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Improved Hot Water Weed Control System

Photo courtesy of Waipuna, Inc.

This technician is applying hot water and foam from the Waipuna system along a path for weed control.

A number of school districts in the U.S. are converting to IPM methods for control of pests. School IPM programs try to control weed problems without applying chemical herbicides. Non-chemical weed control is generally more labor intensive, and many districts are seeking a low-cost replacement for herbicides. Though it has some limitations, the Waipuna hot water system can compete with chemical control methods. The Waipuna system was first described in the IPM Practitioner 16(1):1-5. This article describes a new system that works twice as fast due to a heat-trapping surfactant.

By William Quarles

On November 9, 2000, Debbie Raphael of the San Francisco IPM Program organized a demonstration of the new, improved Waipuna weed control system. At the core of the Waipuna system is a diesel-powered, computer-controlled boiler that delivers hot water to weeds through a supply hose and a treatment wand. Reservoirs of cold water complete the system. Both boiler and water containers are easily transported in a minivan to the treatment site. Water leaves the boiler at temperatures above the boiling point (100°C; 212°F) and exits on the ground at 98°C (208°F). Very little heat is lost through the 100-foot (30 m) delivery hose, and boiling water is generated at the rate that it is used. Operators can literally "mop-up" weeds.

Though earlier versions of the system used only boiling water to control weeds, the new system generates a biodegradable foam from a mixture of corn and coconut sugars added to the treatment water. The foam produces a thin film that prevents heat from immediately dissipating as the hot water is released. When boiling water is applied to soil, at first heat is lost quickly, then surface temperatures stabilize due to the heat retention properties of the foam.

Without the foam, operators had to saturate the ground with hot water to get enough heat to do the job. Now they can get the vegetation wet with water and foam, then move on. Addition of the foam means that treatment of weedy areas can be accomplished twice as fast.

In areas around ornamental beds, underneath shrubs and other areas, the Waipuna system is just as fast as applications of glyphosate (Roundup®). Unfortunately, there is a limitation to how fast large, open areas can be treated. Treatment of open areas with the Waipuna system can take 20-25% longer than treatment of the same area with herbicides.

How Practical is the System?

The mixture of corn and coconut sugars used to make the foam has the consistency of molasses. About 1 quart (0.9 liter) of the material is mixed with 50 gallons (182 liters) of

In This Issue

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treatment water (0.5%), and the polymerized sugars effectively act as a surfactant. Each 50 gallons or so of solution provides enough boiling water for about 15 minutes of operation. A minivan can carry enough water for about 1 hour of work. After this time, water containers must be refilled with new solutions of the surfactant. In practice then, operators get to take a break every hour to refill water containers. Water sources are usually conveniently available in municipal areas, but there could be some delay when the machine is used to treat roadside weeds along the highway.

Photo courtesy of Waipuna, Inc.

The Waipuna system shown here consists of a computer controlled boiler combined with a diesel generator and a source of water.

Photo courtesy of Waipuna, Inc.

Areas around trees can be quickly treated without damaging the tree.

Costs

The cost of the surfactant is about the same as Roundup, since a 55-gallon drum (200 liters) costs about $900. In the past, the Waipuna machine was available only through a leasing arrangement. Now the company will sell the machines outright. The basic machine has one boiler, and costs about $28,500—about half a year's salary for one landscape worker. Cost of the machine varies with the number of boilers. The 2-boiler machine, which works twice as fast, costs about $38,500.

The machine would be cost effective in school districts where pesticide use is forbidden. In the Los Angeles School District, for instance, the number of people employed in weed control has mushroomed from 6 to 37. The Waipuna machine could significantly cut back on labor costs in these big school districts. According to a Wall Street Journal article on October 5, 2000, weeds bursting through asphalt on paved playgrounds are a common problem in the Los Angeles school district. The Waipuna van could be driven quickly to these areas and operators could spot-treat problem weeds.

Municipal Vegetation Control

Municipalities that have pesticide bans or IPM ordinances may find the machine useful. Muncipalities must control weeds growing in cracks of pavement, since uncontrolled weed growth breaks pavement open and leads to potholes and similar damage. The Waipuna system is used in New Zealand to control weeds around curbs and channels, footpath edges, driveways, boundaries and obstacles. When hot water is applied to weeds, all the aboveground foliage is thermally denatured and killed.

Effectiveness

The New Zealand Institute for Crop and Food Research tested the Waipuna system in 1992 and compared results with glyphosate (Roundup™) applications. A block of kiwifruit at the Institute was the test site. The data showed the Waipuna system works faster than glyphosate, and had about the same effectiveness. After 49 days, no annual weeds had survived the Waipuna treatment, but a few perennials had regrown from taproots (Ingels 1992).

Photo courtesy of Waipuna, Inc.

Weeds around the tree have been killed by the Waipuna system. Weeds start to die within 24 hours.

Target weeds in the test included annual bluegrass, *Poa annua*; perennial ryegrass, *Lolium perenne*; fumitory, *Fumaria officinalis*; buttercup, *Ranunculus* spp.; white clover, *Trifolium repens*; dandelion, *Taraxacum officinale*; scrambling speedwell, *Veronica* sp.; twin cress, *Arabidopsis* sp.; bitter cress, *Cardaria* sp.; broadleaf dock, *Rumex* sp.; sow thistle, *Sonchus* sp.; black nightshade, *Solanum nigrum*; creeping woodsorrel, *Oxalis corniculata*; bermudagrass, *Cynodon dactylon*; and field bindweed, *Convolvulus arvensis* (Daar 1994).

Photo courtesy of Waipuna, Inc.

Weeds covering this path are quickly "mopped up" with the Waipuna system.

Normally, treated vegetation blackens and dies within 24 hours, but some species make take several days to show symptoms. The broader and thinner the leaf, the quicker the reaction. Treatments applied in hot, sunny weather are quicker than aplications during cooler weather (Daar 1994).

Tough perennials may require retreatment. For instance, kikuyugrass, *Pennisetum clandestinum*, a perennial from South Africa, causes many problems in New Zealand. After kikuyugrass is treated, it begins to regrow within three weeks. A second treatment at 35-45 days delays growth up to 12 weeks. A third treatment stops regrowth for 3-4 months. Destruction of aboveground leaves, and prevention of photosynthesis reduces nutrients available in the roots, reducing regrowth (Daar 1994).

Waipuna Surfactant

Is the surfactant used in the Waipuna system safe for the environment? The surfactant, called alkyl polyglycoside, is formulated wholly from corn and coconut sugar extracts. The thick, syrupy concentrate is chemically a polymer of glucose. Like soap and other surfactants used for laundry, the

Photo courtesy of Waipuna, Inc.

Weeds growing along this path have been stopped by the Waipuna treatment.

Waipuna surfactant will cause eye irritation. When handling the concentrated surfactant, gloves and protective clothing are recommended to avoid prolonged and repeated skin contact. The surfactant has low toxicity and an oral LD50 in rats greater than 5000 mg/kg.

According to company literature, about 1 mg of the foam is applied per kilogram of soil. The LC50 for the earthworm, *Eisenia* sp. is about 654 mg/kg, and thus earthworms are not threatened by the treatment. Detrimental effects to aquatic organisms are expected at concentrations above 10 mg/liter, although effects on sensitive organisms such as the water flea, *Daphnia* sp., and some fish will occur at lower concentrations. For instance, water concentrations of 1 mg/liter will inhibit reproduction of the water flea, a common test organism for aquatic toxicity. The material can be toxic to fish at concentrations of 3 mg/liter. Because of this, the foam should not be directly applied to surface water. According to company literature, the foam is applied for weed control to soil at concentrations of 0.0004 mg/liter and should be totally benign. When applied to soil, the foam is degraded by soil microorganisms completely within 28 days.

The California Department of Pesticide Regulation has determined that the surfactant is not a pesticide, and therefore does not require registration. Phillip Dickey of the Washington Toxics Coalition has rated the weed foam formula as among the safest of surfactants. The material has been approved by IFOAM for organic agriculture in Australia (Waipuna 2000).

