Agrichemical and Environmental News

A monthly report on pesticides and related environmental issues

In This Issue

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Acetic Acid: “Miracle” Herbicide?

Sour Product Promises Sweet Results

Dr. Timothy W. Miller, Weed Scientist, WSU

Garden experts are everywhere! Nearly every newspaper, radio, television, and magazine staff features a local or syndicated expert who offers advice on the best way to grow spectacular horticultural specimens, produce choice fruits and vegetables, or beautify yards and landscapes. And as Martha Stewart might say, this is a good thing. What is not so good is when these experts offer their faithful readers/viewers recommendations for “natural” alternatives to pesticides—often products that haven’t gone through formal registration by state or federal agencies.

The problem with “home remedies” is that they often haven’t been thoroughly tested toxicologically and their impact on non-target species is undetermined, making them potentially more hazardous than synthetic pesticides that are legal (see “Is It Snake Oil? The Dangers of Cavalier Pest Control,” ***AENews*** Issue 163, November 1999). Furthermore, these products are rarely tested in a systematic way for efficacy. Instead, only anecdotal evidence is cited, claims that tend to make the product sound too good to be true.

A recent example of this phenomenon occurred right here in Washington State. Consider, if you will, the weed control product “Blackberry & Brush Block,” manufactured by Greenergy, Inc., Brookings, OR.

B&BB Gets Ink in the P.I.

The saga begins on June 7, 2001 with an article by Ann Lovejoy, a free-lance gardening and food column writer for the ***Seattle Post-Intelligencer*** newspaper. Carrie Foss, Pesticide Education Coordinator at Washington State University (WSU) Puyallup, brought this article to my attention and wanted

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Acetic Acid, cont.

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to get my thoughts on it. In the article, Lovejoy extols the virtues of Blackberry & Brush Block (we'll call it "B&BB" for short) as the "natural" answer for control of everything from annual weeds to Canada thistle and dock to Scotch broom and, of course, blackberry. Lovejoy notes that weeds quickly wither away after treatment, with a single application lasting up to a year. "No more weeds," she bluntly states. "Period."

Naturally, interest was piqued amongst readers. WSU Cooperative Extension Horticulture Agents and Master Gardeners throughout western Washington were asked by clients how they could get a jug of B&BB. Surprised by the sudden onslaught, these WSU faculty and volunteers scrambled to get some information (***any*** information!) on the product, and wondered whether they could recommend B&BB for safe, effective weed control.

What Is This Wonder Herbicide?

Blackberry & Brush Block contains 5% citric acid as its "active ingredient." The other 95% of the contents are listed as "inert ingredients: acetic acid, water." In other words, the inerts contain plain old vinegar, but the proportion of acetic acid is not detailed (common household vinegar contains about 5% acetic acid in water).

B&BB's material safety data sheet (MSDS) indicates that it also contains other inert components, namely "carboxyl, gibberellic acid, acetic acid calcium carbonate/dry lactic acid (sour milk)," which are described as "mild skin irritants." The MSDS further cautions that ingesting the product may cause pain/irritation/burns, and warns of the potential for severe or permanent corneal (eye) injury. Hmmm...doesn't sound too promising so far. (See sidebar: "Mother Nature Is Meaner Than You Think.")

B&BBs Place on the Regulatory Map

This product falls somewhat into the cracks of the regulatory system in that it is composed of a naturally occurring compound; many such materials are "generally recognized as safe" (GRAS) by the U.S. Food and Drug Administration (FDA), and therefore subject to less toxicological and

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Mother Nature Is Meaner Than You Think

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

While certain advocates and advertisements are fond of equating "natural" with "innocent" and "better," sound science would indicate that is not always the case. If we apply similar standards of judgment to acetic acid as we do to conventional herbicides, dreadful hazards are indicated. Reading the Material Safety Data Sheet (MSDS) for acetic acid may turn you off to oil-and-vinegar salad dressing for life. Here is a laundry list of bad effects associated with acetic acid.

- Severe eye irritation, burns, and possible irreversible damage
- Severe skin irritation and possible allergic sensitization
- Severe and permanent damage to the digestive tract, including severe pain, nausea, vomiting, diarrhea, and shock
- Respiratory tract irritation
- Prolonged or repeated exposure may cause dermatitis, chronic bronchitis, and erosion of teeth

Of course, MSDSs are really meant to communicate hazards to workers of highly concentrated or pure product, not dilute product such as is present in ready-to-use formulations or in dilute sprays. Furthermore, the MSDS does not indicate the likelihood of adverse effects (a.k.a. risk) because no assessment of exposure is included. So, just the right amount of vinegar could safely season your salad or be deadly to your plants.

Acetic Acid, cont.

Dr. Timothy W. Miller, Weed Scientist, WSU

environmental fate scrutiny. As such, B&BB has received a 25(b) exemption label from the U.S. Environmental Protection Agency under the EPA's "fast tracking" of "natural products" for use as pesticides. One can only assume that any toxicological data on B&BB is either largely favorable or was considered unnecessary. Since the product is predominantly vinegar and citric acid, this would not be surprising. (Speaking of which, which acid is the real "active ingredient?" See related commentary, page 4: "Will the Real Active Ingredient Please Stand Up?")

> I am excited as anybody about these promises... but my credulity is badly strained.

The Federal 25(b) designation is only part of the regulatory picture, however. Before any product may be sold in the state of Washington as a herbicide, it must be registered as such with the Washington State Department of Agriculture (WSDA). WSDA granted registration for B&BB to Greenergy in late July.

