COOPERATIVE EXTENSION
Washington State University

# Agrichemical and Environmental News

A monthly report on pesticides and related environmental issues

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Comments to: Catherine Daniels
WSU Pesticide Information Center
2710 University Drive
Richland, WA 99352-1671
Phone: (509) 372-7495
Fax: (509) 372-7491
E-mail: cdaniels@tricity.wsu.edu

The newsletter is on-line at www2.tricity.wsu.edu/aenews, or via the Pesticide Information Center (PICOL) Web page at http://picol.cahe.wsu.edu

Hard-copy subscriptions are $15 a year. Mail check to above address, ATTN: Sally O'Neal Coates, Editor.

# Pesticide Emergencies

## Planning for the Unexpected

**Purdue University Cooperative Extension Service**

You can never completely eliminate the risk of accident or injury when storing, transporting, and working with pesticides. However, preventative planning can reduce the likelihood of emergencies because the process forces us to

- prepare appropriate everyday operational procedures,
- identify potential hazards, and
- develop contingency plans.

Contingency plans can minimize the severity of an emergency and the extent to which business is disrupted. A trained workforce can minimize the immediate and long-term impact of fires, spills, and exposures. Good advance training equips employees to respond appropriately; if they know exactly what to do, they are less likely to panic during an emergency.

Stated simply, the objective of contingency planning is to be ready for emergencies. Management personnel and employees should be trained on how to react in an emergency situation. Community response personnel should be brought on site and familiarized with the various chemicals stored there, their location on the property, and the actions recommended in case of a fire or spill or other incident. Both company personnel and outside responders must understand what they need to do during an emergency to minimize injuries as well as adverse effects on public health, the environment, and the business.

### *Workplace Hazard Assessment*

Employers are responsible for identification of potentially hazardous conditions in their workplace. The term "workplace" can include more than just the main base of operation. It includes off-site locations where any phase of business is conducted, such as restaurants, hospitals, construction sites, farm fields, golf courses, and city parks.

Each business operation has its own unique set of potential hazards based upon the locations in which it conducts business, the types of equipment it uses, and the chemicals that it stores and handles. Both management and employees should be involved in assessment. Particular attention should be paid to company procedures for handling materials.

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# Pesticide Emergencies, cont.



Mixing, applying, transporting, and storing pesticides are all activities affording potential for hazard. Proximity to equipment and objects producing potential penetration, impact, compression, high or low temperature, dust, or other disturbance may increase the potential for hazard.

## Personal Protective Equipment

Personal protective equipment (PPE) is essential for anyone who handles potentially hazardous chemicals or performs hazardous tasks. Employers should identify when, where, and under what circumstances employees might be exposed, then they should implement and enforce a PPE program. Appropriate protective gear—which may include ear plugs, gloves, splash aprons, coveralls, chemical resistant or steel-toed boots, face shields, hard hats, respirators, back supports, nonslip shoes, and/or goggles—is identified on pesticide labels and can be augmented by company policy. Employers must make all appropriate PPE available to all workers involved in potentially hazardous situations.

An effective, proactive PPE policy details the specific equipment required for each task and includes regimented company training on its use.

## Fire Evacuation and Extinguishers

Allowing a fire to spread from its source can increase its seriousness. For instance, a fire that spreads to a pesticide storage room may produce deadly toxic vapors, creating the need to evacuate the premises or the community. Planning for fire emergencies includes

◆ training employees as to evacuation procedures in the event of fire,

◆ training employees to use portable fire extinguishers when appropriate,

◆ inviting local fire department personnel to survey your workplace to acquaint themselves with chemical inventory and location, and

◆ conducting an on-site mock emergency.

The Occupational Safety and Health Administration (OSHA) does not require extinguishers to be placed in a building, nor are they required in vehicles unless they are mandated under Department of Transportation (DOT). Employers who plan to evacuate their facility in case of fire need not train employees on the use of extinguishers—instead, they should train their employees on evacuation procedures. But if extinguishers are located on site, OSHA regulates their inspection, maintenance, and training for use, and OSHA requires certain models and locations.

## First Aid

First aid is the initial action taken to stabilize an injury or illness until the victim can be treated by a qualified medical professional. Untrained employees cannot provide effective aid to injured coworkers. OSHA requires that first-aid kits be available, but it requires certified first-aid personnel only if no local medical services are available within three minutes of the site. First-aid training should be conducted at least every two years; cardiopulmonary resuscitation (CPR) training should be repeated annually. Consider the following:

◆ Do you have at least one employee on each shift qualified to administer first aid and CPR?

◆ Can you verify the training of employees assigned to respond to an injury?

◆ Are first-aid kits inspected at least monthly and contents replenished or replaced as needed?

◆ If your business handles corrosive materials, do you have facilities where the eyes can be flushed or the body showered for a minimum of fifteen minutes?

◆ Are the names of designated, company-trained first responders posted on all first-aid kits?

## Response Mechanisms

Response mechanisms should be in place internally and externally to minimize damage in the event of an emergency.

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# Pesticide Emergencies, cont.



**Purdue University Cooperative Extension Service**

One of the primary elements of effective emergency response is a good telephone number list. A phone list should be developed with only those numbers that are extremely important; that list should be posted throughout the workplace facility and vehicles. Other, less critical numbers may be listed in an emergency response plan document. Consider using the template in the *Quick Response Emergency Plan* (PPP-45), available through the Purdue University Media Distribution Center, (888) 398-4636. Verify phone numbers annually; mark your calendar and check them the same month every year. Post these emergency telephone numbers on all bulletin boards, near all phones, and in all vehicles. Post signs listing emergency contact personnel conspicuously on the outside of all buildings. Provide company contact numbers to local law enforcement agencies, fire departments, and medical responders, updating as necessary.

**_The objective is to prevent emergencies, but if they occur, the objective is to minimize damage..._**

A hierarchy of command known as Hazardous Waste Operations and Emergency Response, or HAZWOPER, should be in place in situations where employees could be exposed to hazards. The five-level HAZWOPER hierarchy is detailed on page 4. It is recommended that all employees be trained to respond to emergencies. The level of training required depends upon company policy, but OSHA mandates that any business working with pesticides and/or fertilizers must at least train their employees (both full- and part-time) to the Awareness Level.

## *Evacuation Considerations*

Exit signs, evacuation maps, and site maps are important parts of an emergency response plan.

Employers often ask why they should post exit signs and escape routes when their employees already know how to exit the building. Excitement is a powerful emotion; during an emergency, people may panic and lose their way. Newer employees may not remember where the exits are, and non-employees (salespeople, customers, visitors) may not be familiar with the facility. Exit signs should be posted conspicuously above each door, and “Not An Exit” signs are a good idea on doors that do not provide egress.
In the interest of uniform and quick evacuation, a facility evacuation map should be posted conspicuously. Such a map should show exit routes and meeting points, and may include locations of fire extinguishers, first-aid kits, sprinkler controls, fire alarms, eye wash areas, emergency showers, circuit-breaker boxes, gas and water shutoffs, and so forth.

The site map is an OSHA requirement. It shows and identifies all buildings and the locations where chemicals are stored. Businesses employing fewer than ten persons are not required to construct a site map or have a written emergency plan. Natural features, utility routes, hazardous materials, and emergency response equipment should be indicated on the map.

## *Emergency Response Plan*

Identification and planning for hazards should culminate in a thorough emergency response plan. The objective of contingency planning is to prevent emergencies, but if emergencies occur, the objective becomes a matter of reacting appropriately to minimize detrimental effects to people, property, and business.

A contingency plan is only as good as the information it conveys to employees and emergency responders. It is useless if the only people who comprehend it are those who wrote it. Employees must be educated to understand the purpose and the contents of the plan, and they must be trained to perform their assigned duties in an emergency situation. Community responders (emergency personnel outside the company) must also be familiar with the plan.

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# Pesticide Emergencies, Cont



The Purdue University document from which this article was excerpted, *Pesticides and Planning for Emergencies: Prevention, Reaction, and Response,* along with its companion document *Quick Response Emergency Plan*, contains templates and recommendations for building your own emergency response plan. Besides the items already mentioned, suggested components include a chemical inventory, an employee profile, and a plan revision history. The book also includes procedures for handling contained and uncontained liquid chemical spills, contained dry fertilizer spills, fires, explosions, vehicle emergencies, and other disasters. A few pages on media management are also included. The manner in which a pesticide emergency is communicated to the public can have great impact on the way the event is perceived and, subsequently, the business' reputation.