Domestic Vegetation Control

The hot water-surfactant weed control system is not the only good news from Waipuna. For homeowners and residents looking to control weeds of the lawn and garden, Waipuna has also developed an electric portable water heater called the Green Weeder. The Green Weeder is made from plastic in a wand shape that allows treatment of weeds without bending or crouching. It is a lightweight, handheld device that targets weeds without damaging desirable plants. Using only tap water and electricity, the Green Weeder exposes plants to high temperature steam and water. The domestic weeder controls weeds in windy or wet weather conditions without posing a danger to prized plants or vegetables.

Conclusion

The Waipuna system provides a non-toxic alternative to chemical herbicides for weed control. School systems and municipalities that have converted to IPM methods or that have pesticide bans could successfully use the system as an economically viable alternative to herbicides. The major disadvantage of the method is that all treatments must be accomplished within 100 ft (30 m) of the boiler and water supply.

Homeowners and others may find the small handheld model useful for lawn and garden weeds. The handheld model is limited only by the length of garden hose and electrical extension cord available. Hot water is very successful for control of annual weeds, but perennial weeds may have to be retreated on a regular basis to deplete food stores in the roots. Like any other weed management method, hot water and the Waipuna system should be used in a complete IPM program that includes prevention as well as positive controls.

Resources

Waipuna USA—701 West Buena No. 3, Chicago, IL 60613; 630/514-0364; Fax 630/654-2380; email jeffw@waipuna.com.

Waipuna International—PO Box 62140, Mt. Wellington, Auckland, New Zealand; 64 9 2765840; Fax 64 9 2760330; email wil@waipuna.com; Web site www.waipuna.com.

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The Attack of the Killer Fungus

By John A. Mitchell

When red blisters began appearing on their melons in the spring of 1997, baffled Texas farmers in the lower Rio Grande Valley called in plant pathologists. The diagnosis: *Didymella bryoniae*, a fungal disease commonly known as gummy stem blight. The news came as a shock.

For twenty years, farmers in the area had used the pesticide benomyl (Benlate™) to ward off fungus. Although the region's generally warm and dry growing season had usually kept fungal disease in check, the DuPont salesman had advised growers to spray anyway—as "insurance."

But during that cold, rainy spring in 1997, the insurance failed. Despite repeated applications of Benlate, blisters broke out on the fruit and leaves shriveled and browned, as gummy stem blight took its toll on thousands of acres of melon and cantaloupe fields. The fungus, it turned out, was resistant to the pesticide that was supposed to kill it. In the end, produce companies in the region lost 68 percent of the melon crop that year. Outraged growers took the pesticide company to court.

This June, a Texas jury ordered DuPont to pay $100.3 million to two fruit companies, Starr Produce Company, and Elmore and Stahl Inc., for their crop losses. DuPont is appealing the judgment and says the farmers ignored the company's recommendations for use. DuPont spokesman Mike Ricciuto also claims that the corporation was persecuted in a region of Texas where juries are notoriously unfriendly to large companies. But during the trial, the plaintiffs' attorneys unearthed a memo from a DuPont salesman showing that the company had known about gummy stem blight's resistance to Benlate since 1994.

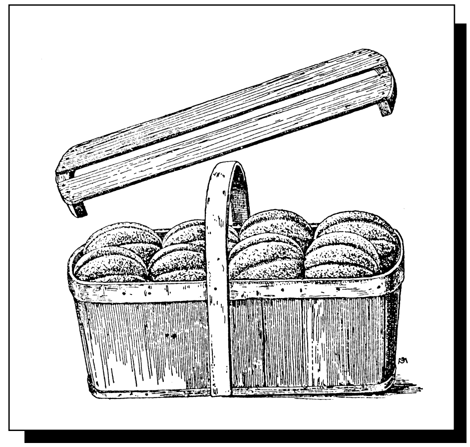
"We will see more liability if pesticide manufacturers such as DuPont act as Firestone did with its tires—they know there is a problem, but until it becomes uneconomical, they continue to sell it," says Robert C. Scott, an attorney for the plaintiffs.

Pesticide Treadmill

The historic response to pesticide resistance in U.S. agriculture has been to use more toxins, which has only magnified the resistance problem and created an exuberant, expensive chemical dependency. Pesticide use in the United States increased tenfold from 1945 through 1989. During the same period, the number of insect pests resistant to pesticides increased, and crop losses nearly doubled, from 7 to 13 percent, according to a report issued last year by the Pesticide Action Network. [The source of the original data can be found in David Pimentel, ed. 1997. *Techniques for Reducing Pesticide Use*. John Wiley and Sons, New York.]

"...farmers are victims of an incredible propaganda campaign by the pesticide industry, but they are sort of willing victims..."

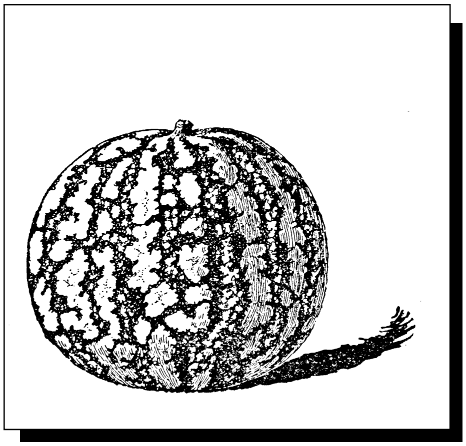
Resistance forms when selection pressure is put on an organism and it changes in response, explains Lynn Brandenberger, a horticulturist with the Texas agricultural extension service." When you apply pressure (in this instance, the pesticide Benlate), the pathogen population begins to shift genetic direction to get around it," says Brandenberger, who worked closely with the farmers in the afflicted area in 1997. "Overuse leads to resistance developing more quickly."



At Starr Produce Company's 5,000-acre farm, spraying in 1997 began even before the first symptoms appeared and continued through the harvest. Or what would have been the harvest. By then, an estimated $6 million worth of melons had been lost.

Tom Isakeit, a plant pathologist at Texas A&M University who identified the pathogen as gummy stem blight, checked for resistance to benomyl, the active ingredient in Benlate. More than 90 percent of the samples were highly resistant. "Sometimes you just up the dose and that helps for a little while. In this case, that wouldn't have worked at all," Isakeit says.

Once resistance develops there isn't always a solution, chemical or otherwise. "About a decade ago, the Colorado potato beetle evolved resistance to everything we had" says David Andow, an entomologist at the University of Minnesota. "Farmers had to stop growing potatoes in several major production areas. And then one chemical company came up with a new chemical that everybody is using now. It's really just a matter of time before resistance to that will start appearing."



IPM the Answer?

One solution environmentalists have long advocated is integrated pest management (IPM), a system that reduces pesticide use without requiring farmers to go entirely organic. IPM calls for using all the biological controls available—crop rotation, predatory insects, and the like, and reserving the chemicals as a last resort. Even then, a farmer sprays only when pests threaten to shrink profits too much; spraying for "insurance" is out of the question. But IPM tactics differ, depending on who's talking. There is currently a battle going on for the heart of IPM: pesticide manufacturers are promoting their own chemical-intensive model.

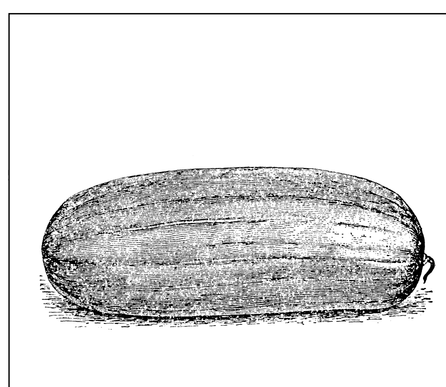
Richard Wiles, research director at the Environmental Working Group (EWG), has sympathy for farmers caught in the cycle of pesticide resistance, but only up to a point. "The farmers are victims of an incredible propaganda campaign by the pesticide industry, but they are sort of willing victims. Alternatives are out there, but if you don't have the initiative, then you just keep doing the same thing," Wiles says. "They are using chemicals instead of their heads. It's a lot harder to think your way through less chemical use."