Now, I am as excited as anybody when a product comes along that purportedly kills such tough weed species as blackberry and horsetail. I live in western Washington and heaven knows I seem to be fighting a losing battle with these and other species myself. But I must admit to being more than a little skeptical that B&BB, or any other acetic acid-based herbicide, could offer such a thorough solution, especially after a single application. I am ready to concede that contact herbicides such as B&BB applied to foliage would cause rapid desiccation. But when I read that B&BB applied to the soil around "a big old blackberry or Scotch broom" results in wilted foliage within a day, my eyebrows rise. And when I read further that established horsetails "begin wilting immediately and are totally dead within a week," my credulity is badly strained.

Acid in Action

Lovejoy explains that "the (B&BB) concentrate takes the soil pH down to 3, a level at which plants can't survive" and that until lime is applied to vinegar-treated soil, "nothing will grow in that area." Dr. David Bezdicek, WSU Extension Soil Scientist at Pullman, says that given enough soil acidity, any weed can likely be killed. Dr. Craig Cogger, Extension Soil Scientist at WSU Puyallup agrees, although he points out that soils have a tremendous ability to buffer pH. Therefore, unless quite a lot of the product were applied, it is doubtful that a single application of even very concentrated acetic acid will have much impact on soil pH.

Lest you worry that killing weeds by treating with acetic (or any other) acid may damage your soil, take heart, for Lovejoy counsels that "soil biota [the living creatures in the topsoil] simply go dormant, waiting for things to get better." In a recent e-mail to weed scientists in the western United States on this topic, Oregon State University Extension Weed Scientist Dr. Ray William says OSU research showed that tillage alone dramatically altered populations of a wide diversity of soil arthropods. Dr. William said that while "general knowledge about soil organisms suggests that some bacteria become quiescent under adverse conditions," most soil organisms "either move or die when conditions change rapidly such as [occurs in the event of] contact with concentrated vinegar or drastic pH changes." He acidly concludes that these and other claims about B&BB "may require your considered judgement."

Sour Conclusions

Dr. Stephen Young at the University of California Research and Extension Center in Hopland has tested several vinegar-based formulations for roadside weed control. His studies show that application of these products results in defoliation, but because established perennial weeds require repeated treatment, the acid products are not cost-effective when compared with treatments such as Roundup.

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Acetic Acid, cont.

Dr. Timothy W. Miller, Weed Scientist, WSU

So, where does all this leave us? Clearly, research must be conducted on B&BB to determine whether the product is effective, and, if so, how its efficacy compares to other herbicides. If use of these acids is not cost effective in all situations, might it be effective for specific applications such as sidewalk and driveway crack-and-crevice treatment? What, in short, is the best and wisest use for these natural products in commercial and/or homeowner applications? Toward finding these answers, Dr. William and I plan to conduct replicated efficacy tests with B&BB on blackberry in Mount Vernon and Corvallis during the coming months. Greenergy is graciously providing a supply of the product. In the end, we all hope to scientifically determine just how and where applications of vinegar can produce sweet results against problem weeds.

Dr. Timothy Miller is an Extension Weed Scientist at WSU's Mount Vernon Research and Extension Unit. He can be reached at (360) 848-6138 or twmiller@wsu.edu.

B&BB: Befuddled and Bemusedly Bewildered

Will the Real Active Ingredient Please Stand Up?

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

A close examination of Greenergy's B&BB product label seems to belie its purported mode of action in taking out troublesome weeds. It is well known that strong acids can desiccate and therefore defoliate most plants. For example, sulfuric acid is used as a defoliant on crops like potatoes and cotton. Acetic acid is weaker than sulfuric acid (i.e., when comparing solutions of the two acids at equal concentration, the former will have a higher pH), but sprayed on young plants, it will probably do the trick.

Acetic acid has a known mode of action. For example, St. Gabriel Laboratories' ready-to-use formulation of "Burn Out" touts its natural character by proclaiming it contains vinegar and lemon juice. Its only "active ingredient" is "6.25% acetic acid." Yet on the B&BB label, acetic acid is not listed as an active ingredient; citric acid is. Citric acid, which is a very common food additive generally recognized as safe (GRAS) by the Food & Drug Administration, is an even weaker acid than acetic acid. Thus, suggesting citric acid is pesticidal stretches credulity. At a pH of 3, most of the citric acid would be in its neutral form, essentially incapable of hurting anything. An acid's ability to desiccate leaves, or to lower the soil pH, would really depend on the strength of the acid (i.e., its ability to give up hydrogen ions), and citric acid seems too weak to be effective. On the other hand, one of its functions is to "tie up" metals, or make them unavailable. This might not be a good thing if you are a plant, as plants need bioavailable copper, iron, zinc, and other metals.

The ***Seattle Post-Intelligencer***'s description of how B&BB works (see accompanying article) seems far-fetched. The "innocuous" lowering of the soil pH to an unhealthy 3.0 due to the vinegar (acetic acid) in the product seems askew from a simple chemistry perspective. The label states that soil can be drenched with the product "so that the material will seep down in and around the root system," but nowhere does it give the homeowner directions for how much product to use nor how to apply it. Assuming that the acetic acid concentration in B&BB is similar to its competitor's ready-to-use formulation of Burn Out (i.e., 6.25%), then the pH of the solution itself could only be as low as 2.36. Considering that healthy soil is going to have a pH somewhere between 6 and 8, enough B&BB would have to be poured on to lower the soil pH anywhere from 3 to 6 pH units. Because pH units represent tenfold changes in the hydrogen ion concentration and soil is extremely well buffered to resist changes in pH, truckloads of product would be needed to treat any sizable area of unwanted perennials.