Accidents can and do happen; emergency situations arise. The disaster is compounded if no advance planning is in place. Preparation of an emergency response plan can help minimize the damage to people, property, the environment, and your business.

## HAZWOPER* Hierarchy

***Hazardous Waste Operations and Emergency Response**

### Awareness Level

All employees working with pesticides should be able to identify hazardous substances, know the risks associated with those substances, understand the repercussions of a hazardous substance emergency, and know evacuation and emergency contact procedures.

### Operations Level

Employees responsible for the protection of other individuals, property, or the environment should be trained to control situations such as spills without actually trying to stop the release or endangering themselves through coming into contact with the substance. OSHA mandates eight hours of training at the operations level, covering basic hazard and risk assessment techniques; proper selection and use of personal protective equipment; basic hazardous materials terminology; basic control and containment techniques; and basic decontamination procedures.

### Technician Level

Employees responsible for stopping an accidental hazardous substance release must complete technician level training. Twenty-four hours of initial training are required, plus eight hours' field experience and eight hours' annual refresher training. Technicians are trained to plug, patch, or otherwise stop the release in an emergency situation.

### Specialist Level

Similar to the technician level, the specialist would have more extensive knowledge about the substances specific to the facility.

### Incident Commander Level

These responders are trained to take command and coordinate on-the-scene emergency operations, making decisions and communicating with external emergency responders.

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This article was excerpted from *Pesticides and Planning for Emergencies: Prevention, Reaction, and Response,* a 112-page handbook from Purdue University Cooperative Extension Service. The entire document (PPP-44) is available on-line at **http://www.btny.purdue.edu/PPP**, or a printed copy can be ordered for $30 from the Media Distribution Center at (888) 398-4636, **Media.Order@ces.purdue.edu**, or Purdue University, Agriculture Communication Service, Media Distribution Center, 301 S. 2nd Street, Lafayette, IN 47901-1232. The companion piece PPP-45, *Quick Response Emergency Plan* (not available on the Internet), can be ordered for $5.

# Input Needed Now for 2001 IR-4 Projects



**Dr. Douglas Walsh, State Liaison Representative, USDA/IR-4 Project**

The Interregional Research Project Number 4 (IR-4) was established in 1963 to increase the availability of crop protection chemistries for minor crop producers. IR-4 is a federal/state/private cooperative that aspires to obtain clearances for pest control chemistries on minor crops. (For a complete description of IR-4's workings see "IR-4: Developing and Delivering Pest Management Solutions for Minor Crop Producers," *AENews* No. 162, Oct. 1999.)

## *Prioritization Workshop THIS MONTH*

On September 11–13, 2000, the IR-4 prioritization workshop for year 2001 projects will take place in Orlando, Florida. Requests to IR-4 are many and the number of projects that can be funded and completed is limited.

## *Your Participation is Encouraged*

As the Washington State Liaison to the IR-4 program and as a commissioner on the Washington State Commission on Pesticide Registration, I need to know the pest control needs and concerns among the diverse agricultural producers of Washington State. The first step toward making a pesticide need known is to submit a Pesticide Clearance Request form (PCR) to IR-4. Anyone can submit a PCR. They are available on the Internet at **http://pestdata.ncsu.edu/ir-4/request.cfm**, or parties in Washington State can obtain them from me.

## *Time Is Short*

By the time this newsletter is released, the prioritization workshop will be imminent. Those who want a specific crop-chemistry combination considered must act quickly. Useful background documents are shown in the adjacent box.

Note that crop-chemistry combinations proposed by multiple states are often received favorably at the prioritization workshop. In last month's electronic newsletter (see URL below), you will find a condensed list of IR-4 projects that have already been proposed for the year 2001. A review of the new pest control chemistries with registration potential (announced last spring, URL below) may also prove useful.

Finally, if there is anything I can do to assist in making your pest control needs and concerns known, please don't hesitate to contact me.

*Dr. Douglas B. Walsh is the Washington State Liaison Representative for IR-4. His office is located at WSU in Prosser. He can be reached at (509) 786-2226 or **dwalsh@tricity.wsu.edu**.*

## ON-LINE RESOURCES

**IR-4 Pesticide Clearance Request form (PCR), a necessary step in making your needs known to IR-4**

**http://pestdata.ncsu.edu/ir-4/request.cfm**

**List of new pest control chemistries with registration potential announced last spring**

**http://www2.tricity.wsu.edu/aenews/April00AENews/NewProducts.html**

**List of projects already proposed for IR-4 consideration for 2001**

**http://www2.tricity.wsu.edu/aenews/Aug00AENews/Aug00AENews.htm/**

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# HRH QBL Asks:
# Wherefore Art Thou*, Revision Information?

**Jane M. Thomas, Pesticide Notification Network, WSU**

***In the May 2000 issue of* Agrichemical and Environmental News*, Jane M. Thomas of Washington State University's Pesticide Information Center pointed out the lack of consistent information and formatting on pesticide labels. She introduced the concept of an omnipotent monarch who would set down rules and regulations for label format and content and would be in charge of enforcing those rules. She further suggested the U.S. Environmental Protection Agency (EPA) hire her in that capacity, and dubbed herself the Queen Bee of Labels, or QBL for short. Until such time as EPA sees the light and appoints Jane to her rightful position, the Queen shall content herself with commentary on particularly pathetic, aggrievedly awful, and terribly tacky pesticide labels.(See "If I Were the Queen of Labels,"* AENews *No. 169, May 2000.)***

In breathtakingly late-breaking news, the QBL-elect set off quite a buzz when she announced that she may have made an error in the form of a tiny royal omission. When declaring her nearly twelve-step get-well program for pesticide label ills (see scroll, page 7), an item was left out (imagine, please, a long, dramatic drum roll): **label revision information!**

The issue of label revision information (or lack thereof) recently reared its ugly head at Washington State University's Pesticide Information Center (PIC). PIC staff members were reviewing two copies of the label for Setre Chemical's Barrage Low Volatile Herbicide. Since PIC maintains a searchable database for Washington and Oregon pesticide labels (the Pesticide Information Center On-Line, or "PICOL" label database, on the Internet at **http://picol.cahe.wsu.edu**), it had two copies—one each from the Washington State Department of Agriculture and the Oregon Department of Agriculture. Much to QBL's Imperial Dismay, the copies of the two labels were found to be quite different from one another. It was the task of the PIC, and, hence, of the QBL, to figure out which was the more recent and therefore the appropriate copy to use as the basis for the PICOL data entry. Neither label carried a revision date or any identifying marks other than Copyright 1997, which was found on both. Seeking a Royal Revelation, We called the registrant and found that the registration specialist could not tell which label copy was the more recent. The QBL sensed serious trouble when, after several phone calls, the registration specialist concluded that the less specific label was actually the more recent. At the risk of being a Doubting Thomas…could this really be the right answer? It seems that registrants typically revise their pesticide labels in a more specific as opposed to less specific direction. (Or at least they should if they are following the QBL's soon-to-be 12-step get-well program for pesticide labels.) To give credit where it's due, the Setre Chemical registration person sounded nearly as frustrated as the PIC staff throughout these conversations.

This sort of thing is exactly why the world needs a QBL. Under the future monarchy, companies shall no longer capriciously identify their label revisions with "Form 1214-C," "RV 013195," and other clever mystery monikers of no use to those without a secret decoder ring. Nor will others (those really bad actors) continue their practice of providing no revision information at all. Once appointed by EPA, the QBL will make a RULE that all labels carry a revision date and that, whatever format is decided upon, the SAME format will be used by ALL registrants on ALL labels. (So come on, EPA—quit fooling around and finalize the QBL's appointment so that this can be taken care of.)

This whole issue has raised the Royal Blood Pressure to a new height. In an effort to cool

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* For the liberal arts scholars in our audience (both of you), please be aware that the QBL and the *AENews* editorial staff are aware that "wherefore" means "why," as opposed to the common misinterpretation "where." But it was funny, so we used it anyway.

