are also not eligible for this insurance.

Insurance can be purchased for the current crop year until May 1, and coverage extends from June 1 until May 31 of the following year. However, if you miss the initial deadline of May 1, insurance can still be obtained anytime during the insurance period up to April 1 with a 30-day waiting period before insurance coverage begins.

Now is a good time to evaluate whether this insurance product makes sense for your operation. If you are a do-it-yourself operator, just follow the steps below to get an initial idea of whether the product will assist you in better managing risk; otherwise, go straight to the list of crop insurance agents (http://ww3.rma.usda.gov/apps/agents/) and have them walk you through the process.

A first step can be to evaluate whether the insured causes of loss are a threat in your area. Are adverse weather conditions such as freeze, wind or hurricane, fire, wildlife, or failure of irrigation supply due to drought a risk for your operation? The insurance does not give operators carte blanche to neglect best practices for growing and adequately protecting plants from such hazards and requires that good practices are followed. If your nursery is potentially affected by any of the insurable losses, the next step is to evaluate whether only container plants, field-grown plants, or both should be insured.

The next step is to consult the eligible plant list and the plant price schedule at http://www.rma.usda.gov/tools/eplpps. Creating a crop-inventory valuation report is the most time-consuming task which is required to calculate the plant inventory value. It requires that each plant species and cultivar is listed by botanical and common name, container size and number of plants in the inventory at the time when insurance is purchased. Further information for each plant includes the hardiness zone for field-grown material that can be insured and winter protection that is required for container plants in different counties. Software is available at the website to assist in the creation of this list. A wholesale catalog of the nursery is required to accompany the crop-inventory valuation report.

Coverage levels between 50 to 75% of the plant inventory value can be purchased with premium subsidies. The most

Table 1. Characteristics of the two types of federal crop insurance available to nursery and floriculture business operators.

	Insurance product	
	Nursery Crop Insurance	**Adjusted Gross Revenue**
Operations eligible	More than 50% of the operation's income is from wholesale nursery revenue	No more than 35% of expected allowable income is from animals or animal products
Plant types eligible	Nursery plants in container or field production (some exceptions)	Nursery and greenhouse products including cut flowers and Christmas trees
Insurance criteria	Crop inventory valuation list	5-year historical farm average revenue reported in 1040 Schedule F tax form
Time	June 1 – May 31 the following year	Any full 12-month tax year
Insurable causes of loss	Adverse weather, fire, wildlife, earthquakes	Yield loss (due to natural causes), price drop (due to market fluctuations)
Maximum coverage claim	None	$6.5 million
Basic catastrophic coverage (CAT)	Yes	No

basic coverage is the catastrophic coverage level which is available for a flat administrative fee of $300; this level covers 27.5% of the plant inventory value and the premium is fully subsidized. If you choose a coverage level of 50% of the plant-inventory value, the premium is subsidized by two-thirds and one-third is paid by the nursery. Under the highest coverage level of 75%, the premium subsidy is 55% and the nursery pays 45% of the premium.

Adjusted Gross Revenue

Adjusted Gross Revenue (AGR) is a whole-farm revenue protection plan of insurance and provides insurance coverage for multiple agricultural commodities in one product. It is available for nearly all agricultural crops grown in California. For example, an operation that produces nursery plants in containers, cut flowers and citrus fruit in an orchard can use AGR insurance to cover all three commodities. The plan provides protection against low revenue due to unavoidable natural disasters and market fluctuations that affect income during the insurance year. More information on AGR policies can be found at: http://www.rma.usda.gov/policies/agr.html.

AGR insurance eligibility requires that farms have five consecutive years of 1040 Schedule F tax records or comparable tax information, and that no more than 35% of the expected allowable income is from animals and animal products. The application also requires a farm report listing commodities and quantities to be produced along with expected prices. Beginning inventories if available should be listed and expected changes in the current year that may lead to lower revenue compared to previous years should be documented. The period of a one-year insurance coverage is for the operation's tax year (depending on whether tax filing is for the calendar or fiscal year). Crop insurance agents for AGR can be located at http://www3.rma.usda.gov/tools/agents/companies/.

