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Riparian Buffer Zones

Summer 2000 Field Study Results

Dr. Douglas B. Walsh with Ron Wight, IAREC, WSU

In the November 1999 *Agrichemical and Environmental News* (Issue No. 163) I published an article "Implications of Buffer Zones on Agricultural Lands: Impacts on Beneficial and Pest Organisms." In that essay, I detailed how regulations resulting from the Endangered Species and Clean Water acts could impact 75% of the land area in Washington State. Key to many federal and state plans that promote salmon recovery is the establishment of riparian buffer zones. Perhaps we can assume that salmon recovery can be achieved through restoration of riparian habitat, but I pointed out in my essay that little consideration has been directed towards what impact the establishment of these buffer zones would have on terrestrial arthropods. I postulated that the plants that persist in rehabilitated riparian zones would affect the population dynamics of the arthropods inhabiting the buffer zones.

In that same article, I reported on an extensive literature search I had conducted on the arthropod pests that have been associated with "native" plants recommended for use in rehabilitating riparian buffer zones (3, 4). My conclusion stated,

> "How the imposition of long, narrow tracts of land planted in native and naturalized weedy plant species will effect beneficial and pest arthropod abundance is yet to be determined. From experience, I think it will lead to greater populations of Lygus bugs and other generalist pests. However, I believe that it will lead to greater populations of beneficial arthropods as well."

Field Trials, Summer 2000

During the summer of 2000 we tested my hypothesis by establishing two field research sites along the banks of Spring Creek near the Irrigated Agriculture Research and Extension Center (IAREC) of Prosser, in Benton County. Spring Creek is a tributary of Snipes Creek. Snipes Creek in turn flows into the Yakima River several miles upriver from Benton City (Figure 1, page 2). The Benton County Conservation District had rehabilitated the riparian study areas along Spring Creek in 1995. Trees had been planted, and grazing by livestock had been curtailed. Unfortunately most of the trees at both sites had been killed or severely damaged by

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Buffer Zone Research, cont.

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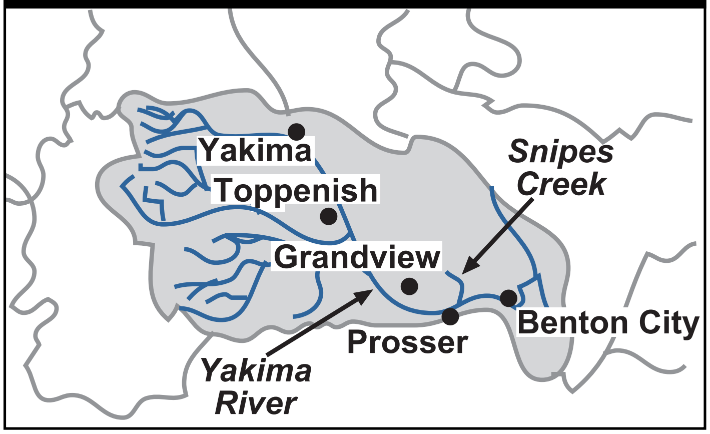
FIGURE 1

Lower Yakima River drainage.



what appeared to be beavers or porcupines. We named each site in reference to the nearest cross streets, Crosby and McCreaddie (Figure 2). The sites are a little over a mile apart. The Crosby site has not been maintained. Infestations of Canada thistle, Kochia, and perennial pepperweed were among a number of introduced (and noxious) flowering weeds that were established at this site. The McCreaddie site had been maintained through selective weed control. Bunchgrasses were the dominant plant type. Both field sites were surrounded by irrigated agriculture. Apples, wine grapes, and hops are the main crops produced along these sections of Spring Creek.