# QBL, cont.

Jane M. Thomas, Pesticide Notification Network, WSU

down, while visualizing the coronation, murmuring affirmations, and looking to the future, it became apparent that something crucial was missing from the plans of assuming the QBL mantle with EPA: A Royal Motto. In keeping with the '90s penchant for mission statements, without further ado (or much thought), The QBL hereby announces her Royal Motto:

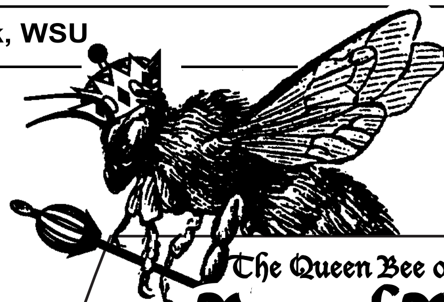
**E pluribus electrolux**
**fusarium helvetica**

An extremely scientific survey found that one's interpretation of this motto depended upon one's perspective.

- Pesticide people translated it as, "Conform to the Royal Rules or Buzz Off!"
- The musically inclined tended to sing out, "Follow the, follow the, follow the, follow the, follow the Royal Rules!"
- Those who favor slogans and catch phrases were divided between the interpretation, "Labels: Clear and Concise - Shorter is Nice," and "Labels: All Terms Defined - Clear All the Time."
- One rogue with a medieval mindset even took quill in hand and made the following effort at translation: "Even a Registrant That's Pure at Heart and Says Its Prayers By Night Is Not Allowed to Write a Bad Label."

Really, it simply translates to "No More Lousy Labels!" What, you doubt me? If you can't trust the Queen, who can you trust?

*Jane M. (QBL) Thomas can be reached at (509) 372-7493 or* ***jmthomas@tricity.wsu.edu****.*



The Queen Bee of Labels'

## Royal Rules

*By application of the following RULES (detailed in May's* AENews*), a nearly twelve-step get-well program, the QBL is certain that all problems caused by poorly written pesticide labels will be resolved.*

1. **Standard Format**
Standardized layout for labels providing designated locations for specific information.
2. **Intended Users**
Each label will specify whether it is intended for commercial or homeowner use.
3. **Ingredients**
All labels will use the same active ingredient name to identify the chemical.
4. **Crop Definitions**
All labels will use standard, clearly defined crop terms.
5. **Label Language (Lists)**
Lists of crops must be either clearly illustrative ("for example…") or clearly exhaustive ("limited to…").
6. **Label Language (Geographic Terms)**
Where a label limits product use to a certain region, the region must be clearly defined and include state or county names.
7. **Product Name**
Must be clearly identified, leaving no doubt as to which snippet of type is the actual name.
8. **Font Size**
Pesticide labels shall contain no fine print.
9. **Use Directions**
Use directions shall listed by crop or crop grouping, with crops/crop groupings presented in alphabetical order.
10. **EPA Label Review**
All labels will receive a thorough and uniform review by EPA, ensuring all QBL criteria are met.

And, finally…

11. **Label Revision Information**
All labels will carry a revision date in the format "01-JAN-00."

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# Herbicide Tolerant Genes

## Part 1: Squaring Up Roundup Ready Crops

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

Here's a novel idea. Let's use a weed control technology that is very likely to eliminate the ubiquitous detection of certain herbicides in water all over the world. No, I'm not suggesting we should start heavily mulching the 140-million-plus acres of soybean and corn in the United States. (After all, those two commodities are responsible for the vast majority of pesticide detections found in ground and surface water.) What I had in mind was the use of a phytotoxic amino acid that binds to soil and therefore doesn't leach nor is it subject to runoff under proper soil conservation practices. Consumers have been buying formulated versions of the chemical for nearly two decades, safely using it to control weeds alongside their driveways and sidewalks, or to prepare vegetated areas for new plantings.

The only problem with this seemingly miraculous product is that it kills just about any plant onto which it is directly sprayed. Thus, until recently, this synthetic amino acid, known as glyphosate (N-phosphonomethyl glycine) has had limited utility in agricultural production. And then along came genetic engineering. In just the last five years, Monsanto has commercialized soybeans, corn, cotton, and rape (canola) genetically engineered to resist the toxic effects of glyphosate. Monsanto trademarked these transgenic cultivars as Roundup Ready (RR), in reference to their commercial formulation of glyphosate.

So everyone should be cheering about the decreased numbers of pesticide applications (or at least the potential to decrease them) on the large U.S. acreages of soybeans, corn, cotton and canola, right? Well, if you read any newspaper today it's clear that everyone is not cheering. In fact, as with all transgenic technology, RR crops have not escaped the wrath of advocates who seem hell bent to trash biotechnology in total rather than judge each development on its own merits or faults. So, in keeping with the National Academy of Sciences recommendation that each transgenic crop involving traits useful for protection from pests be judged individually (14), I will review the biochemistry of glyphosate tolerance and address the validity of critics' concerns.

### *Biochemical Basis for Glyphosate Resistance*

All Roundup Ready crops contain an enzyme known as EPSPS (5-enolpyruvylshikimate-3-phosphate synthase) that is resistant to the effects of glyphosate. EPSPS is naturally found in all plants, fungi, and bacteria but is absent in animals (18). The enzyme is an important catalyst in the biochemical pathway for synthesis of the aromatic amino acids phenylalanine, tryptophan, and tyrosine. Because animals do not contain EPSPS, they must ingest these aromatic amino acids in their diets.

EPSPS is localized in the chloroplasts of plants, the cell organelle responsible for photosynthesis. Glyphosate latches on to EPSPS, inhibiting its synthetic activity. The inability to produce the aromatic amino acids eventually leads to cell death. The glyphosate-tolerant form of EPSPS has a low affinity for binding glyphosate yet it still helps synthesize the amino acids just as efficiently as the glyphosate-susceptible EPSPS.

Roundup Ready canola plants have also been engineered to contain an enzyme called glyphosate oxidoreductase, or GOX. GOX, normally found in a common soil bacterium, *Ochrobactrum anthropi* strain LBAA, quickly metabolizes glyphosate into glyoxalate and aminomethylphosphonic acid (AMPA). Glyoxalate is a naturally occurring plant biochemical involved in carbon cycling and AMPA is of no toxicological concern in food (17).

### *Genetic Basis for Glyphosate Resistance*

Plant species have long been known to be highly variable in their response to herbicides. For example, grasses are very tolerant to 2,4-D and other growth hormone mimics, but dandelions exposed to it wither and die. Soybeans can tolerate trifluralin, but corn never gets big enough to produce an ear. Furthermore, weed populations can become resistant to herbicides. During the 1980s, agricultural scientists tried in vain to take advantage of plants' natural variability to herbicide toxicity and their penchant to

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# Squaring Up Roundup, cont.

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

develop resistance. Attempts to conventionally breed glyphosate-tolerant crops failed (18). Such failure is not surprising; after twenty-five years of glyphosate use, plant resistance in the field has been noted in only two grass species (10). As molecular manipulation technologies developed (i.e., the ability to purposefully transfer specific genetic sequences from one organism to another), the stage was set for engineering plants resistant to glyphosate.

So how does one "make" a plant resistant to glyphosate? Mimic Mother Nature. As with all cases of resistance evolution, two main mechanisms are responsible for herbicide tolerance in plants—an increased ability to detoxify the pesticide and/or an altered biochemical site of interaction with the pesticide (17). Both mechanisms involve altered protein functioning and/or production. In the case of detoxification, the proteins involved are enzymes that possess an enhanced capacity for breaking down the herbicide. Biochemical sites attacked by a herbicide may also be enzymes or alternatively receptors that trigger a cascade of physiological reactions. Altered enzymes and receptors have less affinity than their "normal" counterparts for binding the herbicide.

Whatever the mechanism of herbicide tolerance, genes ultimately determine the characteristics of the proteins. Researchers either search for the genes of an organism which already possesses a detoxification mechanism (such as GOX from *O. anthropi*), or they add chemical reagents to plant cells in vitro (i.e., in cell culture) that change the genetic code and produce an "altered" enzyme (i.e., one with less affinity for glyphosate).