Is Nursery Insurance Practical to Manage Risk in Your Business, Continued

AGR coverage levels and payment rate eligibility vary with the number of commodities a business produces and only one coverage amount may be selected:

65% coverage level with 75% or 90% payment rate (applies to any number of commodities).
75% coverage level with 75% or 90% payment rate (applies to any number of commodities).
80% coverage level with 75% or 90% payment rate (at least 3 commodities required).

A cost estimator is available at http://ewebapp.rma.usda.gov/apps/costestimator.

Summary

While there is some overlap between the two insurance products discussed that are available for nursery and floriculture business operators, AGR covers cut flowers, Christmas trees and lost revenue from market fluctuations. Both products cover a portion of loss due to adverse weather and other natural disasters. Businesses that produce a number of different crops and have some income from animals or animal products may find AGR more flexible because it covers a range of commodities compared to nursery insurance. Contact a crop insurance agent to learn more these crop insurance programs.

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<u>REGIONAL REPORT</u> - Getting serious about palm weevils

by James A. Bethke

Back in May 2010, I was forwarded a notice from a colleague in Florida that the USDA was getting serious about the movement of palms because of the spread of several species of giant palm weevils. A federal order had recently been declared in which palms and palm parts were to be excluded from import into the United States. A few months later, palm weevils were in the news again: a landscaper brought red palm weevils, *Rhynchophorus ferrugineus* (Olivier), from a Canary Island date palm in Laguna Beach to the attention of the county agricultural commissioner. San Diego officials, professional nursery and landscapers, and palm enthusiasts were concerned about this finding because of the great number of palm trees and palm producers in the county and the proximity of Laguna Beach in southern Orange County. While we were all looking north of San Diego County, interceptions of the South American palm weevil, *R. palmarum* L., were being reported from the border of Mexico.

Both of these palm pest species are from the genus *Rhynchophorus*, which are large weevils. The immature forms are esteemed as culinary delights wherever they are found in South America, the Caribbean, Africa and various parts of Asia. Regardless of their ability to feed the human populations, they are very destructive pests of some of the more appealing specimen palm trees. Although landscape trees in Southern California may be heavily impacted, the volume and value of palms in nurseries and their movement could be severely impacted.

From the date of this article, there have been 11 weevils captured in baited traps along the San Diego County border, and a single beetle has been captured in Imperial County as well. If the weevils move northward, not only will they threaten the ornamental plant industry, but also they could severely impact the date-producing areas of Riverside County.

Palm weevil larvae feed within the apical growing point of the palms, creating extensive damage to palm tissues and weakening the structure of the palm trunk. The pineapple-looking tops of severely damaged Canary Island date palms fall from the top of the tree in wind and rainstorms. Giant palm weevils, especially the red palm weevil, are widely considered the most damaging pests of palms in the world. The USDA and CDFA are moving the South American palm weevil traps from the border area to see where the weevils may have dispersed. They are also surveying other states like Nevada (because Las Vegas buys many palms from Southern California), Arizona, Texas and Florida for both the red palm weevil and the South American palm weevil. Results of the surveys will help regulators decide what action should be taken.

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Red palm weevil adult. Photo by John Kabashima.

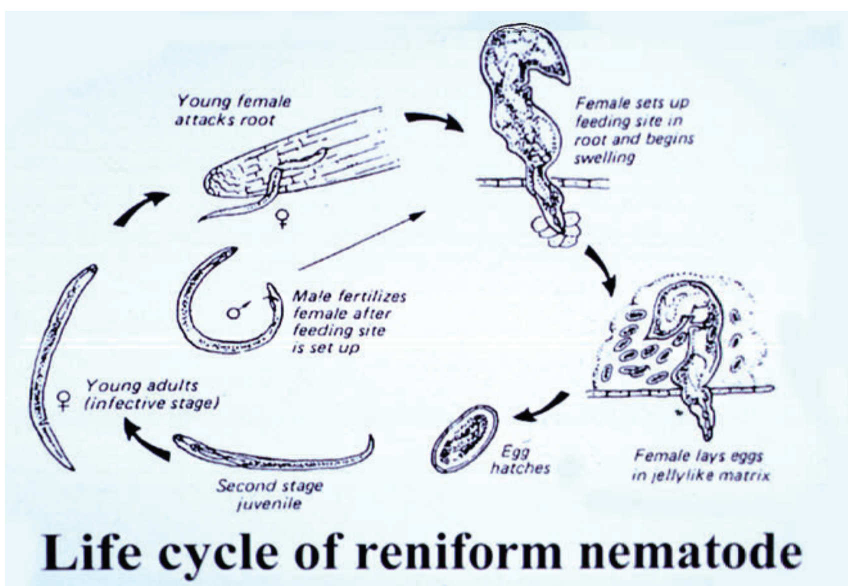
FIELD OBSERVATIONS — UC Cooperative Extension San Diego County