"...as toxic chemicals are lathered over agricultural products in greater and greater amounts, it is the consumer who ends up bearing the brunt of rising production costs and health risks."

But pests can develop resistance even to non-chemical control measures. For instance, even crop rotation, a fairly simple pest-control approach, can become ineffective, says entomologist Ann Sorenson, research director of the American Farmland Trust's Center for Agriculture and the Environment. "Here in the Mid-west, for years we told farmers to rotate corn and soybeans to control corn rootworms," says Sorenson. "The rotations are no longer working because of a behavioral change in the insect." Female corn rootworm moths had generally laid their eggs in corn roots, so that their larvae had a supply of ready food the next spring when the corn was sowed. But now that crop rotation is common, most female corn rootworms are fluttering out of the cornfields to adjacent soybean or alfalfa fields, which are usually seeded to corn the next year

Isakeit, the Texas A&M pathologist, is optimistic about new chemicals being developed that are designed to debilitate only one or a few organs of a target pest. The hope is that their narrow range of effect will make them less toxic to other life-forms than the old broad-spectrum poisons such as DDT. But environmentalists caution that this approach could further accelerate the use of pesticides. In Richard Wiles's view, it creates incentives for chemical companies to develop and introduce an ever-widening arsenal of pesticides, which may have unknown synergistic effects. And as toxic chemicals are lathered over agricultural products in greater and greater amounts, it's the consumer who ends up bearing the brunt of rising production costs and health risks.

DuPont has changed the Benlate label since 1997 so that the product can no longer be used on gummy stem blight. But in general, as Rachel Carson wrote in *Silent Spring*, chemical manufacturers are "understandably loath" to confront the problem of pesticide resistance. With measured understatement, she listed the "unpleasant economic facts" of pests' immunity to chemicals: the ever-increasing costs of insect control as more and more poison is required; the inability to plan ahead because today's promising toxin could be a dismal failure tomorrow; and the loss of costly research and development when "insects prove once more that the effective approach to nature is not through brute force." As Rachel Carson observed nearly forty years ago, however rapidly technology advances, the insects seem to keep a lap ahead.



IPM News

Finally the Final Organic Rule

On December 20, 2000, the USDA released the long-awaited final version of the Organic Rule that defines organic food in the U.S. Genetically engineered organisms, radiation, and sewage sludge are banned in organic production. Details were published in the *Practitioner* last year (IPMP 22(5/6):13). Farmers and processors will now have about 18 months to comply with the new standards. The Final Rule can be found on the Internet at www.access.gpo.gov/su_docs/aces/aces140.html.

Pesticides May Be Killing Frogs

According to an article soon to be published in *Environmental Toxicology and Chemistry*, organophosphate pesticides may be killing off frogs in the California Sierras. Research Biologists Donald Sparling and Gary Fellers found that frogs in California's Coast Range seem to be doing well, but those in the Sierras are in decline. The Coast Range is not exposed to pesticide-laden winds from California's Central Valley. This is not the case for the Sierras, where frogs are exposed to western crosswinds blowing up from the Valley. Frogs in the Sierras had lower levels of plasma cholinesterase than those in the Coast Range. Also, about half the frogs studied in the Sierras had measurable traces of chlorpyrifos or diazinon, compared with 9% of the frogs in the Coastal Range. The authors speculate that depressed levels of cholinesterase may make the frogs more susceptible to predators.

Diazinon Restricted

Since the Food Quality Protection Act was passed in 1996, organophosphate pesticides, which are broadspectrum neurotoxins, have been under increased regulatory scrutiny. Chlorpyrifos (Dursban®), one of the most widely used organophosphates, was restricted in June 2000 (see *IPMP* 22(7):8-9). On December 5, 2000, the EPA restricted diazinon, another commonly used organophosphate.

Diazinon is one of the most widely used organophosphate insecticides in the U.S. Over the ten year period from 1987 to 1997 in the U.S., about 13 million pounds of diazinon active ingredient was applied each year. Formulations include dust, wettable powder, granules, seed dressings, emulsions, encapsulated materials, soluble concentrates, flowable concentrates, and ready-to-use solutions.

It is applied to residential lawns, turf, gardens, and to agricultural crops. It is applied indoors in houses, office buildings, schools, warehouses, and other structures. Although diazinon is registered for use on about 64 food crops, about 75% of diazinon is used in and around the home, and it accounts for about 30% of all insecticides sold directly to homeowners.

Danger to Wildlife

Broadcast application of diazinon to turf poses one of the greatest pesticide risks to birds. Just one granule or seed treated with diazinon is enough to kill a small bird. Birds of many species have been killed, including ducks, geese, hawks, songbirds, woodpeckers and others. On March 29, 1988 diazinon use on golf courses and sod farms was canceled because of its acute risk to birds.

Diazinon is toxic to honey bees, beneficial insects, and fish. At current environmental concentrations, diazinon causes diminished olfactory response in Atlantic salmon, reducing responsiveness of male salmon to female pheromones. Chinook salmon are more likely to die from predation after exposure, and show a reduced homing response.

Water Contamination

Diazinon is found in air, rain and fog. Diazinon is also commonly found in surface water in urban areas as a result of runoff from residential use. Residential applications are potentially a major source of drinking water contamination. Phasing out and eventually canceling the outdoor residential uses of diazinon will help reduce residues in surface water.

Diazinon is used in crop production, but surprisingly, sheep fat and beef fat "have been identified as the food commodities contributing the most to the acute dietary risk estimates." For workers in greenhouses, "combined dermal and inhalation exposures are of concern at the current reentry interval of 12 hours." The EPA estimates that for the usual rate of 0.58 lb/ai/acre, "all dermal and inhalation exposures to workers reentering greenhouses after treatment with diazinon type products exceed the Agency's level of concern until 8-10 days after application." The safe reentry period is so long that many greenhouses may stop applying the product.

Time Line of Phase Out

As a result of an agreement between the EPA and the pesticide manufacturer, diazinon will no longer be sold to homeowners for insecticidal treatments indoors after December 31, 2002. Producers must reduce by 50% the amount produced for outdoor non-agricultural uses by the start of 2003. Formulations for this purpose will no longer be produced after June 2003, and sales to retailers must stop by 2003. Producers will buy back any products that remain at the end of 2004.

If you are still using diazinon, the EPA suggests that you wear gloves, long pants, and long-sleeve shirts when applying the product. If you apply it to a lawn or garden, use a sprinkler to water the product into the soil. Keep children, pets and others off the lawn for several hours, until sprays have dried. Wash your hands and your clothes after applying the product. Take extra precautions to prevent contamination of nearby rivers, lakes and streams.

The agreement allows about 70% of current agricultural diazinon uses to continue.—*Bill Quarles*

True Costs of School IPM

Do school IPM programs increase the cost of pest control? Kathleen Murray, an IPM Entomologist with the Maine Department of Agriculture recently asked experts on an Internet school IPM network about their experiences. John Carter, Director of Planning at the Monroe County Community School Corporation in Bloomington, Indiana said that the IPM program there costs less than the conventional pest control program the school district had before. According to John, the District's pest control expenses before were about $34,000 per year. They did not bid on pest control, but had three different pest control operators (PCOs) managing their pests.

When they converted to IPM, they hired an IPM coordinator who spent about one-half time doing IPM, and this amounts to about $19,400 in labor. According to Carter, "we are purchasing products, monitors, baits, and traps, but that has totaled less than $1000 per year. We have had a 92% reduction in pesticide applications and an 80% reduction in pest complaints. We still have an occasional infestation, but we are no longer fighting a losing battle."

"The expense for most schools is the transition from the old way to IPM....We knew we could not do it all at once. As an example, we still have a kitchen storeroom or two with wooden shelves. We've got twenty buildings, and the majority of them now have metal shelves, but we did not have the money to convert them all at once."

IPM Costs Less

According to Bob Stoddard of EnviroSafe, Inc., converting the public schools of Grand Rapids, MI to IPM did not cost more than conventional pest control. The biggest cost came with the implementation of the notification system, and not the IPM program itself. [Many states have mandated notification programs, but have not legislated mandatory IPM programs. In those cases, if Stoddard is right, conversion to a full IPM program might not cost that much more.]