Presently, only canola plants have been successfully engineered to contain a functional GOX enzyme (1). However, all the commercial RR crops contain a tolerant EPSPS gene. For soybean, cotton, and canola the glyphosate-resistant EPSPS was obtained from a soil bacterium in the genus *Agrobacterium* (strain CP4) (1, 15, 18). For corn, the source of EPSPS was its own cloned gene that had been mutagenized in vitro (i.e., in cell culture) (20). This technique involves changing the DNA bases of cultured plant cells by adding mutagenic chemical reagents. Resulting changes in DNA bases could slightly affect the amino acid composition of the host (i.e., corn) enzyme. Normally, mutagenesis will produce nonfunctional enzymes, but in some cases a few changes in amino acid sequence can still produce a functional enzyme. With the mutagenized corn line, the resulting EPSPS was 99.3% similar to the nonmutagenized EPSPS and still functional (i.e., it produced the aromatic amino acids), but it was resistant to the effects of glyphosate (20). The development of RR corn using a mutant version of its own EPSPS gene followed research nearly a decade earlier where petunia EPSPS was successfully altered and then reintroduced into the plant to effect tolerance to glyphosate (1,13).

## Preparing the Genes for Transfer to Plants

Scientists have honed to a fine art the isolation of tolerant GOX or EPSPS genes. Before transfer to recipient plant cells, however, the genes must be modified to be capable of translation into proteins. Basically, the genes are linked to other pieces of DNA that serve as start and stop signals (promoter and terminator sequences, respectively) for "reading" the herbicide-tolerant gene. Modification of the desired-trait gene is accomplished in an intermediate organism or host known as a vector.

The most commonly used gene vector is a nonpathogenic strain of the *E. coli* bacterium that we all carry in our intestines. The genetics and structure of the *E. coli* chromosome are very thoroughly understood. More importantly, *E. coli,* like many other bacteria, contain in addition to their chromosome a smaller piece of double stranded DNA called a plasmid. Plasmids have the unique ability to replicate themselves independently of cell division. When they replicate, they can make numerous copies of desirable genes. Thus, *E. coli* can serve as a factory for gene synthesis or cloning; therefore it makes an excellent vector for transferring genes from one host to another.

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# Squaring Up Roundup, cont.

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

Using various tricks of the trade, the molecular biologist piece-by-piece links the desirable sets of promoter and terminator DNA to the *E. coli* plasmid that will allow translation of the herbicide-tolerant gene into the EPSPS enzyme. These "translator" sequences of DNA come from other plants and their naturally associated viruses. For example, the source of the promoter for soybean and cotton was the cauliflower mosaic virus (15, 18); a rice promoter DNA sequence was used for corn (1) (Table 1). A terminator sequence, which signals the end of the gene message, was supplied by attaching part of an *Arabidopsis* gene called nopaline synthase to the plasmid vector. Neither the promoter nor terminator sequences are translated into a protein product.

**TABLE 1**

**Source of trait genes and ancillary genetic elements in Roundup Ready Crops**

| | **Canola** | **Corn** | **Cotton** | **Soybean** |
|---|---|---|---|---|
| **EPSPS** | *Agrobacterium* CP4[1,15,18] | Corn[20] (mutagenized) | *Agrobacterium* CP4[1,15,18] | *Agrobacterium* CP4[1,15,18] |
| **CTP**[17] | Arabidopsis | Sunflower & Corn | Arabidopsis | Petunia |
| **GOX** | *Ochrobactrum anthropi* strain LBAA[1] | Not Present | Not Present | Not Present |
| **Promoter Sequence** | Figwort Mosaic Virus | Rice[1] | Cauliflower Mosaic Virus[15,18] | Cauliflower Mosaic Virus[15,18] |
| **Terminator Sequence** | Pea | *Agrobacterium tumefaciens* | Arabidopsis | Arabidopsis |
| **Antibiotic**[15] **Resistance Marker Gene** | Streptomycin (not expressed) | Beta-lactamase (not expressed) | Neomycin phosphotransferase II (expressed) | Neomycin phosphotransferase II (not expressed) |

Other DNA sequences and/or genes are spliced onto the vector plasmid to aid proper functioning of the herbicide tolerant gene after it is transferred to the plant cells. For example, plant EPSPS is synthesized with a small, attached protein called the chloroplast transporter peptide (CTP). This peptide helps carry the EPSPS from its site of synthesis in the cytoplasm to the chloroplast. The peptide is cleaved from the EPSPS at this point to make it a functional enzyme. The source of the CTP DNA is the petunia plant for soybeans, the *Arabidopsis* plant for cotton and canola, and a combination of sunflower and corn itself for corn (1, 15, 18) (Table 1).

Building the plasmid vector with all the appropriate genes and DNA sequences is not a matter of simply throwing DNA at a bacterial cell. Not all *E. coli* cells will contain the right combination of elements on its plasmid. To help select only the *E. coli* cells containing the plasmids with the right combination of genes, marker sequences of DNA are also linked to the plasmid. Some common markers are genes for antibiotic resistance (Table 1). For example, the plasmid used to make RR cotton and soybean contain a gene coding for an enzyme (NPII) that makes bacteria resistant to neomycin. Such resistance is already widely disseminated among bacteria in the environment (7). When bacterial cells are exposed to neomycin, plasmids without the linked EPSPS and NPII gene will die. The remaining living cells will be further cultured to build up large amounts of the vector plasmid.

## *Gene Transfer Techniques*

The bacterial plasmids can be introduced into plant cells in one of two ways. The oldest way of transferring DNA is to allow the vector bacteria to "mate" with a plant parasitic bacterium called *Agrobacterium tumefasciens. A. tumefaciens* is normally responsible for crown gall disease, but this strain's DNA is disarmed of disease traits without affecting its natural ability to transfer its plasmids directly into the plant cells (1, 15). The recipient plant cells (embryonic-like plant tissue known as a callus) are co-cultured with *A. tumefaciens* containing the engineered plasmids,

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# Squaring Up Roundup, cont.

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which are then "injected" into the cells. Canola and cotton cells were transformed using *Agrobacteri-um*, but the technique does not work well with grasses.

A more recent method for transferring genes is to shoot them into the plant cells. The *E. coli* cells are broken apart to recover the engineered plasmids. The plasmids are coated on miniscule tungsten or gold particles and fired from a gun-like device into a plant callus culture. Some of the DNA moves to the nucleus of the calli cells where it is incorporated into the genome. Soybeans and corn were transformed using this ballistic technique (18).

Regardless of which gene transfer technique is employed, not all of the DNA will be successfully incorporated into the plant genome. Thus, another round of selection is imposed on the cultured plant tissue. Basically, the plant tissue is exposed to different doses of glyphosate, and the tissue showing no signs of toxicity is grown up into a whole plant. The resulting plants are allowed to flower, pollinate, and produce seed for further testing.

## Technology Critics Are Skeptics, Too

As a proponent of skepticism in scientific research and teaching, I find it perfectly logical for gene technology critics to pose fanciful "what if" questions and worst case scenarios. In essence, these hypotheses are addressed by the Federal regulatory agencies when assessing the safety of transgenic crops (see "Regulating Herbicide Tolerant Plants," *AENews* No. 172, August 2000).

The broad concerns about herbicide-tolerant genes are essentially the same as those of the insecticidal Bt transgenic technology (5)—food safety and ecological effects. For herbicide tolerant genes, however, safety of the herbicides is also questioned. Therefore, focusing specifically on Roundup Ready crops, five questions immediately come to mind.

◆ Do engineered RR genes have unintended effects on other plant genes or traits?

◆ Is plant metabolism sufficiently affected to produce new toxic proteins or allergens?

◆ Are RR crops nutritionally equivalent to traditionally bred crops?

◆ What do we know about the safety of glyphosate herbicide?

◆ Can RR crop genes escape to other plants and create superweeds?

## Epistasis and Pleiotropy

When the herbicide tolerance gene is transferred to plants, no one knows exactly where in the plant genome the DNA sequences are inserted, even though the gene is completely functional. One concern has been that random insertion of genes may either adversely affect or alter the expression of other genes or traits. Single genes are known to affect the expression of other unrelated genes (epistasis), while the protein produced by a single gene can have effects on multiple plant traits (pleiotropy). Thus, not knowing exactly where engineered genes are located in the plant genome makes some people nervous because of the possibility of abnormal epistatic and/or pleiotropic effects. Some envisioned problems include poor agronomic performance, susceptibility of crops to disease, production of new toxins or allergens, and nutritional differences from conventionally bred crops.