Reniform nematode causing problems for local growers

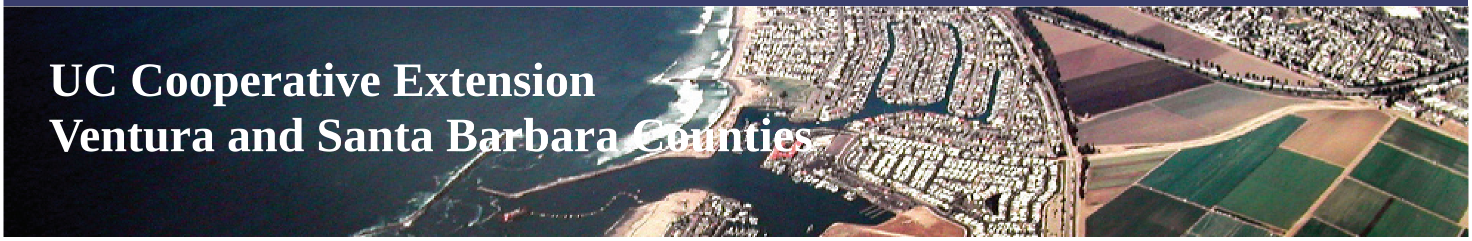
The reniform nematode, *Rotylenchulus reniformis* Linford and Oliveira, causes economic damage (up to 10% losses) to cotton, sweet potato and other vegetable crops in the continental United States, and to pineapple in Hawaii. At present, there are no field populations of reniform nematode in California and regulators would like to keep it that way.

The California Code of Regulations mandates that nursery stock shall be commercially clean with respect to economically important nematode species detrimental to agriculture, and incoming and outgoing shipments need to be free from these nematode pests to fulfill phytosanitary quarantine requirements. Thus California recently halted several shipments of potted plants from Hawaii due to infestations of reniform nematode, causing great concern for both California and Hawaii agricultural inspectors. An investigation identified an isolated source of infested cinder, and the issue has been resolved for now. Unfortunately, the nematode was also detected in potted plants in San Diego and Riverside counties during inspections in 2011.

There are no highly effective nematicides left in California, which means that an effective eradication treatment eludes the ornamental plant industry. Therefore, if plant parasitic nematodes are present, shipments will be held for treatment and re-inspection, and potentially may be destroyed. Further, without a proper identification of immature stages of nematodes, regulators have no choice but to err on the side of caution to protect vulnerable agriculture. Our trading partners do not want the problem sent to them either.



Graphic by Charles Overstreet. Source: Nemaplex Virtual Encyclopedia on Soil and Plant Nematodes, http://plpnemweb.ucdavis.edu.



REGIONAL REPORT - Mitigating Pesticide Runoff While Managing Invasive Pests

by Julie Newman

In the past decade, invasive pests such as light brown apple moth (LBAM), Asian citrus psyllid (ACP) and glassy-winged sharpshooter (GWSS) have caused considerable economic hardship for certain flower and nursery growers in Ventura and Santa Barbara counties due to restrictions on the movement of potentially infested nursery plants. Moreover, some of the pesticide treatments that are mandated in quarantine protocols are known to impair water quality and have been detected in ag waiver and TMDL monitoring programs. The continued degradation of surface waters and documented exceedance of pesticide and toxicity benchmarks set by the Central Coast and Los Angeles regional water boards have led to increasing regulations. Meanwhile, there is a threat of new invasive species from neighboring counties (e.g., red palm weevil, red imported fire ant) that could potentially lead to more mandated pesticide treatments in the future. It is therefore critical that flower and nursery growers in Ventura and Santa Barbara counties implement BMPs to prevent pesticides, including those required in quarantine protocols, from moving off production sites in irrigation and storm runoff.