Stoddard said, "we were contracting out about $35,000 [worth of pest control work] and when we decided to go in-house, we did not add more staffing. The $35,000 was for management of a very few pests in about 22 of the 80 buildings in the district. When we converted to IPM, we covered all buildings and all pests."

"The hard part for me on estimating cost is that many of the things we started to address by doing IPM were really maintenance issues that would have been addressed sooner or later. Our IPM program just made things happen sooner than later."

"From a contractors viewpoint, generally a complete IPM program is going to cost a little more compared to the 'see a bug, spray a bug' method. But you cannot really compare the two systems. I think comparing the two systems on a cost basis is just too difficult. If you compare them on a benefits basis, then IPM wins every time."

"Having worked in public schools for 13 years, and a contractor for four years, I can tell you that the only way to manage pests is with an IPM program that covers all pests, using pesticides as a last resort."

IPM in Florida

Eric Althouse of the State of Florida Department of Education conducted a survey on overall pest management practices in schools that included a question on IPM costs. "Surprisingly," said Althouse, "it seemed as though IPM schools were paying less for services. Unfortunately, I failed to ask specific enough questions, and the data are not comparable or reliable in my opinion."

"As a last minute thought, we added the general question: 'How much does your District spend per year for pest control services?' The average expenditure of the IPM districts was lower than those who practiced traditionally. Some Districts included expenditures for landscape and athletic fields while others may have undercalculated the cost of in-house personnel labor. The less tangible costs such as legal settlements and damages from pests were obviously not considered. Therefore, I can't conclusively say that IPM costs more or less. But from our perspective, cost is secondary, because IPM is the right thing to do."

"My informal visits to individual districts seem to show cost savings, or at the very least comparable costs. In starting an IPM program, some of the Districts initially had to invest significant time and resources to get rid of terrible infestations and building neglect. (Doing practically nothing is bound to be cheaper than IPM!) But once an investment in preventive measures is made, it seems to be easier and cheaper to maintain."

IPM in Illinois

Linn David Haramis, Ph.D., of the Illinois Department of Public Health thinks that "this is a topic where there is some disagreement. Some say that IPM costs less in the long run, but there are startup costs. Others state that IPM costs more because many schools have been paying low bid costs for marginally effective pest control....In Illinois, we have had several [public] school districts "waive" conducting IPM programs [as permitted by state law] because they stated that their costs increased significantly."

Generally, there seems to be consensus that costs are going to vary with the situation. Where there has been longterm neglect of maintenance for buildings and school grounds, money will have to be spent on building repair to exclude pests and correction of water drainage problems that encourage termites. If these tasks are not charged to the pest control budget, conversion to IPM may cost less than a school administrator may think. What is needed in many cases is for someone to make the effort for change.—*Bill Quarles*

Conference Notes

ESA Conference—Part 9

By Joel Grossman

This is the ninth and last installment of the ESA 1999 Conference. Information was selected from among 1,700 presentations of the Entomological Society of America's (ESA) annual meeting in Atlanta, GA, December 12-16, 1999. Next month, we will start summaries of the 2000 meeting, which was held December 3-7, 2000 in Montreal, Canada. For more info, contact the ESA, 9301 Annapolis, RD., Lanham, MD 20706; 301/731-4535 or program chairman Marlin Rice, Iowa State Univ., Ames, IA 50011; 515/294-1101; fax 515/294-8027; merice@iastate.edu.

Entomopathogenic fungi such as *Beauveria bassiana* and *Metarhizium anisopliae* can kill the blacklegged tick, *Ixodes scapularis*, that carries Lyme disease. Sandra Allan (Univ of Florida, PO Box 110880, Gainesville, FL 32611) tested commercial formulations of *B. bassiana* and *M. anisopliae* as alternatives to conventional chemical sprays for tick control. Compatibility of the microbials with herbicides and fungicides was also tested, as homeowners and PCOs typically apply mixtures of insecticides, fungicides and herbicides to turfgrass.

Commercial formulations of *M. anisopliae* (Bioblast™) and *B. bassiana* (BotaniGard™) can control *I. scapularis* nymphs, according to Allan. However, germination of the fungi is suppressed by fungicides such as myclobutanil (Rally™), triadimefon (Bayleton™) and chlorothanil (Bravo™) and herbicides such as 2,4-D (Weed-B-Gone™). Malathion was the only insecticide tested that interfered with germination of the fungi. However, high rates of malathion and chlorpyrifos (Dursban™) altered growth of the biocontrol fungi.

Though *Verticillium lecanii* and *Paecilomyces farinosus* are the predominant fungal species attacking the pest tick in nature, *M. anisopliae* is highly pathogenic to all stages of *I. scapularis*, engorged as well as unfed, according to Elyes Zhioua (Univ of Rhode Island, Kingston, RI 02881). Zhioua thinks *M. anisopliae* could be utilized to control pest tick populations.

The nematodes *Steinernema carpocapsae* and *S. glaseri* are pathogenic to engorged *I. scapularis* females, but not to unfed females, engorged nymphs, or engorged larvae. According to Zhioua, nematodes enter the tick through the genital pore, and thus immature ticks are not affected. Since these nematodes do not complete their life cycle or produce infective juveniles in *I. scapularis*, they may have limited application as biocontrol agents for ticks.

However, *Bacillus thuringiensis kurstaki* (BT) "gave 96% mortality 3 weeks after infection" when engorged tick larvae were dipped in a solution of 10^8 spores/ml. "BT shows considerable potential as a microbial control agent for the management of *I. scapularis*," said Zhioua. [A microbial dip is obviously the best case for tick exposure. Field trials are needed to show how practical BT will be as a biocontrol agent for ticks.]

M. anisopliae is being tested in Rhode Island using self-treatment of deer with a self-activated acaricide applicator (US Patent 5,988, 133). Deer are attracted to baits such as alfalfa, apples or corn. Then the device "automatically sprays entomopathogenic fungi on the head, neck and ears of the deer," says Zhioua. A large field application is currently underway on Prudence Island, RI.

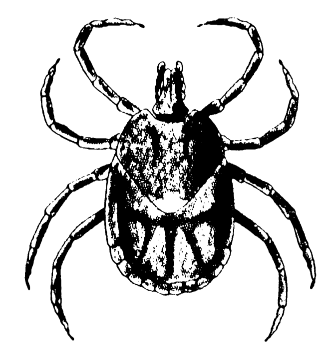
Texas Tick IPM

White-tailed deer host the blacklegged tick, *I. scapularis*, and are an important host of the lone star tick, *Amblyomma americanum*, the primary vector of human monocytic ehrlichiosis, *Ehrlichia chaffeensis*. In a 3-year Texas field trial, deer were allowed to treat themselves for ticks with the USDA-ARS patented 4-poster topical treatment device. Kernel corn attracted deer to rollers applying 2% amitraz (Mitac™) during feeding. In the treated pasture, the roller was charged with acaricide, and in the untreated pasture the roller lacked acaricide. Treatments lasted from mid-spring to late summer or early fall. Pretreatment sampling of nymph and adult ticks with dry ice and larvae with flip cloths showed no significant differences between pastures at the start of treatments.

"However, following 3 years of treatment, control of nymphal and adult ticks in the treated pasture was 91.9% and 93.7%, respectively, when compared to the untreated pasture," said J. Pound (U.S. Livestock Insects Lab, 2700 Fredericksburg Rd, Kerrville, TX 78028). These results with amitraz were comparable to a similar study using a systemic compound, ivermectin, which leaves a residue that may make it unacceptable during deer hunting season. Amitraz also shows "the yearly pattern of incremental increases in control."