When the U.S. Food and Drug Administration (FDA) implemented its 1992 "new" plant variety foods policy (6), it examined the possible consequences of epistatic and pleiotropic effects in RR crops (11). Unintended gene effects and plant traits can be tested directly and indirectly. Direct tests include studies of the inheritance and expression of the new genes in the recipient crops. Indirect tests include studies for plant agronomic performance, toxicity, allergenicity, and nutritional equivalence.

Despite not knowing exactly where the engineered genes are located on the plant chromosomes, scientists are able to measure directly the number of inser-

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# Squaring Up Roundup, cont.

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tion points in the plant. The number of insertion points is important, because a high number of random insertions would have a greater probability of causing unpredictable epistatic or pleiotropic effects, assuming the plant survived the genetic engineering event in the first place. Knowing that there are only one or two insertion points in the genome of a plant that can then be bred through several generations of fertile seed production, scientists can confidentally predict a very low likelihood of unintended genetic effects. Pertinently, RR corn and soybean have been shown to have only one or two copies of the glyphosate-tolerant gene at a single chromosomal insertion point (18, 20).

A second direct way to determine the probability of epistatic and pleiotropic effects is to backcross (i.e., mate) the transgenic variety with its conventionally bred (i.e., isogenic) cultivar from which it was derived or to mate it with other cultivars. In these experiments, the breeder is ensuring that the inheritance of the herbicide tolerant gene trait is stable over numerous generations and that the resulting plants grow, yield, and reproduce normally in the field. If the engineered gene had unpredicted effects, then you might expect agronomic failure when each generation of seeds is grown under a variety of environmental conditions in numerous locations. Genetic backcrossing studies with RR cotton, corn, and soybean show that the engineered EPSPS gene segregates during pollination in a manner consistent with typical dominant gene inheritance rules (15, 18, 20).

One indirect method for testing unintended epistatic and pleiotropic effects is to ensure that the gene expresses itself similarly among each cropping cycle. Levels of EPSPS enzyme were found to be similar in RR cotton and soybean leaves and seeds grown in two successive growing seasons prior to commercialization (15, 18). More importantly, agronomic performance of RR crops was measured repeatedly in many plot locations around the United States over several growing seasons. For example, RR soybeans were tested in about twenty locations around the United States during each growing season from 1992 to 1994. Different rates of Roundup were applied to different growth stages at one or two different times; furthermore, other registered soybean herbicides were tested for comparison to glyphosate. Visible crop injury and yield of RR soybeans were not significantly different than the isogenic controls at nearly every single site during all three years of the study (3). Thus, the stable field performance of RR soybean at least over three seasons lead to the conclusion that the transgenic EPSPS was not behaving any differently than the EPSPS of the isogenic line.

## *Unintended Byproducts— Toxic Proteins and Allergenicity*

The concern over the possibility that novel gene insertions might cause plants to unleash production of toxic proteins or allergens leads to tests that also indirectly address the issue of epistatic and pleiotropic effects. Even before conducting the tests, however, the specific biochemistry of gene and plant metabolism can be examined to glean some answers. For example, while concern over toxic/allergenic byproducts of RR crops is genuine, it seemingly implies that the conventionally bred crops do not naturally contain toxicants and allergens. Yet, naturally occurring soy lecithin can cause severe nausea, vomiting, and diarrhea if not removed and destroyed by proper soaking and cooking (6). Plants in the family Cruciferae (which includes canola) contain glucosinolates that can impair thyroid function (6).

While risk, or the probability of an adverse toxicological or allergenic reaction, can never be zero, close examination of RR technology suggests that the transgenic versions of crops should essentially have no more risk for toxic or allergenic effects than the conventionally bred versions. Recall that all plants

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contain the EPSPS enzyme. The difference between the plant enzyme and the bacterial source is in the amino acid sequence of the protein, not in its physiological functions (9). The changes in amino acid sequence greatly reduce the tendency of glyphosate to bind to the enzyme, but do not completely negate binding at extremely high doses of glyphosate.

Given that variations in EPSPS protein among different food sources is also due to differences in amino acid sequence, it is unlikely that humans would have any trouble handling the RR EPSPS (9). In fact, our intestinal tract has a wonderful ability to digest many plant proteins into either their constituent amino acids or small chains of amino acids called peptides. In the extreme acid environment of the stomach, many proteins are at least partially degraded. A common method for testing allergenicity is to place the isolated protein extract into a simulated gastric environment that contains the stomach enzyme pepsin and has a pH of 1.2. RR EPSPS degraded in fifteen seconds under such conditions, an amount of time similar to many common plant proteins (12). Furthermore, there were no detectable protein fragments resulting from the digestion. Known allergenic proteins persist much longer under simulated gastric conditions.

Another method for testing for allergenicity is to determine whether the amino acid sequence of the transgenic protein has any similarity to known allergens. RR EPSPS also passed this test (9). Soybean extracts from RR seeds were tested for their ability to react with soybean-specific antibodies taken from the blood of individuals allergic to soy products (2). The reactions were identical between transgenic soybeans and their conventional parent cultivars.

## *Nutritional Equivalence*

Another indirect method to test for unintended consequences of inserting new or altered genes is to study the nutritional equivalence between parental lines from which a transgenic crop was bred and several generations of the transgenic cultivars. The harvested seed can also be fed to animals to examine for toxic effects and more subtle effects on growth.

The concept of substantial nutritional equivalence between new food varieties and their conventional counterparts is a principle adopted internationally by the World Health Organization (WHO), the United Nations Food and Agricultural Organization (FAO), and the Organization for Economic Cooperation and Development (OECD) (20). The principle asserts that if a new food or feed derived from conventional breeding or genetic engineering is substantially equivalent in standard nutritional parameters to its conventional counterpart, then the new food should be considered equally safe.

Nutritional parameters were studied for several generations of RR crops, and results from RR corn, cotton, and soybean have now been published in the peer-reviewed literature (16, 19, 20, 21). Commonly measured parameters include content of protein, oil, ash, fiber, carbohydrates, and amino acids. No statistically significant differences were found between the transgenic cultivars and the parental strain of any of the crops, nor were differences found between different years of cultivation.

Critics have pointed out that perhaps RR crops may not show glyphosate injury symptoms when sprayed directly with Roundup, but the plants may still be under enough stress to alter their normal nutritive value. Nutritional compositional analysis has been studied comparing RR soybeans sprayed directly with glyphosate and untreated RR soybeans (21). Furthermore, the crops were grown in soil that had been treated the previous growing season with glyphosate prior to soybean seedling emergence, controlling for the possibility that old residues might enter the crop through the root system. When compared to the untreated nontransgenic parental soybean cultivar, no statistically significant differences were noted in nutritional composition of two generations of RR seeds.

In addition to standard nutritional composition analysis, recognized beneficial plant chemicals like phytoestrogens in the biochemical group known as isoflavones have also been measured in soybeans (19, 21). Again, no differences were discovered in

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isoflavone content between RR soybeans sprayed with glyphosate, unsprayed RR soybeans, and the unsprayed glyphosate-susceptible parental cultivar.

Of course, conducting a nutrient analysis may still miss subtle biochemical effects. So the question becomes whether animals grow normally when fed RR crops. Livestock are perfect subjects for testing this hypothesis because a major part of their diet is made up of the ground grain. A diet of 50-60% (by weight) corn was fed to broiler chickens from two to forty days old. No differences were found in growth, feed efficiency, and fat pad weights between chickens fed RR corn and the parental nontransgenic control grain (20). Similarly, growth, feed efficiency, and muscle and fat tissue were not affected in rats, broiler chickens, catfish, and dairy cows fed conventional or RR soybeans (8). Compositional analysis of cow milk revealed no significant nutritional differences (8).

In summary, no problems with RR crops related to agronomic performance, toxicity, allergenicity, or nutritional and phytochemical equivalence surfaced during several years of pre-commercial testing. Given the sound understanding that the glyphosate-tolerant EPSPS gene has a single insertion site on the plant genome, and the gene is stably inherited in back-crosses to parent cultivars as a typical dominant character, the probability of unintended crop and human safety concerns seems remote. Given wide-spread RR soybean cultivation in the United States without reported problems over five additional commercial growing seasons (4), one wonders how long to wait before declaring epistatic and pleiotropic effects a nonissue.