Reducing Pesticide Loads

An important strategy for reducing chemical inputs is to establish an IPM program that includes a regularly scheduled monitoring program. Scouting to detect pests is especially critical when there is risk of establishment of invasive pest species. In fact, quarantine compliance agreements for pests such as LBAM require monitoring and written documentation of in-house inspections and results. All nursery personnel should be trained to recognize pests found in the nursery, especially any invasive pests.

Implement preventative control techniques to prevent spread of pests and diseases and reduce the size of areas requiring treatment. Landscapes, native plants and weeds in nonproduction areas can serve as a source of infestations and should be repeatedly inspected, in addition to the crop. Good sanitation practices are critical and include starting with clean plants and maintaining a clean growing environment (e.g., heat steaming or chemically treating growing media before establishing a new crop). In addition to good sanitation, practices that help to reduce pesticide loads include using resistant plant varieties and providing a growing environment that promotes plant health to improve host resistance to pests and diseases.

Nonchemical control methods (cultural, mechanical, environmental and biological control) should be incorporated as appropriate in the overall IPM program to reduce chemical inputs. For example, one mechanical control method is pest exclusion: in areas where there are quarantine restrictions for invasive pests such as LBAM or glassy-winged sharpshooter, pest access to outdoor nursery stock can be restricted by using hoop covers or greenhouses to protect preferred host species.

When selecting pesticides, chemical inputs can be minimized by rotating pesticides from different modes of action (although choices may be limited by quarantine protocols) and using other management strategies to avoid pesticide resistance. Choosing pesticides that are the most selective for the target pest species may also reduce chemical inputs by minimizing disruption of control by natural beneficial populations.

When applying pesticides, the use of adjuvants such as spreader-stickers may reduce the amount of pesticides applied. Generally, pesticides should be applied only when justified by pest population size and crop damage-threshold levels. This will result in fewer pesticide applications and reduce pesticide drift and runoff. However, when invasive pests are detected in quarantine areas, quarantine protocols for destruction/treatment of infested plants must be followed.

Spot-spray applications should be made only to infested plants to limit the negative impact on other organisms, including beneficials. Re-inspect treated plants after the label re-entry period expires to confirm treatment efficacy. When spot treatment fails, infestation is widespread, or recurrence of infestation is demonstrated, entire blocks of plants known or suspected to be infested may need to be treated, especially for eradication of an invasive pest.

Reducing Pesticide Movement in Water

When pesticides are selected, it is important to know the site conditions of the area to be treated and potential hazard of spray drift or subsequent pesticide movement to surrounding areas. Check the label and online resources, such as the "Water Quality Compare Treatments" provided in the University of California IPM Pest Management Guidelines (http://www.ipm.ucdavis.edu/PMG/crops-agriculture.html), to select products with reduced runoff potential and toxicity. When quarantine protocols specify the use of pesticides that could potentially impair water quality (e.g., certain organophosphates, carbamate insecticides, synthetic pyrethroids), it is especially important to implement practices to prevent pesticide movement off site. Irrigation efficiency, irrigation uniformity, methods of irrigation, and timing of irrigation events all affect pesticide runoff. Irrigation systems should be designed to ensure uniform irrigation distribution. Regular irrigation system maintenance is critical to maintain irrigation uniformity and prevent runoff due to leaks and clogged lines. Irrigation should be based on environmental conditions and plant water requirements, applying the required amount of water only to plants, and not to walkways or roads. To reduce runoff when using overhead irrigation, place containers as closely as possible without reducing plant quality. With drip systems, ensure that each emitter is located in a pot. When containers are moved, plants should be reconsolidated and the irrigation turned off in unused portions. Hand watering should be performed carefully to avoid creating runoff between pots and on walkways. Do not apply pesticides before an irrigation or storm event, unless label instructions specify otherwise.

Pesticide spraying equipment should be calibrated to ensure the best coverage and accurate application rates. Pesticide mixing and loading operations should be conducted on an impermeable surface such as a concrete floor to avoid groundwater infiltration. To eliminate disposal problems associated with excess spray solutions, only mix up the volume of spray that is actually needed. If there are leftover pesticide materials, consult the pesticide label for proper disposal instructions.