Lyme Disease in the South

T. Lin (PO Box 8056, Georgia Southern Uni, Statesboro, GA 30460) isolated 57 strains of *Borrelia burgdorferi*, the Lyme disease pathogen, from rodents and ticks in four southern states, Georgia, South Carolina, Florida and Missouri. There were 9 strains of *B. burgdorferi*, 37 strains of *B.*



Lone star tick, *Amblyomma americanum*

andersonii, 5 strains of *B. bissettii*, and 2 undescribed species. The southeast mostly had *B. burgdorferi*, while Missouri mostly had *B. andersonii*. Rodent hosts included the cotton mouse, *Peromyscus gossypinus*, the cotton rat, *Sigmodon hispidus*, and the woodrat, *Neotoma floridana*. Infected ticks included *I. scapularis, I. affinis, I. dentatus*, and *I. minor.*

B. andersonii strains from Georgia and Missouri are likely confined to *I. dentatus* and cottontail rabbits. In Europe, *B. bissettii* strains like those isolated from South Carolina and Florida have been implicated in human cases of Lyme disease, though the infectivity and pathogenicity of the U.S. genospecies is unknown. *B. burgdorferi* strains are presumed infectious to humans. "There is much greater genetic heterogeneity among the southern isolates and also greater variety of tick vectors and reservoir hosts compared to those in the North," said Lin.

Lyme Disease in California

Bob Lane (Univ of California, 201 Wellman Hall, Berkeley, CA 94720) discussed the genospecies of *Borrelia* associated with small mammals and ixodid ticks in California. Polymerase chain reaction (PCR) amplification revealed up to 41% *Borrelia* infestation of *Ixodes pacificus* ticks in some western sites. The infection rate of the dusty-footed woodrat may be 40-85%. California kangaroo rats are also infected. There may be as many as 3 different Lyme disease genospecies in California, including *B. burgdorferi* and *B. bissettii*. Genetic heterogeneity is high, with perhaps 104 strains of *B. burgdorferi* in California ticks and rodents.

Eastern Ticks

Connecticut had 3,334 cases of Lyme disease in 1998, along with a few cases of Rocky Mountain spotted fever. White-footed mice, *Peromyscus leucopus*, were the likely carrier, but the process and dynamics of infection over time are not understood, said Kirby C. Stafford III (Connecticut Agric Exper Stn, PO Box 1106, New Haven, CT 06504).

Sherman box traps were set out monthly to capture and tag mice. Samples of fifty mice were caught 88 times, and 973 tick larvae and 79 nymphs were counted. PCR was used to detect the Lyme disease pathogen in the ticks.

IFA (Fluorescent Antibody) methods, ELISA (Enzyme-Linked Immunosorbent Antibody), and PCR were among the technologies used to deduce the presence of Lyme disease pathogens in the mice. Mice were also tested for human granulocytic ehrlichiosis and babesiosis.

In the Lyme, CT, area, half the mice showed evidence of infection by all 3 pathogens at some point in time, and 87% of mice were infected by at least one pathogen species. Besides human granulocytic ehrlichiosis antibodies, the majority also had *B. burgdorferi* and *B. microti* antibodies. Many mice tested negative with PCR, but serological tests indicated transient serum positives, indicating there was disease persistence in the mice.

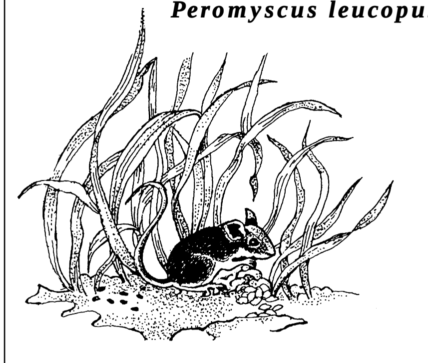
One mouse was negative for all the pathogens in June, but when recaptured in August had ticks and tested positive for a recent infection. Another mouse tested negative in April, and by June had high titres for all the pathogens. By September, *Borrelia* titres were large, and when recaptured in April 1998 the mouse also had high titres for human granulocytic ehrlichiosis.

Illinois Tick IPM

Controlled burns and Damminix™ are among the tick IPM options evaluated in Illinois, said Carl Jones (Univ of Illinois, 2001 S Lincoln, Urbana, IL 61802). One option is Damminix, twice a year. This treatment involves putting out permethrin-soaked cotton for white-footed mice to take back to the nest to control ticks.

A baited self-treatment device can also be used for mice and chipmunks. Rodents enter holes in the side of the feeding trap, and dust themselves with deltamethrin as they eat. Raccoons can disturb these traps, especially when there is a mouse inside, so the traps have to be nailed down. The trap consists of a 6-inch (15 cm) PVC pipe with a permethrin-treated rug inside. Traps are baited with corn and are effective for 2 weeks. Damminix works well against tick larvae on mice, with almost 95% control of larval ticks if treated cotton is taken to the nest, but the traps may be more effective in the field for tick control.

White-footed mouse, *Peromyscus leucopus*



Controlled burns require a park permit, and there can be weather difficulties, such as snow on the ground. Success was variable with the first 2-ha (5-acre) controlled burn of a wooded area in the spring, as there was moisture on the ground. The median temperature at soil level was 177-204°C (351-399°F) during the first burn. However, the average temperature was probably less than 121°C (250°F), with many places under 100°C (212°F), limiting effectiveness.

Hantavirus and Chiggers

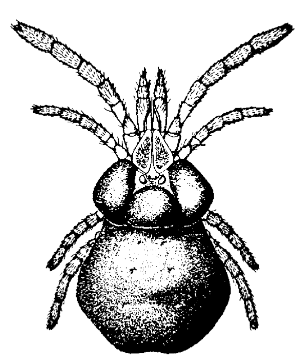
"Clearly mites and rodents are hosts of hantavirus," said M.A. Houck (Texas Tech Univ, Lubbock, TX 79409). But not all the details, such as overwintering patterns, are known. Many rodents from varied rural southeast Texas habitats were collected and analyzed via ELISA for IgG antibodies and hantavirus. Parasites collected from *Oryzomys palustris*, a hantavirus host, and other rodents were tested for hantavirus. One of 14 trombiculids (chiggers) had a hantavirus-specific RNA. Chiggers may have trans-stadial (stage-to-stage) or trans-ovarial (genetic) transmission of hantavirus, which implies long-term persistence of the virus.

Microwaves Fry Stored Grain Insects

Microwaves are a viable alternative to grain fumigation, according to Thomas Phillips (Oklahoma State Univ., 127 Noble Res. Cent., Stillwater, OK 74078), who is collaborating with Steve Halverson of Micro-Grain Inc. (424 Wagner Dr., Clinton, WI 53525) to commercialize microwave grain irradiation. Microwave pulse duration (exposure time) can be varied, and pulses can be long duration and low frequency or short duration and high frequency. Grain disinfestation works because insects containing 10-12% moisture heat faster than low moisture materials such as grain.

A 28 GHz grain heater quickly activates water molecules, compared to the 900 MHz of home microwave ovens. Powerful microwaves of 1.8-15 KW—compared to 0.8 KW for home microwave ovens—are directed against rice weevil, *Sitophilus oryzae*, eggs and larvae inside grains, red flour beetle, *Tribolium castaneum*, eggs and larvae outside grains, and lesser grain borer, *Rhizopertha dominica*, larvae inside and eggs external to grains.

The grain is treated in an inverted cone, so there is also air present for effective microwave heating. In 540 milliseconds, the grain moves from top to bottom, and as it moves is exposed to even faster microwave pulses. A thermocouple tracks grain temperatures, which do not get hot enough to kill dry fungal spores, as there is too little free water. But big wet rice weevil pupae are easily killed by the 34.9 joules/gram of applied energy. The prototype treats 850 bushels/hour (24 tons/hr), which is slow by commercial grain elevator standards, but a faster design is in the works. Grain quality is acceptable for baking and dough mixes, with good crumb characteristics, flour yield and protein content (10-11%). Also, the germ survives, and the grain can germinate.



A chigger, *Trombicula* sp.

Heat Fumigation for Food Processing

Alan Dowdy (USDA-ARS,1515 College Ave., Manhattan, KS 66502) talked about using heat to kill insects in food processing facilities. According to Dowdy, one of the limiting factors is the time needed for heat to penetrate into closed spaces of processing equipment and wall voids. Insects must be directly exposed to lethal temperatures long enough to kill them, otherwise a control failure will result.