Pesticide Container Recycling Schedule

Washington Pest Consultants Association

Washington Pest Consultants Association (WaPCA) contracts with Northwest Ag Plastics to collect and recycle plastic pesticide containers. Containers should be clean and dry, with lids removed. For more information on the program, contact Clarke Brown at (509) 965-6809, Dave Brown at (509) 961-8524, or Northwest Ag Plastics at (509) 457-3850. The table below shows dates for September and early October only; a complete schedule through October is on-line at **http://pep.wsu.edu/waste/wapca.html**. For information on a specific collection date or site, call the contact number listed in this table. THERE IS NO FEE FOR THIS SERVICE.

DATE	TIME	LOCATION	SPONSOR	CONTACT	PHONE
Sept. 4	8a-10a	Sunnyside	Bleyhl Farm Service	Vern Bos	(509) 839-4200
	1p-3p	Zillah		Dan Simmons	(509) 829-6922
Sept. 5	8a-10a	Toppenish	Kenny Sealock Farms	Ken Sealock	(509) 865-6119
	1p-3p	Buena	Heli-Flight	Bill Fork	(509) 453-0345
Sept. 11	8a-10a	Wilbur Airport	Greg's Crop Care	Greg Leyva	(509) 647-2441
	1p-3p	Davenport	Northwest Aviation Inc.	Lee Swain	(509) 725-0011
Sept. 12	8a-10a	Odessa	Smith Air Inc.		(509) 982-2231
Sept. 13	8a-11a	Moses Lake	Tom Dent Aviation	Tom Dent	(509) 765-6926
	2p-4p		Moses Lake Air Svc.	Perry Davis	(509) 765-7689
Sept. 14	8a-10a	Warden	Wilbur Ellis	Brian Preston	(509) 349-2333
	1p-3p		Kilmer Crop Dusting	Terry Kilmer	(509) 349-2491
Sept. 24	1p-3p	Pasco	Air Trac	Gerald Titus	(509) 547-5301
Sept. 25	8a-10a	Eltopia	Wilbur Ellis	Vern Records	(509) 297-4291
	1p-3p		E WA Spray Service	Willis Maxon	(509) 297-4387
Sept. 26	8a-10a	Pasco	Pfister Crop Care	Steve Pfister	(509) 297-4304
	1p-3p	Connell	B&R Crop Care	Chris Eskildsen	(509) 234-7791
Sept. 27	8a-10a	Othello	Airport Conner Flying	Mark Conner	(509) 488-2921
	1p-3p		B&H Chemical	Larry Hawley	(509) 488-6576
Oct. 2	9a-11a	Ephrata	The Crop Duster	Martin Shaw	(509) 754-3461
Oct. 3	9a-11a	Quincy	Wilbur Ellis	Dale Martin	(509) 787-4433
Oct. 4	9a-11a	Waterville	Western Farm Service	Dale Gromley	(509) 745-8857
	2p-4p	Coulee City		Pete Thiry	(509) 632-5697
Oct. 9	8a-11a	Mount Vernon	Wilbur Ellis	Marty Coble	(360) 466-3138
Oct. 10	8a-11a	Conway	Cenex Farm Supply	Will Cox	(360) 445-5015
			Tronsdal Air Service	Kevin Belisle	(360) 661-0422
	12p-2p	Seattle	WA Tree Service	Ron Angle	(206) 362-9100
Oct. 11	8a-11a	Puyallup	WSU Research Station	Roy Jensen	(253) 445-4517
	8a-10a	Tacoma	Wilbur Ellis and DOT	Randy Knutsen	(253) 351-6591
				Dave Patterson	(253) 589-7255
Oct. 12	8a-10a	Centralia	Lewis Cty Public Works	John Prigmore	(360) 740-1193
	8a-10a	Vancouver	WSU Research Station	Martin Nicholson	(360) 576-6030
	1p-3p	Chehalis	Farm & Forest Helo	Dan Foster	(360) 262-3197
	3p-4p	Morton	DOT	Craig Robbins	(360) 496-5516

"Our industry does not want pesticide containers to become a waste issue. If we take the time to clean and recycle these products, we can save money, show that the industry is responsible in its use of pesticides, and reduce inputs to the waste stream."

Viability of Insect Pathogens as Biological Control Agents

Drs. Lawrence A. Lacey, Roger Frutos, Harry K. Kaya, and Patrick Vail

This article was excerpted from "Insect Pathogens as Biological Control Agents: Do They Have a Future?" in* Biological Control*, Vol. 21, Issue 3, July 2001. The entire article is available on the Internet via http://www.idealibrary.com. The full article contains numerous examples and illustrations of the principles discussed, plus over 250 references for further information.

The idea of applying microorganisms to control insect pests has its roots in the early days of invertebrate pathology. Pioneers including Agostino Bassi, Louis Pasteur, and Elie Metchnikoff proposed the concept and several researchers experimented with the use of fungi as microbial control agents in the late 19th century (53, 54). However, it was not until the development of the bacterium ***Bacillus thuringiensis*** Berliner that the use of microbes for the control of insects became widespread.

Organisms harmful to insects are known as "entomopathogens." Types of bacteria, viruses, fungi, protozoa, and nematodes can all function as entomopathogens. Today, a variety of such organisms are used for the control of invertebrate pests in glasshouse and row crops, orchards, ornamentals, range, turf and lawn, stored products, and forestry and for abatement of pest and vector insects of veterinary and medical importance (6, 36, 55).