Practices should be implemented to avoid leaks or spills during pesticide transportation, usage and storage. Any pesticide spills should be cleaned immediately according to a predetermined protocol based on the product MSDS. Any runoff from areas where pesticides are used should be contained or directed to a treatment area for mitigation.

Reducing Pesticide Movement on Soil and Potting Media

Pesticides like synthetic pyrethroids that are strongly adsorbed to soil particles run off with loose soil particles, including potting soil mix. Spills of potting media during production and transportation have been identified as a main source for pesticides. Furthermore, historical pesticides such as DDT compounds still persist in farm soil and are consistently detected in agricultural monitoring programs. Therefore, growers must implement practices to keep soil, sediment and potting soil on site.

If pesticides are mixed into container media before transplanting, concrete curbs or sand bags should be used to isolate these areas so that media is not washed away. Any spilled potting media that contains pesticide residues

Some pesticides like pyrethroids and chlorpyrifos that are used to control invasive pests such as glassy-winged sharpshooter (left) and light brown apple moth (right) are known to impair water quality. Photos by Jack Kelly Clark.

should be collected to avoid off-site movement by wind or water. Storing container media in a location sheltered from wind and away from drainage channels reduces the risk of media blowing into waterbodies.

Bare soil and hillsides in nonproduction areas must be protected from concentrated flows of water that cause erosion by establishing plant covers or ground covers (e.g., mulch, gravel) or sediment barriers (e.g., sand bags, straw wattle, synthetic hay bales). Areas susceptible to erosion can also be treated with polyacrylamides (PAM) to improve stabilization.

Treating and Capturing Runoff and Sediment

If irrigation or storm water is discharged from the nursery, pollution can be mitigated by first conveying runoff water through treatment areas such as vegetative buffers (e.g., filter strips, bioswales, constructed wetlands, landscape plantings) and sand filtration systems. Furthermore, water bodies and drainage channels located on the nursery property should be protected by vegetated filter strips. Growers should be aware that vegetative buffers may harbor pests such as active LBAM or glassy-winged sharpshooter infestations. These plants should therefore be included in scouting and pest management programs.

Many types of impoundments are used in nurseries for capturing runoff water and sediment (e.g., sediment basins, detention basins, retention basins, ponds, recycling systems, tailwater recovery systems, reservoirs). Water dissipates by evaporation and by infiltration into the ground from unlined impoundments. Seepage into the ground could be problematic and should be considered in the design of the impoundment. Impoundments may not have the capacity to store all rainfall from precipitation events. Discharges and overflow from impoundments should be treated to prevent polluted runoff from off-site movement. Overflow may be alleviated by using the collected water to irrigate landscapes and other non-crop areas, or by recycling it for irrigating crops.

Resources

Growers should contact their local ag commissioner concerning specific county requirements for quarantined pests. In addition, regulatory requirements, including some monitoring and treatment information, is available at the California Department of Food and Agriculture (CDFA) website (e.g., GWSS http://www.cdfa.ca.gov/pdcp/Regulations.html, LBAM http://www.cdfa.ca.gov/phpps/regs_lbam.html, ACP http://www.cdfa.ca.gov/phpps/regs_acp.html). The *Light Brown Apple Moth Nursery Industry Best Management Practices: Integrated Pest Management Practices Manual* (www.**cdfa.ca.gov**/phpps/PDEP/lbam/rpts/LBAM_BMP-Rev_3.pdf) is an excellent resource guide for reducing risk caused by LBAM. It includes practices that result in reduction of pesticide loads.

There is a wealth of information available from the University of California on invasive pests of interest to flower and nursery growers in Ventura and Santa Barbara counties. For example, for general pest management information and pest biology of invasive pests, a good source of information is the Center for Invasive Species Research at http://cisr.ucr.edu/invasive_species.html. ANR Publications provides free downloadable information on ACP monitoring and treatment (http://anrcatalog.ucdavis.edu/Citrus/8205.aspx). For GWSS, there is a DVD on pest identification and monitoring (http://anrcatalog.ucdavis.edu/GrapesGrapeProducts/6584D.aspx) and free downloadable information on pest management guidelines (http://www.ipm.ucdavis.edu/PMG/r280301711.html).