To subject cereal grain processing equipment to 50°C (122°F) for 20 hours, temperatures outside the equipment have to be 59-64°C (138-147°F). Equilbrium temperatures inside and outside the equipment were similar, regardless of whether the equipment was left open or closed during the heat fumigation. Normally, equipment is cleaned and left open prior to heat treatment, which is a good precaution against insect infestation.

Atmospheric Gas Fumigation Key to Greenhouse IPM

Greenhouses are enclosed environments, but insects can still enter through open doors or vents and with new plant material. While working as a greenhouse manager, David Held (Univ. of Kentucky, Lexington, KY 40546) noticed that planting stock from other growers was often infested with insects, which then spread into his greenhouse, requiring widespread pest control treatments. Held decided that the key to greenhouse IPM was disinfestation of new plant material, and for this purpose he tried reduced oxygen atmospheres.

Low oxygen atmospheres are already used effectively against arthropod pests of stored fruit and vegetables, and as an added benefit, low oxygen increases post-harvest life of the commodity. Greenhouse plants and their pests were exposed to mixtures of various atmospheric gases at 20°C (68°F). After 6 hours in 100% CO_2 or nitrogen (N_2), there were fewer green peach aphids, *Myzus persicae*; western flower thrips, *Frankliniella occidentalis*; two-spotted mites, *Tetranychus urticae*; larval fungal gnats, *Bradysia* sp. and sweet potato whitefly, *Bemisia* sp. After 18 hours, four of the five pest species had died, a result Held attributed to desiccation, not anoxia. Even 12 hours exposure provided good control of mite eggs and adults.

Held also treated seedling impatiens, then examined the plants four weeks after transplanting. After 12 hours of N_2, flowering took significantly longer (25 vs 21-22 days), but there were just as many flowers. Chrysanthemum cultivars showed more variability, with one cultivar being desiccated even by regular air.

Held also examined the effects of lighting, as well as pest survival with and without plants, in conjunction with atmospheric gas fumigations. Thrips in low oxygen were not affected by the presence or absence of plant material or light. However, spider mite survival was greater in the absence of plants. Held concluded that 6-18 hours of 100% CO_2 or N_2 was lethal to most greenhouse pests.

Low Pressure Kills Stored Grain Pests

"One of the alternatives to insecticides is the manipulation of the atmosphere to produce environments that are lethal to insects," said George Mbata (Oklahoma State Univ., 127 Noble Res. Cent., Stillwater, OK 74078). When

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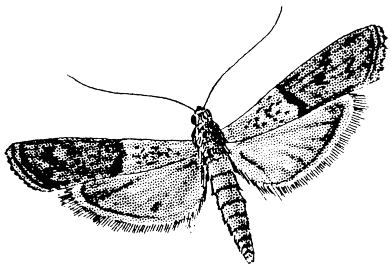


Indianmeal moth, *Plodia interpunctella*

O_2(oxygen) is less than 1%, the pressure inside insects is greater than external pressure. This imbalance causes rapid moisture loss through the spiracles, and combined with elevated temperature, rapidly kills them.

Mbata put eggs, larvae and pupae of lesser grain borers, *Rhizopertha dominica*; Indianmeal moths, *Plodia interpunctella*; and red flour beetles, *Tribolium castaneum* into flasks at low pressure (32.5 mm Hg) at various temperatures—25, 33, 37 and 40°C (77,91,99,104°F). Indianmeal moth mortality was 100% after 2 hours at 40°C (104°F). It took 3 hours at 40°C (104°F) to kill 99% of the red flour beetles. Lesser grain borer mortality was 100% after 12 hours at 40°C (104°F). At lower temperatures, longer times of exposure were needed—144 hrs at 25°C (77°F) were required for 100% mortality. The larval life stage was most susceptible to heat.

Mbata also covered commercial bags of grain with a plastic sheet, and pumped out the air from under the lining. The low pressure successfully disinfested commodities stored in jute bags. The exposure period needed for 100% mortality should be determined by insect eggs, says Mbata, with 40°C (104°F) better than 25°C (77°F).

Aeration & Cool Grain

Frank Arthur (USDA-ARS, 1515 College Ave., Manhattan, KS 66502) used low-volume aeration to cool grain and to slow development of the maize weevil, *Sitophilus zeamais*, a major pest of stored corn in various northern U.S. climate zones. Aeration reduced temperature and relative humidity at a faster rate than untreated grain, though by the end of the year there was no difference in temperature or humidity between aerated and unaerated corn. However, aerated corn had about half as many weevil larvae and adults as unaerated corn.

David Hagstrum (USDA-ARS, 1515 College Ave., Manhattan, KS 66502) used probe and ventilation traps to monitor insects immigrating into newly harvested Kansas wheat, and found that "immigration of all species into bins was very low after 19 weeks when grain temperatures dropped below 20°C (68°F). Probe trap catches during the fourth week of storage were considered a good indication of insect immigration into bins "because their offspring have not had time to complete development."

According to Paul Flinn (USDA-ARS, 1515 College Ave., Manhattan, KS 66502), temperature affects biological control of the lesser grain borer, "one of the most common and damaging insect pests of stored wheat in the U.S." The parasitoid *Theocolax elegans* (Pteromalidae) is almost too tiny to see, but it parasitizes lesser grain borers hidden inside grain kernels. *T. elegans* is found naturally in stored grain, but is filtered out by normal grain cleaning processes.

Temperatures above 30°C (86°F) and below 25°C (77°F) impair biological control *by T. elegans*. "For *T. elegans* to be effective in suppressing *R. dominica*, it may be necessary to cool the grain to temperatures below 30°C (86°F) using aeration," said Flinn. Aeration would also have the beneficial effect of slowing *R. dominica* development in stored grain.

Nematodes for Borer Biocontrol

The sugarcane rootstalk borer weevil, *Diaprepes abbreviatus*, is a major pest of citrus, ornamentals and vegetables in Florida and the Caribbean. According to David Shapiro (Univ of Florida, Citrus Res Cent, Lake Alfred, FL 33850), entomopathogenic nematodes can provide substantial control of the root feeding larvae, but nematode efficacy can be affected by soil type. In all three soil types tested, *Steinernema riobravis* was more effective against the borer than *Heterorhabditis bacteriophora*.

Both nematode species were more virulent and persistent in marl soil (80% silt and 15% clay) than sandy soils. About 93% sand is typical of Florida citrus soils. The trend was for entomopathogenic nematodes to be most effective in soils highest in calcium, nitrogen and organic matter, and least effective in soils high in phosphate. The heavy marl soil, where the biocontrol nematodes did best, was higher in water content than the lighter soils.

Root Weevil Growth Inhibitor

Although numerous citrus cultivars and species have been tested, none show resistance to *D. abbreviatus*, said Jeffrey Shapiro (USDA-ARS-CMAVE, 1700 SW 23rd Dr, Gainesville, FL 326080. However, live and milled roots of seedlings of the citrus relatives *Glycosmis pentaphylla*; and *Murraya koenigii* inhibit growth of *D. abbreviatus* larvae. The natural growth inhibiting compound was identified as dehydrothalebanin B.

Fungi for Root Maggot IPM

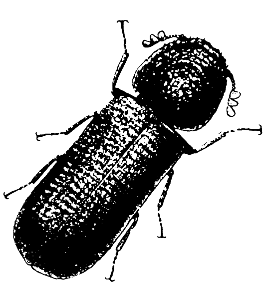
"Entomopathogenic fungi have shown promise as management tools for the sugarbeet root maggot, *Tetanops myopaeformis*," said Randall Pingel (Northern Crop Sci Lab , USDA-ARS, 1307 N 18th St, Fargo 58105). Several strains of *Metarhizium anisopliae* work well in the laboratory, but results have been variable during the last five years of field testing in North Dakota's Red River Valley. Broadcast applications of *M. anisopliae* (ATCC 22099) grown and applied on barley seed are useful experimentally, but are impractical and uneconomical for widespread application.

In 1999, *M. anisopliae* and *Beauveria bassiana* strain GHA were broadcast before planting or banded at or after planting with lawn fertilizer spreaders, then incorporated into the soil with field cultivators. Incorporation of fungal conidia into the soil maintained fungal concentrations during the June-Sept maggot activity period. Conidia levels increased in broadcast plots, but fell sharply in band application plots. More lab research is needed to determine the dose of fungal conidia needed to kill early instar root maggots.