Entomopathogens are often compared with conventional chemical pesticides solely in terms of efficacy and cost. But there can be other advantages to using entomopathogenic controls, such as environmental benefits (including safety for humans and other nontarget organisms), reduction of pesticide residues in food, increased activity of most other natural enemies, and increased biodiversity in managed ecosystems.

Entomopathogens also compare favorably to arthropod biocontrol agents, since most entomopathogens can be applied using conventional equipment and many can be produced using artificial media and can be stored for extended periods of time. Like arthropod natural enemies (i.e., predators and parasitoids), many entomopathogens are specific to certain species or groups of insect pests and some have the potential to provide long-term control. Disadvantages of entomopathogens include, in some cases, their lack of persistence, speed of kill, specificity (too broad or too narrow host range), and cost relative to conventional chemical insecticides.

Can Naturally-Occurring Pathogens Be Managed?

Like other natural enemies, insect pathogens can exert considerable control of target populations. A disease event of epidemic proportions is known as an "epizootic." Epizootics caused by naturally occurring viral and fungal pathogens can be responsible for spectacular crashes of insect pest populations (9, 42), often eliminating the need for further interventions (9, 28, 56).

But relying on the natural occurrence of entomopathogens for management of pest insects is risky; a host of unpredictable factors govern epizootics. Many pathogens require a critical host density, therefore natural epizootics often occur after economic thresholds of a pest have been surpassed. Careful management can help the natural pathogenic processes evolve into useful techniques for pest control.

Strategies for the use of entomopathogenic organisms for insect control are basically the same as for other biological control agents (23). They may be used to augment naturally-occurring pathogens (augmentation), conserved or activated in nature (conservation), introduced into pest populations to become established and exert long-term regulation of the pest (inoculative release), or used inundatively for rapid short-term control (inundative release). The balance of this excerpt focuses on the concepts of inoculative and inundative releases.

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Pathogens as Biocontrol, cont.

Drs. Lawrence A. Lacey, Roger Frutos, Harry K. Kaya, and Patrick Vail

Inoculative Introductions

The intentional introduction of exotic pathogens as classical biocontrol agents has lagged considerably behind the introduction of predators and parasitoids (41). ("Classical biocontrol" is defined as importing a natural enemy of a pest insect to an area where it does not naturally occur. For this and other related information on biocontrol, see "Biocontrol of Insect Pests in Potato," ***AENews*** No. 181, May 2001.) Regulatory restrictions on the introduction of exotic pathogens into the United States have nearly eliminated this potential strategy against introduced insect pests. However, the unintentional or accidental introduction of pathogens has in several cases resulted in significant and ongoing natural control (2, 4).

The principal criteria most successful inoculative agents have in common are persistence in the environment and/or host and the ability to cause epizootics and to be transmitted within and between host populations and/or generations. The ecosystems and host plants that have best supported establishment and persistence of introduced entomopathogens are permanent and perennial and can tolerate attack by the targeted insect (i.e., they have a high economic threshold) while inoculum levels increase. Forests are ideal habitats in this sense.

Inundative Applications

Bacteria. The most widely used, inundatively applied microbial control agent is ***B. thuringiensis***. As of 1998, about 200 ***B. thuringiensis***-based products were registered in the United States alone (50). ***Bacillus thuringiensis*** insecticidal proteins are delivered to insects in formulated products and transgenic plants. These proteins are highly specific insect gut toxins with a superior safety record regarding their effects on nontarget organisms (18, 37, 38, 43). Varieties of Bt are currently used to control a broad range of crop and forestry pests and larvae of several blood-sucking pests of humans and domestic animals (7, 10, 12, 18, 24, 39, 49, 51).

Other species of bacteria are used on a much smaller scale for insect control. These include ***Paenibacillus (=Bacillus) popilliae*** (Dutky) Pettersson et al., and related species; ***Serratia entomophila*** Grimont et al. for control of white grubs (Scarabaeidae); and ***Bacillus sphaericus*** Neide for control of mosquito larvae.

Viruses. A large number of viruses offer potential as microbial control agents of insects (46). Those with the greatest microbial control potential are in the Baculoviridae family (nucleopolyhedroviruses [NPV] and granuloviruses [GV]) (21, 27). More than 400 insect species, mostly Lepidoptera and Hymenoptera, have been reported as hosts for baculoviruses.

The use of viral pathogens of insects in most agricultural crops is inundative. This does not utilize their full epizootic potential, but does take advantage of their virulence and specificity (46). Their efficacy, specificity, and production of secondary inoculum make baculoviruses attractive alternatives to broad-spectrum insecticides. Due to their lack of untoward effects on beneficial insects including other biological control organisms, baculoviruses could be ideal components of integrated pest management (IPM) systems. Unfortunately, the selectivity of many baculoviruses, often targeting only one individual species, coupled with the requirement for and cost of ***in vivo*** production, has deterred large-scale commercial development. Several baculoviruses that have relatively broad host ranges have recently been isolated; these may prove more commercially viable.

Besides cost and the "good-news-bad-news" element of specificity, entomopathogenic viruses present a few other drawbacks compared to chemical insecticides, including relatively slow action, sensitivity to ultraviolet light, and requiring living production systems.

The use of baculoviruses for insect control within the IPM context is expected to increase in the coming years, particularly in developing countries and for the control of insects in high value crops grown on small acreages.