## *Substantial Equivalence and Ecological Concerns*

The principle of substantial nutritional equivalence might be analogously applied to the two remaining concerns about RR crops--glyphosate safety and potential for superweeds. Is the widespread implementation of the technology doing anything to the environment that conventional agriculture has not already wrought? Might there, in fact, be environmental benefits from RR technology that surpass conventional crop management? Does more widespread use of glyphosate pose a substantially different risk than the amount currently used for weed control? Is glyphosate perhaps “greener” than other herbicides? Get ready for subsequent issues of this newsletter; I will round up the answers to these burning questions.

*Dr. Allan S. Felsot is an Environmental Toxicologist with Washington State University’s Food and Environmental Quality Laboratory. He can be reached at (509) 372-7365 or* ***afelsot@tricity.wsu.edu.***

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# PNW Ag/Water Quality Conference

Far West Agribusiness Association, in cooperation with a number of public and private entities throughout the Pacific Northwest, has announced the **Agriculture and Water Quality in the Pacific Northwest** conference. The conference, "designed to improve communication, build understanding, and foster cooperation between people in agriculture, the environment, and government," is being held

**October 24-25, 2000 • Valley River Inn • Eugene, Oregon**

Featuring over sixty speakers, the conference presents two full days of topics ranging from Irrigation Management to Salmon and Riparian Issues, from Meeting Water Quality Standards to Water Quantity. Keynote presentations will be given by Will Steele (National Marine Fisheries Service), Sandy Williamson (US Geological Survey), Jerry Marguth (Nixon Farms, Inc.), and Anne Schwartz (Washington Tilth). Full conference details, including schedule and registration information, is available online at

**http://www.agwaterqualitynw.org**

or call (509) 465-5055 or e-mail pete@fwaa.org. Cost is $120 before October 2, $175 after.

# WSCPR Funding Shifts

## Changes in Proposal Timing and Format

**Dr. Douglas B. Walsh, WSU Entomologist and WSCPR Commissioner**

In 1995, the Washington State Legislature created the Washington State Commission on Pesticide Registration (WSCPR) to assist users of pesticides in obtaining and maintaining pesticide registrations for minor uses in Washington State. WSCPR allocates funding to research or service projects directed toward solving applied, real-world pest management problems.

Subsequently, the WSCPR became a victim of its own success. In 1999, the state legislature increased WSCPR's funding by $500,000 annually. Now over $800,000 in funding is available through WSCPR each year. But growth sometimes causes growing pains; the resulting influx of proposals has led WSCPR to make some changes in the the process and timing of application for this funding.

### *Expanded Mission*

The WSCPR's initial mandate, set forth in its enabling legislation in 1995, had been rather narrow in scope. It allowed funding of projects directed toward new registration or registration maintenance of pesticide products, and for projects that provided information on the registration of pesticide products. The new mandate permits the WSCPR to consider funding of projects that encompass broader aspects of applied pest management and integrated pest management, including biological control, pesticide resistance management, and cultural pest control techniques.

Proposals for funding through WSCPR must originate from an affected pest management user group (e.g., tree fruit growers, vegetation management applicators, pest control operators, organic vegetable growers). An individual, company or organization may make the request on behalf of a pest management user group, if supported by the affected group. Requests are not accepted from manufacturers, pest management companies, dealers, or distributors. University or federal scientists, private researchers or laboratories, and other individuals may not submit proposals or carry out projects without demonstrable collaborative support from user groups. Individuals and organizations in other states may submit proposals or work collaboratively on Washington-based projects.

### *New Funding Cycle*

The WSCPR's practice until now has been to consider proposals every two months. The new, broadened mandate resulted in a dramatic increase in proposals. Commissioners have reviewed over eighty proposals in the past year, and funding requests exceeded available resources. The new funding cycle is designed to allow a thorough review of proposals and the most effective and appropriate dispersal of funds.

Two WSCPR funding meetings are scheduled, each of which will result in allocation of $300,000. The first will be held in Ellensburg November 7 and 8, 2000, and the second will be held in the Tri-Cities January 9 and 10, 2001. Proposals are due to the WSCPR Administrator Dr. Alan Schreiber one month prior to each meeting date. Proposals not funded at the November meeting may be revised and re-submitted for consideration at the January meeting. Additional funds beyond the $300,000 scheduled for allocation at the January meeting may be awarded, but some contingency funds will be held back for potential emergency situations.

### *New Proposal Format*

A uniform project proposal form is being adopted by the WSCPR. It will consist of three sections, to which commissioners will apply numerical scores.

- Problem Description (30 points)
- Project Description (30 points)
- Administrative Considerations (40 points)

Sample copies of the new proposal form/score sheet will be distributed when the new request for proposals is mailed out in September. Further information, including full details about submitting proposals, is available on the WSCPR's website at **http://www.wscpr.org**.

*Dr. Douglas B. Walsh is an Entomologist and an Agrichemical and Environmental Education Specialist with Washington State University. He holds the WSU seat on the Washington State Commission on Pesticide Registration and can be reached at (509) 786-2226 or* ***dwalsh@tricity.wsu.edu****.*

# 2000 Pesticide Container Recycling Schedule

**Washington Pest Consultants Association**

Washington Pest Consultants Association organizes an annual series of collection dates and sites for empty pesticide containers. The dates and locations in the table below are subject to change; use the contact names and telephone numbers provided to confirm. For general questions, or to host an event at your farm, business, or in a central location in your area, contact Northwest Ag Plastics representative Clarke Brown at (509) 965-6809 or David Brown at (509) 469-2550 or **dbrownwash@msn.com**. More information on pesticide waste and container recycling is available on the Internet at **http://pep.wsu.edu/waste/wd.html**.

**CONTAINERS MUST MEET THE FOLLOWING CRITERIA:**

• Rinsed—no residue remaining • Clean and dry, inside and out, with no apparent odor •
• Majority of foil seal removed from spout (small amount remaining on rim OK) •
• Half-pint, pint, quart, one and two-and-a-half gallon containers accepted whole •
• Hard plastic lids and slip-on lids removed • Five-gallon containers accepted whole if lids and bails removed •
• 30 and 55-gallon containers accepted whole if above criteria is met •

| DATE | TIME | LOCATION | SPONSOR | CONTACT | PHONE |
|---|---|---|---|---|---|
| Sept. 5 | 8a-11a | Chelan | Northwest Wholesale | Herb Teas | (509) 662-2141 |
| Sept. 6 | 8a-11a | WenatcheeTree Fruit Station | Fieldmen's Assoc. | Floyd Stutzman | (509) 669-0420 |
| Sept. 11 | 9a-11a | St John | Gossard Aviation Inc. | Wesley Gossard | (509) 648-3722 |
| | 1p-3p | Pine City | Reed Aviation | Pete Reed | (509) 523-3950 |
| Sept. 12 | 8a-10a | Warden | Kilmer Crop Dusting | Terry Kilmer | (509) 349-2491 |
| | 11a-1p | Bruce | Simplot | Chuck Spytex | (509) 488-2132 |
| | 3p-5p | Othello | South Saddle Orchard | Mike Macy | (509) 539-5836 |
| Sept. 14 | 8a-11a | Zillah | Bleyhl Farm Service | Ray Oversby | (509) 829-6922 |
| Oct. 3 | 9a-10a | Ellensburg | DOT | Susanne Tarr | (509) 962-7577 |
| Oct. 13 | 8a-3p | Othello | Conner Flying Inc. | Mark Conner | (509) 488-2921 |
| Oct. 16 | 8a-10a | Waterville | Western Farm Service | Dale Gromley | (509) 745-8857 |
| | 11a-2p | Coulee City | | Pete Thiry | (509) 632-5697 |
| | 3p-5p | Ephrata | The Crop Duster | Martin Shaw | (509) 754-3461 |
| Oct. 17 | 8a-11a | Wilbur Airport | Greg's Crop Care | Greg Leyva | (509) 647-2441 |
| | 1p-4p | Davenport Airport | Northwest Aviation Inc. | Lee Swain | (509) 725-0011 |
| Oct. 18 | 8a-Noon | Rosalia | Western Farm Service | John Hartley | (509) 523-6811 |
| | 1p-3p | Mockonema | McGregor's | Dale Deerkop | (509) 635-1591 |
| Oct. 19 | 8a-10a | Connell | B&R Aerial Crop Care | Chris Eskildsen | (509) 234-7791 |
| | 1p-3p | Pasco, Kahlotus Rd. | Air Trac | Gerald Titus | (509) 547-5301 |
| Oct. 23 | 8a-10a | Spokane, 222 N Havana | WSDA & WSU | Tim Schultz | (509) 533-2690 |
| | | | | Jim Lindstrom | (509) 533-2686 |
| | 11a-1p | Mead | Cenex | Todd Race | (509) 466-5192 |
| | 3p-5p | Deer Park | Inland Agronomy | Jim McAdams | (509) 276-2611 |
| Oct. 26 | 9a-Noon | Coulee City | Cenex | Huck Dilling | (509) 632-5292 |
| | 1p-3p | Almira | | Don Felker | (509) 639-2421 |
| Oct. 27 | 8a-Noon | Moses Lake | Tom Dent Aviation | Tom Dent | (509) 765-6926 |
| | 2p-5p | Warden | Kilmer Crop Dusting | Terry Kilmer | (509) 349-2491 |
| Oct. 30 | 9a-3p | Outlook | Snipes Mtn. Trans. Stn. | Mark Nedrow | (509) 574-2472 |
| Oct. 31 | 8:30a-3p | Yakima | Terrace Hts. Landfill | | |