Avocado Thrips Biocontrol

"The United States is the second largest producer of avocados in the world, and California's 60,000 bearing acres produce 90% of the U.S. crop," said Cressida Silvers (1106 Linden St #206, Riverside, CA 92507). In 1996 the avocado thrips, *Scirtothrips perseae*, arrived in Southern California, establishing itself as a major avocado pest. By 1997 it caused as much as 80% fruit damage in heavily infested orchards. Prior to this pest, the rich complex of natural enemies in avocado orchards kept pesticide use to a minimum, and growers are anxious to continue this history with natural enemies for thrips control.

A predatory thrips, *Franklinothrips* sp., is associated with avocado thrips in avocado growing regions from California to Latin America, where avocado thrips are not damaging. Some growers have been releasing green lacewings, *Chrysoperla rufilabris*, to control the thrips problem. The ability of both predators to search for and consume 50% or more of *S. perseae* on avocado test branches during a 24-hour period suggests a potential to do so in an orchard situation, though field tests are still needed.



Lesser grain borer, *Rhizopertha dominica*

Sabadilla for Avocado Thrips

Avocado thrips scar avocado fruit, either reducing fruit price or causing the fruit to be discarded, said Wee Yee (Univ. of California, Coop Ext, Ventura, CA 93003), who tested aerial helicopter spraying of hillside groves with Veratran™, a botanical insecticide formulated with sabadilla, *Schoenocaulon officinale*. Another product, Agri-Mek™ (abamectin), made by fermentation with the bacterium *Streptomyces avermitilis*, is registered for emergency use, and leaves a one-month residual.

Large trees, 7-8 m (23-26 ft) tall, were sprayed with 12 lb (5.4 kg) of Veratran D mixed with 10 lb (4.5 kg) of sugar. Spray coverage was better on small trees (2.8 m = 9.2 ft), and sabadilla sprays provided 1-2 weeks of thrips control. The best spray volume for tall trees was 85-125 gal/acre (130-191 liter/ha), with higher or lower volumes not helping control. In contrast, 40 gal/acre (61 liter/ha) was sufficient for small trees. Sabadilla is applied to large avocado trees just after bloom. Abamectin is applied 4-6 weeks prior to bloom, because there is a 3-week delay before it provides control.

Biopesticide Discovery Accelerates

"The list of biologically active natural product agrochemicals is impressive," said Jean Franklin (AgraQuest, 1530 Drew Av, Davis, CA 95616). In general, bioactive natural products are larger, more complex, and contain more rings and chiral centers than their synthetic counterparts. More astonishing is the rate at which natural product chemistries are commercialized. The spinosyns, azoxystobins and avermectins all became lead products within a few years of their introduction.

With fast screening systems, it is theoretically possible to screen 100,000 botanical samples per day, though the human activity needed to feed samples to the system slows this down to 20,000 samples per eight-hour shift. "Between 1960 and 1965, 800 novel natural products were described," said Franklin. "Between 1990 and 1995, over 5,000 natural products with novel biological activity were cataloged."

Automated screening of insecticides and fungicides is the center of a streamlined system designed to rapidly develop biopesticides for specific agricultural markets. All of AgraQuest's insecticide assays detect both contact and feeding activity. The aphid assay is composed of two 96-well microtitre plates that house aphids atop filter paper with the extract being tested. The company can also assay an array of other organisms ranging from spider mites and beet armyworms to fungi.

One product in the development pipeline, IPD006, a Streptomycete, has potential similar to *Saccharopolyspora spinosa*, which produces spinosyns. In all, the pipeline includes two promising bionematicides, two bioinsecticides, and two biofungicides. One of the *Bacillus*-based biofungicides, Serenade, is expected to hit the market in 2001.

Citrus Leafminer IPM in Mexico

Mexico is among the world's largest citrus producers (41% of production is in Veracruz), exporting 110,000 tons, mostly lemons. "The citrus leafminer, *Phyllocnistis citrella*, was first recorded in citrus areas in the Gulf of Mexico in 1994," about the same time the pest was first found in Texas, said

Calendar

January 5-7, 2001. Organic Farming and Health. Royal Agricultural College, Cirencester. Contact: Soil Association, Bristol House, 40-56 Victoria St., Bristol, BS1 6BY;email sbrenman@soilassociation.org

January 6, 2001. BAEER Fair, Marin County CA Civic Center. Contact: BAEER Fair, PO Box 3239, Fremont, CA 94539; 510/657-4847.

January 8-10, 2001. Annual Conference, CA Weed Science Society, PO Box 609, Fremont, CA 94537. Contact: jwarnert@uckac.edu; www.cwss.org.

January 16, 2001. Nematodes in Lodi Vineyards. Contact: Lodi Woodbridge Winegrape Commission, 2445 West Turner Road, Lodi, CA 95242; 209/367-4727; www.lodiwine.com

January 24-27, 2001. 21st Ecological Farming Conference. Asilomar Conference Center, Pacific Grove, CA. Contact EFA, 406 Main St., Suite 313, Watsonville, CA 95076; 831/763-2111; Fax 831/763-2112; www.eco-farm.org.

February 4-6, 2001. 35th Annual Meeting Association of Applied Insect Ecologists, Riverside, CA. Contact: AAIE, 1008 10th Street, Suite 549, Sacramento, CA 95814; 916/393-3995; email plainaaie9@aol.com

February 11-15, 2001. Annual Meeting Weed Science Society of America. Greensboro, NC. Contact: WSSA, J. Breithaupt, PO Box 1897, Lawrence, KS 66044; 913/843-1235; Fax 913/843-1274; jbreith@allenpress.com

February 2001. BioFach, World Organic Trade Fair. Nuremberg, Germany. email info@bio-fach.de; www.biofach.de

February 28-March 3, 2001. European Whitefly Symposium, Ragusa, Sicily, Italy. Contact: EWSN Office, JIC, Norwich Research Park, Colney Norwich NR4 7UH; network.ewsn@bbsrc.ac.uk

March 14-16, 2001. Green Building Tradeshow. Westin Peachtree Hotel, Atlanta, GA. www.greenprints.org

May 17-20, 2001. Organic Trade Association Trade Show. Austin, TX. Contact: OTA, 74 Fairview St., PO Box 547, Greenfield, MA 01302; 413/774-7511; email info@ota.com.

June 11-15, 2001. 4th Intl. Seminar on Plant Protection. Varadero, Cuba. Contact: I.S Ramierez; email inisav@ceniai.inf.cu

October 8-12, 2001. 9th International Workshop on Fire Blight. Napier, New Zealand. Contact: C.N. Hale, email chales@hort.cri.nz.

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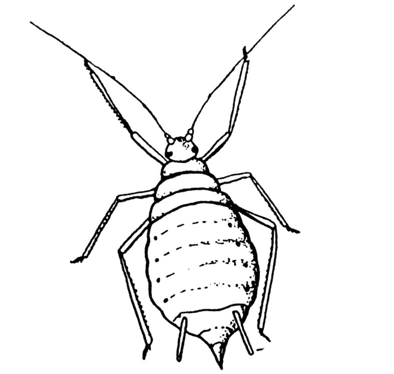


Peach aphid, *Myzus persicae*

Juan Villanueva-Jimenez (Colegio de Postraduados, Apdo, Postal 421, Col Centro, Veracruz 91700, Mexico). "Since then, this Gracillariidae moth has moved to the Pacific, invading most citrus areas in Mexico."

Citrus leafminer moths lay eggs on new leaves, and larvae enter the leaf cuticle and form "serpentine mines" through the leaves, causing reduced photosynthesis, defoliation and adverse effects on plant growth and production. Though all citrus varieties are affected, damage to new growth of young trees is most serious. "The impact of leaf damage was very strong, and growers began spraying any type of pesticide available," said Villanueva-Jimenez.