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Pathogens as Biocontrol, cont.

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Fungi. Some 700 species of entomopathogenic fungi have been reported, but only ten of these have been or are now being developed for insect control (22).

Many entomopathogenic fungi are responsible for epizootics that successfully regulate pest insect populations. Although inoculation of insect populations with entomopathogenic fungi has provided classical biological control of some pests (most notably the gypsy moth), the most common method of employing fungi for insect control is through inundative means. Most species of entomopathogenic fungi are relatively difficult to produce and are short-lived, making timing of inundative applications difficult or impossible.

Hyphomycetes species demonstrate activity against a broad range of insects pests; these are the main contenders for commercial production and use against homopterous pest insects. Several species offer good potential for production on inexpensive artificial media and have good shelf lives. Entomopathogenic Hyphomycetes have been investigated for use against a broad range of insect pests including whiteflies, aphids, thrips, termites, grasshoppers and locusts, beetles, and others (8, 11, 13, 14, 19, 20, 32, 33, 34, 42, 44, 45, 57).

A complex set of interacting processes, both environmental and biotic, is necessary for or inhibitory to development of epizootics caused by entomopathogenic fungi. To take full advantage of the epizootic potential of fungi, we need to understand the elements that determine virulence and infection and learn how to control these elements. These factors include sensitivity to solar radiation; microbial antagonists; host behavior and physiological condition and age; pathogen vigor and age; presence of pesticides; and appropriate temperature, humidity and inoculum thresholds (14, 22, 35, 42). We can exert a measure of control over these factors through optimization of culture methods, formulation, environmental manipulation, and genetic engineering. Combining the microbial control activity of entomopathogenic fungi with other interventions and technologies promises to produce both additive and synergistic results, in keeping with IPM strategies.

Nematodes. Nematode species in more than thirty families are associated with insects and other invertebrates (31, 47, 48). Most research and development has focused on nematode species in seven families: Mermithidae, Tetradonematidae, Allantonematidae, Phaenopsitylenchidae, Sphaerulariidae, Steinernematidae and Heterorhabditidae (31). The steinernematids and heterorhabditids are currently receiving the most attention as microbial control agents of soil insects. After ***B. thuringiensis*** (see “Bacteria,” above), nematodes are next in commercial sales at US$2-3 million annually (15).

The entomopathogenic steinernematid and heterorhabditid nematode species possess many attributes of parasitoids and pathogens. They infect a number of insect pest species, yet pose no threat to plants, vertebrates, and many invertebrates (1, 30). They can be mass produced, formulated, and easily applied as biopesticides (16, 17), have been exempt from registration in many countries, are compatible with many pesticides, and are amenable to genetic selection (30).

When an entomopathogenic nematode species is used against a pest insect, it is critical to match the right nematode species to the target insect pest (3, 30). (See also “Using Beneficial Nematodes for Crop Insect Pest Control,” ***AENews*** No. 180, April 2001).

Although they are used primarily as biopesticides, some species of nematodes persist and recycle in the host habitat bringing about sustained suppression of some insect pests (26, 29).

Significant advances have been made in the use of entomopathogenic nematodes, but the high costs associated with production and formulation in comparison to chemical pesticides and other biologicals (i.e., ***B. thuringiensis***) will restrict their use to high value niche markets and sensitive areas where chemicals cannot be used (15).

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Pathogens as Biocontrol, cont.

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Protozoa. Protozoan diseases of insects are ubiquitous; they play an important role in regulating insect populations (5, 40). Protozoan diseases are generally host-specific and slow-acting, most often producing chronic infections. Their main advantages are persistence and their tendency to recycle in host populations, plus their debilitating effect on reproduction and overall fitness of target insects. As inundatively applied microbial control agents only a few species have been moderately successful (52). The grasshopper pathogen ***Nosema locustae*** Canning is the only species that has been registered and commercially developed (25). The main disadvantages of protozoa are that they must be produced ***in vivo*** and they result in low levels of immediate target pest mortality.

The Future of Insect Pathogens

Control of pest insects using chemical pesticides has generated several problems including insecticide resistance; outbreaks of secondary pests normally held in check by natural enemies; safety risks for humans and domestic animals; contamination of ground water; decreased biodiversity; and other environmental concerns. These problems and sustainability of programs based predominantly on conventional insecticides have stimulated increased interest in IPM.

Sustainable agriculture in the 21st century will rely increasingly on alternative interventions to chemical pesticides for pest management that are environmentally friendly and reduce the amount of human contact with pesticides. The mandate of the 1996 Food Quality Protection Act (FQPA) strongly influences the development and registration of chemical pesticides today and will continue to do so in the future.

Certain microbial control agents can help fill the void left by phased-out chemicals, but their further development and implementation will require improvements in the production and formulation of the pathogens; better understanding of how they will fit into integrated systems; greater appreciation for their full advantages (e.g., efficacy, safety, selectivity), not simply their comparison with chemical pesticides; and acceptance by growers and the general public. If future development is driven exclusively by the market, implementation of microbial control agents will be delayed.

The editors of AENews ***wish to thank the authors for allowing us to excerpt their article. Dr. Lacey is with the U.S. Department Agriculture's Agricultural Research Service (USDA-ARS) at the Yakima Agricultural Research Laboratory in Wapato; he can be reached at llacey@yarl.ars.usda.gov or (509) 454-6550. Dr. Frutos is with the Centre de Coopération Internationale en Recherche Agronomique pour le Développement in France. Dr. Kaya is with the Department of Nematology at the University of California at Davis. Dr. Vail is with USDA-ARS Horticultural Crops Research Laboratory in Fresno, California.***

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WSCPR: Assisting Minor Crops in Washington State

Agrichemical and Environmental News Staff

Crops/Sites Supported by WSCPR 1999-2000

Number of projects indicated in parentheses.