***"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."***

# Pesticide Issues Conference
## To Focus on Home & Garden

The Washington State University Pesticide Education Program presents the fifth annual Pesticide Issues Conference. This year's conference will be held on the west side of the Cascades, and will focus on urban issues. The conference will present information to educators, regulators, public works professionals, and others who work with people who use pesticides in their homes, yards, or gardens. The public is using pesticides and it is necessary to mitigate the risk. Education is the key to risk mitigation, whether the risk is to humans, domestic animals, or the environment. In order to provide proper advice, develop public policy, or simply to "be informed," it is important to understand the underlying concerns about home and garden pesticide use and some of the educational and regulatory efforts underway to mitigate risk. (*8 pesticide recertification credits)*

## October 19, 2000
## Pacific Lutheran University, Tacoma, WA
## University Center, Chris Knutzen Hall
## 7:50 a.m. to 4:00 p.m.

**Pre-Registration:** $70 before October 1; $100 if postmarked after October 1. Visa/MC/checks accepted.

**Refund/Cancellation Policy:** Cancellations can be made until October 1, 2000. The registration fee, less $15, will be refunded if you cancel prior to October 1, 2000. After that time, no refunds will be made for cancellations.

**Onsite Registration:** $100; from 7:15-7:45 a.m.

**Contacts**
Carol Ramsay (509-335-9222 or ramsay@wsu.edu)
Carrie Foss (253-445-4577 or cfoss @wsu.edu)
Cheryl Hill (509-335-2830 or hillcr@wsu.edu)
**http://pep.wsu.edu/education/issues.html**

## CONFERENCE AGENDA

**The Problems with Home and Garden Pesticide Use**
- Human Health
- Water Quality
- Pesticide Misuse

**Dealing with the Problems Associated with Home and Garden Pesticide Use**

**Dursban & Crane Fly**

**Status of Alternatives and Research**

**Consumer Labeling Initiative**

**Federal Disposal Guidance**

**LUNCHEON AND SPEAKER**
**Mass Media Advertising**

**How to Reach Users of**
- Home and Garden Pesticides
- Master Gardener Program
- K-12 Curriculum
- Green Gardening Program
- Home To Ocean Program

**Home & Garden Resources**
- Books, Web Pages, Newspaper, Radio
- National Pesticide Telecommunications Network

**Regulating Domestic Pesticide Use**
- 25b Exemptions from Registration
- New Domestic Use Category
- Future State Regulations
- Impacts on Manufacturers

# Insect of the Month
# Yellowjackets

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Agrichemical & Environmental News
Sept. 2000
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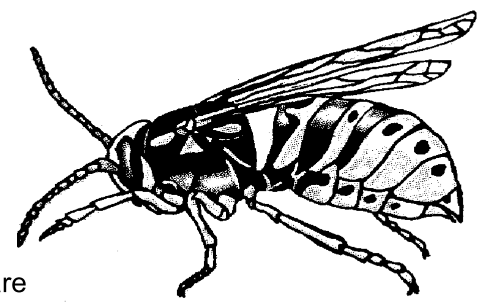
**Excerpted from the work of Drs. Roger D. Akre and Arthur L. Antonelli, WSU**

Yellowjackets (Hymenoptera: Vespidae) are a conundrum. On the one hand, they are beneficial insects—they feed their young many pest insects that ordinarily damage shade trees and crops. On the other hand, they are serious stinging hazards to humans throughout much of the temperate area of the world, including here in the Pacific Northwest. Some species become particularly troublesome because of their tendency to scavenge for meat and sweets, making them dangerous uninvited picnic guests.

## *Physical Description*

Yellowjackets are yellow and black or white and black. Workers are about half an inch long, with a stubby, blocky appearance, while queens are twice as long.



## *Life Cycle*

It's no coincidence that we are most aware of yellowjackets as pests during the Indian summer days around September. This is optimum picnic time, and also the time when workers reach maximum size and colonies reach maximum population level. (The German yellowjacket, *Paravespula germanica,* peaks slightly later, in October or November.) This is also the time when new males mate with queens.

After mating, the males die, and the inseminated yellowjacket queens seek shelter. Queens overwinter under loose tree bark, roof shakes, or other protected locations, emerging in spring to begin the cycle again.

Queens emerge during the first warm days of spring (as early as March, usually May), select a nest site, and build a small paper-like nest in which they lay their eggs. When the eggs hatch, the queen feeds the young larvae for about 18 to 20 days, after which the larvae pupate, then emerge later as small, infertile females called workers. Once the first five to seven workers appear, they begin rearing and feeding the brood. The queen is rarely seen outside the nest after this time.

When colony populations peak in late summer, reproductive cells are built in the nest and new males and queens are produced, which emerge and mate.

## *Controlling Yellowjackets*

If you want to avoid problems with yellowjackets, don't encourage their presence. Foraging yellowjackets are attracted to sweets and meat, so keep garbage cans and dumpsters covered, keep summertime sweets under wraps, and clean up spills (soda pop, etc.) promptly.

Keep an eye out for nests, which can be either overhead (e.g., in trees, sheds, or under eaves of houses) or underground. Avoid dining or placing garbage near those areas. Nests are abandoned by the colony each year, and they usually disintegrate over the winter months, so removal is not necessary. Because they could serve a a winter home for other pests, it might be wise to remove nests in your attic or eaves after the yellowjackets are gone for the season.

Mechanical controls at picnics generally involve an attractant such as fresh meat or fish hung over a basin of water to which a surfactant such as dishwashing liquid has been added. Yellowjackets tend to strip off a piece of food too large for them to carry, causing them to fall into the water, where the detergent helps saturate them and cause them to drown. A drawback to meat-baited traps is the need to change the bait daily; yellowjackets are not attracted to rotting meat, and vertebrate pests are.

Synthetic attractants are available as well. Most formulations attract a narrow range of species, but a new formulation patented July 2000, using acetic acid and isobutanol, seems attractive to a range of species including *Vespula germanica* (German yellowjacket) and *V. pensylvanica* (western yellowjacket). This new chemistry is expected to be commercially available within the next year.

When yellowjackets are present, chemical controls can be used including various pyrethroids such as cyfluthrin or cypermethrin. Spray into the entrance hole of either aerial or subterranean nests after dark, when most of

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# Yellowjackets, cont.

**Excerpted from the work of Drs. Roger D. Akre and Arthur L. Antonelli, WSU**

the insects have returned to the nest, then saturate the nest. Do not plug the entrance hole. Use of pesticides does not negate the need to discourage yellowjackets from returning.

### *Ask the Experts*

Further information on specific controls for your area can be obtained through your county extension agent. Pesticides registered for use in Washington and Oregon are listed in the Pesticide Label Database on the Pesticide Information Center On-Line (PICOL) website, **http://picol.cahe.wsu.edu**. If you have any doubts about performing pest control operations yourself, contact a pest control professional.