There are numerous resources on BMPs for reducing pesticide runoff. For example, *Greenhouse and Nursery Management Practices to Protect Water Quality* (available at http://anrcatalog.ucdavis.edu/Items/3508.aspx) includes a chapter on pesticide use and water quality management, as well as a list of BMPs to mitigate pesticide runoff. A more in-depth list of BMPs can be found in the Checklist for Assessing and Mitigating Runoff in Greenhouses and Nurseries, available on my website at http://ceventura.ucdavis.edu/Com_Ag/Ag_Water/.

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REGIONAL REPORT - Environmental conditions could be monitored in the nursery to limit the spread of sudden oak death

by Steve Tjosvold

Sudden oak death (SOD) is a disease that has spread to new areas in the United States by ornamental nursery stock. It is likely that it will eventually establish in eastern forests and wildlands with yet unknown impact. The causal agent of the disease, *Phytophthora ramorum,* is a water mold that produces aerial spores (sporangia and zoospores) capable of being spread by splashing rainfall and sprinkler irrigation to adjacent plants and by water runoff, streams and other waterways. Although we know much about how temperature and moisture influence the production of spores in the laboratory, no studies, until the one we have just completed, has determined how these factors are integrated under nursery conditions.

Experimental factors we studied for two years included the effect of season, temperature, leaf wetness, lesion size and age on spore production of the pathogen on two important ornamental hosts (camellia and rhododendron) and one epidemiologically important forest host (California bay). Experimental leaf wetness regimes were established with overhead misting to simulate rainfall, fog, dew, or conditions that might occur in an overhead irrigated nursery or landscape.

A research paper was recently presented at a scientific meeting on our findings, and for this report, we present the general findings and conclusions as to how this information might be implemented into nursery practices.

As expected, spores were most likely produced with simulated rainfall, followed by simulated fog, followed by natural conditions. Sporulation remained fairly constant in the 50 to 86 ^{o}F (10 ^{o}C to 30 ^{o}C) range, given sufficient leaf moisture, but stopped quickly when maximum daily temperatures were above about 91 ^{o}F (33 ^{o}C) in all species. Sporulation increased logarithmically with increasing consecutive hours of leaf wetness. Sporulation on California bay and rhododendron began at the onset of leaf wetness, while camellia began to sporulate in about 8 hours. For all species, the highest rate of sporulation was seen after 1 day of artificial misting (fog or rain conditions), with the highest level after 4 days. Over 1 day of leaf wetness was necessary to detect significant sporulation in camellia and rhododendron, but in California bay, sporulation was measured at the end of the first day. Lesion size on rhododendron and California bay plants did not predict sporulation well, and was not significant for camellia; therefore lesion size was not included in the final statistical models. However, lesion age was a much stronger predictor of sporulation (fig. 1). Sporulation increased from 3 weeks age to 9 weeks for California bay, from 3 weeks to 6 or 9 weeks for camellia, but decreased from 3 weeks to 6 or 9 weeks for rhododendron. Sporulation often occurred in the spring and fall when clear cold nights produced heavy natural fog on the top and bottom of leaves.

Fig. 1. Leaf lesions on rhododendron caused by *Phytophthora ramorum.* Lesion age is a stronger predictor of sporulation than lesion size. Photo by S. Tjosvold.

Using this information and readily available electronic environmental sensors (such as the equipment used in this experiment, illustrated in fig. 2.), nursery operators could monitor environmental conditions and in high-risk temperature and leaf-wetness conditions, avoid certain cultural practices such as plant handling or pruning that might increase the chance of infection. Likewise, avoid conditions such as overhead irrigation that would lengthen the duration of leaf wetness which would logarithmically increase the production of spores. Further, preventative fungicides could be applied at times when there is a high risk of sporulation.

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Fig. 2. To simulate fog or rain to test different leaf wetness regimes on *Phytophthora ramorum* sporulation, an Onset U-30 WiFi wireless datalogger with relay was used in conjunction with an Onset LW-1 Leaf Wetness sensor to control Netafim (Tel Aviv, Israel) Vibronet Misters (# 0354025-B). Photo by S. Tjosvold.

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***compiled by* Steve Tjosvold**

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