Apple/Pear (11)
Asparagus (5)
Barley (1)
Blueberry (4)
Cabbage (1)
Canola (2)
Carrot (2)
Cherry (2)
Christmas Tree (4)
Clover Seed (2)
Cranberry (4)
Edamame (1)
Grape (3)
Grass Seed (2)
Green Pea (6)
Greenhouse Rose (1)
Home Lawn (1)
Honey Bee (3)
Hop (4)
Mint (3)
Onion (1)
Ornamentals (1)
Oyster (1)
Pea/Lentil/Chickpea (4)
Potato (4)
Rhubarb (1)
Scotch Broom (1)
Spartina (3)
Strawberry (10)
Structural Pests (1)
Sweet Corn (1)
Vegetable Seed (9)
Vegetables (2)
Wheat (1)

The Washington State Commission on Pesticide Registration (WSCPR) was created by the Washington State Legislature in 1995 to address the pest control issues facing minor crops and minor uses in Washington. Because the cost to obtain and maintain pesticide registrations is high, it is not always commercially viable to pursue pest control technologies for crops and sites involving limited acreage. WSCPR provides a funding opportunity to meet these pest management needs.

This table shows a six-year history of WSCPR funding.

WSCPR Funding History by Source

Year	# Projects	$ WSCPR	$ Match	$ Total
1995	8	97,405	85,982	183,387
1996	46	507,029	515,207	1,022,236
1997	39	358,664	507,721	866,385
1998	56	606,211	619,231	1,225,442
1999	40	551,026	1,598,687	2,149,713
2000	64	995,985	1,283,389	2,279,374
Total	253	3,116,320	4,610,217	7,726,537

In 1999, the legislature expanded the commission's mandate, allowing it to support a wider range of pest management options. Previously, WSCPR could only support projects that were directed at obtaining or maintaining pesticide registrations. The new mandate, which took effect in 2000, allowed the commission to fund research, implementation, and demonstration of any aspect of integrated pest management and pesticide resistance. In the first year of the new mandate, forty-three percent of WSCPR funding was directed toward twenty-one of these new types of projects, many of which focus on biological control and other alternatives to pesticides.

Between January 1999 and June 2000, WSCPR provided a total of $1,547,011 in funding to support 104 projects affecting 35 crops or crop groupings (representing over 70 total crops). Grower groups submitting proposals generated an additional $2,882,076 in cash or in-kind matching contributions to these WSCPR-funded projects.

In keeping with its mission to support minor crops and minor uses (i.e., those crops and uses for which research might not prove commercially viable due to limited acreage), WSCPR

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WSCPR, cont.

***Agrichemical and Environmental News* Staff**

funded predominately minor crops during the 1999-2000 period. (For specific crops and sites supported, see sidebar, "Crops/Sites Supported by WSCPR.") The enabling legislation requires that WSCPR direct a minimum of twenty-five percent of its total funding to projects for crops not ranked among the top twenty agricultural commodities in the state. During 1999-2000, fifty-four percent of funding went to a total of sixty-nine such projects.

The Washington State Commission on Pesticide Registration consists of twelve voting members and five non-voting members representing various agricultural and public sectors of Washington State. Further information about the commission can be found on its Web site, **http://www.wscpr.org/**. This site also includes a downloadable Request for Proposal form and examples of previously submitted proposals. Proposals for funding must originate from or be supported by an affected pest management user group. WSCPR considers proposals twice yearly, at its November and January meetings. Emergency proposals can be submitted for consideration at any time.

Source: WSCPR 1999-2000 Progress Report and WSCPR Web site.