*This information was adapted from Washington State University Cooperative Extension Bulletin EB0643,* Yellowjackets and Paper Wasps, *revised June 1997, by Dr. Roger D. Akre (deceased) and Dr. Arthur L. Antonelli of the WSU Puyallup Research and Extension Center. For questions about pest control, contact your county extension agent or a pest control professional.*

# PNN Update

The Pesticide Notification Network (PNN) is operated by WSU's Pesticide Information Center for the Washington State Commission on Pesticide Registration. The system is designed to distribute pesticide registration and label change information to groups representing Washington's pesticide users.

PNN notifications are available on our web page. To review those sent out in July, either access the PNN page via the Pesticide Information Center On-Line (PICOL) Main Page, **http://picol.cahe.wsu.edu/,** or directly, at **http://www.pnn.wsu.edu/**.

We hope that this new electronic format will be useful. Please let us know what you think by submitting comments to Jane Thomas at (509) 372-7493 or **jmthomas@tricity.wsu.edu**.

# Pesticide Applicator Training

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 2000 will be offered on November 7 and 8 in Pasco and November 14 and 15 in Lynnwood. A Spanish course will be offered in Pasco November 7. For more information or registration, call (509) 335-2830, e-mail **pest@cahe.wsu.edu**, or see the website at **http://pep.wsu.edu/education/educ.html.**

A full schedule of 2001 courses will be available soon. Watch the website and this newsletter.

# Federal Register Excerpts

***In reviewing the July postings in the Federal Register, we found the following items that may be of interest to the readers of*** **Agrichemical and Environmental News.**

In the July 12 Federal Register, EPA announced the availability of the revised version of the pesticide science policy document "Available EPA Information on Assessing Exposure to Pesticides in Food--A User's Guide." An electronic copy of this document is available on the following URL under "What's New:" **http://www.epa.gov/pesticides/**. (Page 43009)

# Tolerance Information



| Chemical (type) | Federal Register | Tolerance (ppm) | Commodity (raw) | Time-Limited | | |
|---|---|---|---|---|---|---|
| | | | | Yes/No | New/Extension | Expiration Date |
| methoxyfenozide (insecticide) | 07/05/00 Page 41355 | 7.00 | apple pomace, wet | No | N/A | N/A |
| | | 0.02 | milk | | | |
| | | 0.10 | fat of cattle, goats, hogs, horses, sheep | | | |
| | | 0.02 | meat of cattle, goats, hogs, horses, sheep | | | |
| | | 1.50 | pome fruits | | | |
| | | 0.10 | liver of cattle, goats, hogs, horses, sheep | | | |
| | | 0.02 | mbp of cattle, goats, hogs, horses, sheep | | | |
| fludioxonil (fungicide) | 07/06/00 Page 41601 | 2.00 | strawberries | Yes | Extension | 05/31/01 |
| Comment: This time-limited tolerance is being extended in response to EPA again granting an emergency exemption for the use of this compound on South Carolina strawberries. | | | | | | |
| tebufenozide (insecticide) | 07/06/00 Page 41594 | 3.00 | grapes (wine) | Yes | New | 12/31/01 |
| Comment: This time-limited tolerance is being established in response to EPA granting a Section 18 emergency exemption for the use of tebufenozide to control omnivorous and grape leafrollers in California wine grapes. | | | | | | |
| bifenthrin (insecticide) | 07/12/00 Page 42863 | 3.00 | lettuce, head | No | N/A | N/A |
| | | 0.50 | peppers | | | |
| | | 0.20 | grapes | | | |
| | | 1.00 | caneberry subgroup | | | |
| pyridaben (insecticide) | 07/14/00 Page 43704 | 0.50 | apple | No | N/A | N/A |
| | | 0.75 | apple, wet pomace | | | |
| | | 0.05 | apricot | | | |
| | | 0.05 | fat, meat, and mbp of cattle, goats, hogs, horses, and sheep | | | |
| | | 0.05 | cherry | | | |
| | | 1.50 | grape | | | |
| | | 0.01 | milk | | | |
| | | 2.50 | nectarine | | | |
| | | 0.05 | nut, tree crop group | | | |
| | | 2.50 | peach | | | |
| | | 0.75 | pear | | | |
| | | 2.50 | plum and prune | | | |
| | | 0.50 | cranberry (see comment) | | | |
| Comment: The tolerance for cranberry is a regional tolerance and is limited to the states of Maine, New Jersey, Rhode Island, Massachusetts, New York, Connecticut, New Hampshire, Vermont, and Delaware. | | | | | | |
| tebuconazole (fungicide) | 07/18/00 pg. 44472 | 0.10 | garlic | Yes | Extension | 12/31/01 |
| Comment: This time-limited tolerance is being extended in response to EPA again granting a Section 18 exemption for the use of tebuconazole on garlic for control of rust in Arizona, California, and Nevada. | | | | | | |

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# Tolerance Info, cont.

| Chemical (type) | Federal Register | Tolerance (ppm) | Commodity (raw) | Time-Limited | | |
|---|---|---|---|---|---|---|
| | | | | Yes/No | New/Extension | Expiration Date |
| trifloxystrobin (fungicide) | 07/18/00 pg. 44447 | 11.00 | dried hop cones | No | N/A | N/A |
| | | 5.00 | aspirated grain fractions | | | |
| | | 0.50 | fruiting vegetables | | | |
| | | 0.04 | potato tubers | | | |
| | | 0.40 | sugar beet, dried pulp | | | |
| | | 0.20 | sugar beet, molasses | | | |
| | | 0.10 | sugar beet, roots | | | |
| | | 4.00 | sugar beet, tops | | | |
| | | 0.15 | wheat, bran | | | |
| | | 0.30 | wheat, forage | | | |
| | | 0.05 | wheat, grain | | | |
| | | 0.20 | wheat, hay | | | |
| | | 5.00 | wheat, straw | | | |
| vinclozolin (fungicide) | 07/18/00 pg. 44453 | 2.00 | beans, succulent | | | 09/30/03 |
| | | 1.00 | canola | | | |
| | | 0.05 | milk | | | |
| | | 0.10 | poultry fat, meat, MBP | | | |
| | | 0.05 | eggs | | | |
| | | 0.05 | meat, fat, and mbp of cattle, goats, hogs, horses, and sheep | | | |
| Comment: EPA has established these as time-limited tolerances due to outstanding data requirements. | | | | | | |
| azoxystrobin (fungicide) | 07/19/00 pg. 44696 | 10.00 | strawberry | Yes | Extension | 12/30/01 |
| | | 0.20 | soybean forage | | | |
| | | 1.00 | soybean hay | | | |
| | | 2.00 | soybean hulls | | | |
| | | 0.30 | soybean meal | | | |
| | | 2.00 | soybean oil | | | |
| | | 0.10 | soybean seed | | | |
| | | 2.00 | soybean silage | | | |
| | | 0.05 | sugar beet root | | | |
| | | 1.00 | sugar beet, dried pulp | | | |
| | | 0.70 | sugar beet, molasses | | | |
| | | 0.70 | sugar beet, refined sugar | | | |
| Comment: These time-limited tolerances are being extended in response to Section 18 requests made to EPA to extend the use of azoxystrobin for the control of anthracnose on Florida strawberries, cercospora leafspots on Minnesota sugar beets, and for the control of aerial blight on Arkansas soybeans. | | | | | | |
| pendimethalin (herbicide) | 07/19/00 pg. 44694 | 0.10 | fresh mint hay | Yes | Extension | 12/31/01 |
| | | 5.00 | mint oil | | | |
| Comment: These time-limited tolerances are being extended in response to Section 18 requests from Idaho, Oregon, South Dakota, Utah, and Washington for the use of pendimethalin on mint for control of kochia and redroot pigweed. | | | | | | |
| imidacloprid (insecticide) | 07/27/00 pg. 45922 | 0.10 | strawberries | Yes | Extension | 06/30/02 |
| | | 1.00 | legume vegetables (crop group 6) | | | |
| Comment: These time-limited tolerance are being extended in response to Section 18 requests made to EPA to extend the use of imidacloprid for the control of silverleaf whitefly on succulent beans (part of the legume vegetable crop group) grown in Georgia and on California strawberries. | | | | | | |