A number of generalist natural enemies attack citrus leafminer in Mexican citrus areas such as Tamaulipas and Veracruz, including: green lacewings, *Chrysoperla carnea*; the ants *Crematogaster aff-brevispinosa* and *Conomyrma bicolor*; the Araneidae spiders *Araneus* sp., *Argiope argentato* and *Leucauge argyra*; the Theridiidae spider *Thymoites unimaculatum*; and salticid spiders, *Habronatus* sp.

Parasitoids attacking citrus leafminer include *Elasmus tischeriae* (Elasmidae), several Encrytidae and Eulophidae, including *Cirrospilus*, *Closterocerus*, *Galeopsomyia*, *Prigalio* and *Zagrammosoma multilineatum*. Parasitism rates in Cuitlahuac, Veracruz, range from 33% in August to 100% in July. Classical biocontrol with *Ageniaspis citricola* includes unsuccessful rearing attempts and field releases with a few recoveries.

Pesticides such as avermectin are being used to improve the appearance of exported grapefruits, limes and lemons. Neem trees are also being planted. According to Villanueva-Jimenez, "these plantings will provide enough biopesticide for some citrus growers." Intercropping is being tested, and "preliminary results indicate more parasitism and less leaf damage in intercropping systems."

Citrus Psylla Biocontrol in Florida

The Asian citrus psylla, *Diaphorina citri*, has spread to 12 Florida counties since its June 1998 discovery, and is expected to colonize the entire state and spread a gram-negative bacterium, *Liberobacter asiaticum*, which causes greening disease that reduces citrus yields and lifespan. In Taiwan and Reunion Island, the parasitoids *Tamarixia radiata* and *Diaphorencyrtus aligarhensis* provide natural control of the psylla. Populations of these parasitoids from Taiwan and Vietnam are being reared and studied under quarantine on ornamental orange jasmine, *Murraya paniculata*, in Florida, said Clint McFarland (Univ of Florida, PO Box 110620, Gainesville, FL 32611).

Tamarixia radiata was released into Florida fields in July 1999 for classical biocontrol of Asian citrus psylla after the parasitoids in quarantine were certified as being free of the greening bacterium. "Long PCR was more efficient than standard PCR, which allowed us to detect small amounts of greening DNA mixed with a large amount of insect DNA," said Ayyamperumal Jeyaprakash (Bldg 970, Univ of Florida, Surge Area Dr, Gainesville, FL 32611). "A sensitity analysis showed the Long PCR assay amplified greening DNA from as little as 1 fg (about 100 molecules) of plasmid DNA containing the greening sequence."

Books

THE ORGANIC APPLE PRODUCTION MANUAL. S. Swezy, P. Vossen, J.Caprile, W. Bentley. 2000. University of California, Division of Agriculture and Natural Resources Publication 3403. 72pp. $18.00.

The *Organic Apple Production Manual* is an innovative manual aimed at current and potential producers of certified organic apples. The manual was written as a companion publication to two other University of California Agriculture and Natural Resources (ANR) publications: *Commercial Apple Growing in California* (ANR Publication 2456,1992) and *Integrated Pest Management for Apples and Pears, 2nd ed.* (ANR Publication 3340, 1999). Although this manual outlines production practices for California's apple growing areas, the concepts presented may be useful to any apple producers concerned about pesticide use and about farmer and farm worker health and safety.

The *Organic Apple Production Manual* begins with an overview of the current state of the organic apple industry. A brief history of the growth in demand for organic apples is given, with the focus being on the period following the 1989 Alar controversy. The regulatory structure governing California apples is also outlined.

While organic and conventional apple production systems are similar in many aspects, a grower's familiarity with the orchard site and with local microclimates is of critical importance for the production of high quality organic apples. The grower needs to take these factors into account when making decisions about orchard management. The manual discusses the appropriateness of several orchard management techniques for different growing conditions. An entire chapter is devoted to disease and pest management as this is of key importance to the production of a high quality organic apple. Of particular interest is the information presented on biological control options. Additional factors affecting fruit quality are picking fruit at optimal maturity and the careful handling of fruit during packing and processing.

Organic apples can be sold via intermediaries and/or directly to consumers. The latter can provide an interesting niche market and can include farmers' markets as well as Community Supported Agriculture (CSA). Even though consumers are generally willing to pay more for organic produce, apple producers should study the market, as the quantity and types of conventional and organic apple varieties on the market will affect prices. The manual concludes with a discussion on economic performance. The conversion from conventional to organic apple production can be costly and risky. Nonetheless, a carefully managed organic orchard has the potential to be highly profitable. Readers seeking information on organic apple production will find the *Organic Apple Production Manual* useful and easy to read.- *Pascale Dennery*

INTEGRATED PEST MANAGEMENT FOR BEDDING PLANTS: A SCOUTING AND PEST MANAGEMENT GUIDE. Christine Casey, ed. 2000. Cornell Cooperative Extension, Cornell University, 7 Business and Technology Park, Ithaca, NY 14850. 607/255-2080. 118 pp. $14.50.

This book has concise and practical information on basic IPM in a greenhouse. It sticks to the basic pests: western flower thrips, fungus gnats, shore flies, green peach aphid, melon aphid, mealybugs. Also discussed are two-spotted, cyclamen and broad mites, and greenhouse and silverleaf whiteflies.

Basics of monitoring and least-toxic treatments are covered. There is a 17-page section on biological control that will be very useful to those just getting started with this approach.

Greenhouse workers who are just learning the IPM method will find this book is a useful primer and an excellent starting point for implementation of IPM in a greenhouse.- *Bill Quarles*

Readers' Column

Tanglefoot Problems are Rare

In the October 2000, issue, Earlene Millier wrote the following letter:

I gave a workshop yesterday, and one of the attendees objected to the use of Tanglefoot because birds could get it on their feet or get stuck in it. Do you have any information on this or can you suggest anything that would prevent this?

William Quarles replied:

Tanglefoot is used to gird a tree trunk to prevent ants from climbing the tree. Once they are out on the foliage, they farm aphids and other Homoptera for their honeydew production. The ants protect aphids from predators and other natural enemies. Tanglefoot is thus a good integrated control for aphids. A 2-inch strip around the trunk is enough. I have never heard of that becoming a bird problem. [Dear readers: If you have ever had difficulties of this kind with these sticky barriers let us know.]

We received the following letter in response:

Dear Editors,

You asked if any of your readers has had problems with birds getting stuck on Tangletrap. I trap apple pests using red balls coated with tangletrap and white wing traps baited with pheromone and sticky tangletrap bottoms. In my 12 years we have only caught birds on three occasions. I think they are attracted to the insect buffet on the tangletrap. This has been a very rare occurrence for us, and we hang about 20 of each type of trap each year. As I recall, the white wing traps were the most likely to capture birds, maybe the birds could not get free because of the confining nature of the trap. It is more common for us to find a cluster of feathers on the sticky tangletrap, indicating that a bird came for a meal, but was able to get away.

Jody Fetzer
IPM Coordinator
Minnesota Landscape Arboretum
Chanhassen, MN

New Biocontrol Resource

Dear Editors,

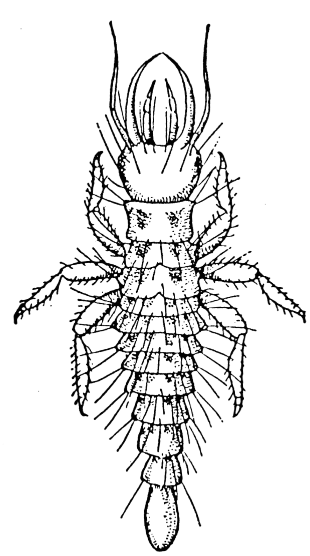
The Green Spot, Ltd., a major supplier of biological pest control agents and IPM equipment, is pleased to announce the availability of its *2001 Green Methods Catalog.*

The *2001 Green Methods Catalog* is 56 pages in length and chock full of information. It is free. To receive your copy, please contact the Green Spot, 93 Priest Road, Nottingham, NH 03290. Or call 603/942-8925. The email is: info@GreenMethods.com

Thanks,
Mike Cherim

Online Publications

BIRC Publications can now be ordered online at www.ipmnow.org



Larval lacewing biocontrol agent