Projects Funded by WSCPR in 2001

Project	$ Old Mandate	$ New Mandate	$ Match
Fungicides & Timing for Alternaria Fruit Rot on Highbush Blueberry	8,570		7,000
Field Evaluation of Fungicides for ***Botrytis cinerea*** on Strawberry	4,370		5,200
Beneficial Arthropods in Washington Hop Yards		15,540	15,540
Beneficial Arthropods in Washington Vineyards		15,540	15,540
Biocontrol of Cereal Leaf Beetle		16,000	24,800
Evaluation of Insecticides for Control of Flea Beetles in Potato	9,841		9,841
Integrated Management of Greenhouse Rose Pests		11,754	398,945
Fungicidal Control of Alternaria Leaf Spot on Cabbage Seed Crops	9,182		14,282
Feeding Enhancements for Insecticides		18,680	26,000
RAYNOX, a Particle Film for Suppression of Insects in Apple/Pear	3,500	20,000	23,500
IR-4 GLP Residue Studies on Hops	25,000		25,001
Powdery Mildew on Hops in the Pacific Northwest		45,000	82,206
Development of an IPM Program for Aphid Control in Crucifers		20,253	10,077
Annosus Root Rot in Noble Fir Christmas Trees	15,783		18,002
Acquisition of a Mechanical Red Raspberry Harvester	1,500	3,500	3,000
Mowing Height and Nitrogen Fertility in Home Lawn Turf		1,500	1,500
Effect of Pesticides and Repellents on Bees	9,612	1,068	8,000
Developing a Pest Monitoring Plan for Burrowing Shrimp		25,207	17,961
Chemical Control of Powdery Mildew in Washington Sweet Cherries	15,000	2,644	61,288
Magnitude of Residue Field Trials for Thiocloprid and Bifenazate		5,000	7,500
Assessing Grape Quality Reduction from Spider Mite Feeding		5,000	6,500
Biorational Screening of Mint Insecticides and Acaricides		15,000	15,000
Screening of Pesticides and GLP Magnitude of Residue Studies	7,836		5,000
Weed Control in Direct-Seed Grain Legume Production	10,348		9,800
Control and Management of Common Smut on Corn	7,500	7,500	16,000
Asparagus Pest Management Program	30,000		49,891
Maintenance of Guthion Registrations on Pome Fruits	11,721	11,721	34,072
Potato Areawide IPM Program		25,000	86,000
IPM System for Pears in the Wenatchee Valley		6,200	16,200
Improving Grass Seed Production Practices for the Columbia Basin	21,600	5,400	36,700
Ornamental Disease Control	5,500		7,000
Managing Soil Pests in Potatoes with Yellow Mustard Green Manures		5,919	13,018
Cranberry Pest Management with Low-Risk Alternative Pesticides	17,640		73,268
Cover Crops to Enhance Biological Control in Orchards		14,300	14,300
Develop an IPM Program for Hybrid Poplar Plantings	6,618	15,442	24,000
Herbicide Trials for Mustard and Canola	7,500		
Biocontrol of Leafrollers		10,320	10,320
Weed Control in Spinach and Table Beets Grown for Seed	5,100		5,100
Weed Control in Newly Planted Strawberries	6,225		6,225
Organic Herbicides and Flaming for Weed Control in Strawberries	1,107	2,583	1,370
Field Evaluation of a New Strain of Aphids in Potatoes		10,300	10,300
Control of Winter Moth in Pacific Northwest Blueberries	5,200	800	8,000
A Test of Phytotoxicity, Efficacy and Resistance	6,050		6,050
Pest Management Strategies in Riparian Buffer Zones	14,400	3,600	23,000
Crop Protection Plan for Clover Grown for Seed in WA	8,500		7,750
Alternative Raspberry Production and Pest Management Study		8,000	13,200
GLP Field Trial for New Cranberry Pesticides in OR and WA	3,000		3,750
Assessing Thrips Feeding Damage to Dry Bulb Onions in WA	7,750	7,750	9,500
IPM of Lygus Bugs		25,060	15,590

WSDA Receives $178,000 to Support Exports

Washington State Department of Agriculture

The Western United States Agricultural Trade Association (WUSATA) has allocated $178,000 to the Washington State Department of Agriculture (WSDA) marketing program to promote overseas sales of Washington food and agricultural products. These funds will be used to expand produce sales into Southeast Asian countries, to grow seafood markets in the European Union, to promote consumer food products in Mexico and Taiwan, and to increase sales of Northwest food ingredients in Japan.

Enjoying a six and a half percent increase over last year's allotment, the state department of agriculture received twelve percent of all the funds available to the thirteen member states. The WSDA marketing program and the Oregon Department of Agriculture also were allocated $100,000 to jointly manage a nursery project in Japan.

In addition to these funds, sixteen Washington companies have applied for $1.4 million from WUSATA to market their branded products overseas with assistance from the marketing program. Branded products are those that carry the labels of specific companies. For the first time this year, apple companies are participating in the program.

WUSATA is a non-profit organization that combines federal, state and industry resources to carry out programs that help to increase exports of food and agricultural products from the Western region of the United States. The activities of WUSATA are directed by the thirteen Western states and funded through contributions from the U.S. Department of Agriculture's Foreign Agricultural Service, the state departments of agriculture, and private firms.

One of four international trade development organizations known as "state regional trade groups," WUSATA often secures more money for its members than the states would be able to get on their own. A vital link between international food buyers, Western U.S. food suppliers, state agricultural agencies and the federal government, WUSATA services include export promotion, customized export assistance, a cost-share funding program, international trade exhibitions, overseas trade missions, export seminars, in-country research, and point-of-sale promotions in foreign food chains and restaurants. For more information about WUSATA, see its Web site on the Internet at **http://www.wusata.org/.**

This news was released by the Washington State Department of Agriculture on August 9, 2001. WSDA's Web site can be found on the Internet at http://www.wa.gov/agr. Inquiries may be directed to the WSDA Public Information Office 360/902-1813 or Telecommunications Device for the Deaf (TDD) 360/902-1996.

WaPCA Annual Meeting

The annual meeting for the Washington Pest Consultants Association is scheduled for November 15 and 16, 2001. The meeting will be held at the Yakima Convention Center. The schedule includes sessions for tree fruits (cherry virus management, fruit lenticel disorders); row crops (micronutrients in row crop production, onion neck rot, plant physiology during drought conditions), dryland cropping systems (attacking recalcitrant broadleaf weeds in cereal production, when and how to use surfactants, nitrogen management in hard red spring wheat). Topics of general interest will include the impact of airborne herbicide residues on wine grape production, riparian buffers and pending regulations, household pest control, systemic acquired resistance strategies, fine-tuning irrigation scheduling, improving soil water use efficiency with organic amendments, polymers and calcium, and precision agriculture opportunities in Washington State. State representative Gary Chandler will be the featured luncheon speaker. For further information, contact Ellen Bentley at **ellen_bentley@wsu.edu** or (509) 786-9271.

First Year Retrospective
And a Look toward the Future at FEQL

Dr. Vincent R. Hebert, Analytical Chemist, WSU

It's hard to believe a year has gone by. I'm still the newest member of the Food and Environmental Quality Laboratory (FEQL) team here at Washington State University, but I have in fact been on board for over a year now.

Looking Back

We have made a great deal of progress this year. One of my primary objectives when I took this position was to institute the policies and procedures that would result in the FEQL being approved as a Good Laboratory Practices (GLP) facility. This designation allows our lab to perform certain analytical work on pesticides proposed to the U.S. Environmental Protection Agency (EPA) for registration. (For more information on GLP, see "Is 'Good' Enough?" ***AENews*** Issue No. 184, August 2001.) Today, we have a viable GLP program in place, having added an independent quality assurance unit to our operating protocol.

Another objective for the analytical laboratory in 2000-2001 was the revitalization of the analytical aspect of our state's Interregional Research Program #4 (IR-4). This has been accomplished through the cooperation of individuals including Chuck Mourer and Matt Hengel at the IR-4 Western Regional Laboratory and with the support of key individuals in Washington State such as Rocky Lundy in his role as chair of the commodity liaison committee. Working together with our state's IR-4 Representative Liaison and fellow FEQL faculty member Doug Walsh, our group has met this objective as well.

Finally, looking at the broader mandate of the FEQL—seeking effective crop production technologies that are protective of human and environmental health—Allan Felsot and I have been able to combine our areas of expertise to develop regional air, deposition, and biological monitoring programs that will have immediate and long-term benefits for the Pacific Northwest grower community and public sectors.

Looking at the Present

While I am pleased that we have been able to meet these primary objectives my first year at FEQL and WSU, it is apparent that change is in the air. (I've performed considerable research on atmospheric transport, so I can say that with authority!) It seems to me that the role of residue laboratories at land-grant universities is changing with respect to supporting minor crop registrations.

To understand why I've come to this conclusion during my short time here in Washington, some background on residue analysis is in order. Analytical sensitivity began increasing dramatically in the 1980s. Around this time, it became possible to identify pesticide candidates solely by chemical structure and target site of action using quantitative structural activity relationship (QSAR) models. Add to this the subsequent passage of the Food Quality Protection Act (FQPA) calling for safer alternative chemistries and integrated pest management (IPM) strategies. As a result, alternative pest management chemistries are being developed at an unprecedented rate (thereby requiring new analytical approaches) and lower use rates are being explored for efficacy (thereby requiring heightened sensitivity in analytical instrumentation).

To keep up with this surge of change, and provide the data necessary to register new chemistries through EPA, pesticide manufacturers and contractual laboratories today must invest large sums of money into state-of-the-art instrumentation that can handle the new chemistries and the ever-decreasing amounts of tolerable residues.

Looking Ahead

Our nation's land-grant universities have been key players in the performance of residue analysis. Universities have the intellectual resources to stay on top of the latest scientific developments, so this role has been appropriate. But the fact is that when a single analytical instrument can cost upwards of $200,000 to $300,000, many of the land-grant universities simply can't keep pace. Not only is it expensive to acquire the equipment necessary to perform the high standard of analyses demanded today, this equipment is expensive to maintain and to upgrade.

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Retrospective, cont.

Dr. Vincent R. Hebert, Analytical Chemist, WSU

One consequence of this situation is that many pesticide manufacturers are now investing in this instrumentation and analyzing residue samples in-house, analyses that previously might have been conducted by IR-4 land-grant satellite laboratories.

Where does this leave a laboratory like FEQL? We will most certainly continue to play a key role in the effort to ensure minor crop growers are properly armed with IPM strategies and softer alternative crop protection chemistries as part of the IR-4 program. After all, supporting Pacific Northwest agriculture within a context of protecting human and environmental health is a principal mission of the FEQL, and the IR-4 program is perhaps the most highly evolved framework for supporting the minor crops that are such an important part of Washington State agriculture. But to keep pace with the breakneck evolution of chemical analysis, our laboratory must also evolve, and this co-evolution must include acquisition of state-of-the-art instrumentation to keep pace with the necessities and demand for a safer food supply.

In addition to analyzing residues, we will expand our focus on product understanding studies, especially of newer and alternative chemistries. Such studies will ensure that pest control products are used safely and effectively. We expect the FEQL will be using all of its skill in environmental chemistry and toxicology to aid the development of best management practices and, with the help of the information dissemination resources of the Pesticide Information Center, the promotion of agricultural stewardship.

Dr. Vince Hebert is the Analytical Chemist with the Food and Environmental Quality Laboratory. His office and laboratory are located on the Tri-Cities campus of Washington State University. He can be reached at (509) 372-7393 or vhebert@tricity.wsu.edu.

Pesticide Applicator Training

“Last Chance” 2001 Courses

Washington State University offers recertification courses for those who need to renew their current pesticide applicator licenses. Fees for these courses (which offer 6 credits per day) are $35 per day if postmarked 14 days before the program, otherwise $50 per day. (This fee DOES NOT include WSDA license test fee.)

The LAST CHANCE to take courses in 2001 will be offered on November 6 and 7 in Pasco and on November 19 and 20 in Lynnwood. A workshop in Weed Identification and Management will be held October 17 in Seattle and a Christmas Tree workshop will be held October 30 in Puyallup. For more information or registration, call (509) 335-2830, e-mail **pest@cahe.wsu.edu**, or see the Web site at **http://pep.wsu.edu/**.

A full schedule of 2002 courses is now available on the Web site.