Plot Design

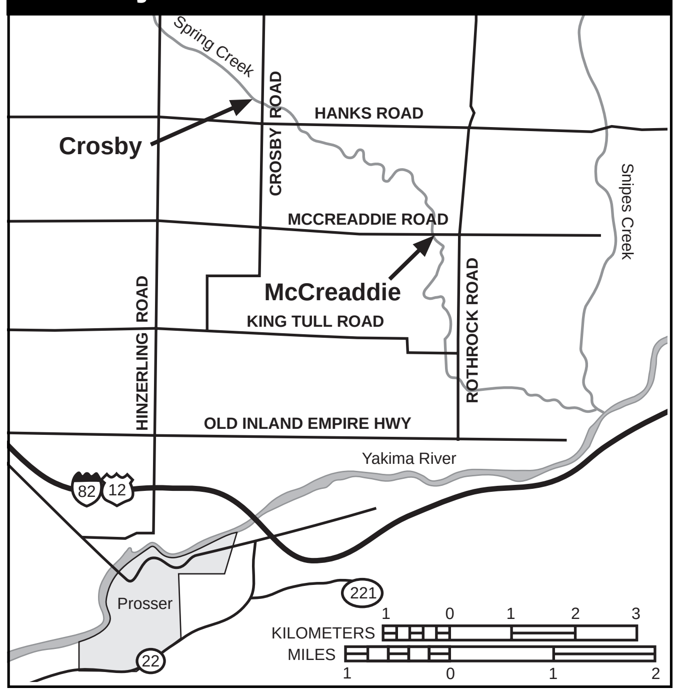
At each site we established a 180-foot grid with Spring Creek serving as the center line (Figure 3). Within this grid we established eighteen survey stations—six stations placed within five feet, thirty-five feet, or seventy-five feet of the stream bank (Figure 3). On 21 July and 16 August 2000 we sampled the insect fauna at each of the eighteen stations at both sites using an insect sweep net as detailed by Snoddgrass (5). Additionally, we placed four-inch, modified beverage cup pitfall traps at each station at both sites on July 21. The pitfall traps were placed in four-inch holes dug with an auger. Each trap was a twenty fluid ounce plastic beverage cup with several ounces of an ethylene glycol mixture in the bottom. The traps were left in the field for three days and then removed. Insects, spiders, pillbugs, and several voles fell into the traps and drowned. The contents of the pitfall traps were then transported back to the lab where the arthropods captured were identified and quantified.

Sweep-Net Surveys

Analysis of variance (ANOVA) from the sweep-net surveys (Table 1) determined that there were highly significant ($p<0.01$) differences in the population abundance of Lygus bugs, grasshoppers, and spiders between the Crosby and McCreaddie sites. Proximity to the water's edge (whether five, thirty-five, or seventy-five feet) was not significant, nor was the relationship of proximity and sample date. Sample date and the interaction of site with sample date were highly significant ($p<0.01$) for Lygus abundance and significant ($p<0.05$) for grasshoppers. The results determined that we could not pool sample dates, therefore we ran separate ANOVAs for each of the sample dates for each of the insect groups studied

FIGURE 2

Crosby and McCreaddie research sites.



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Buffer Zone Research, cont.

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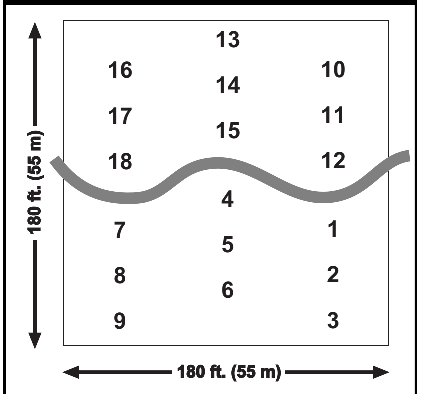
FIGURE 3

Research Station Layout.



(Table 2). Spiders proved to be somewhat different, but conservatively we chose to analyze spider population abundance separately by sample date.

Lygus

Lygus were the predominant insect pest captured in the sweep-net surveys. Significantly greater (*p*<0.01) population of Lygus bugs were present at the Crosby site than at the McCreaddie site on both dates.

Grasshoppers

Grasshopper population was significantly greater (*p*<0.01) at the Crosby site than the McCreaddie site on 21 July, but populations declined dramatically at the Crosby site by 16 August.

Spiders

While crab spiders were the predominant species caught in sweep-net surveys, we pooled all spider species in our analysis. On both sample dates of 21 July and 16 August spider populations were significantly greater (*p*<0.01) at the Crosby site than at the McCreaddie site.

TABLE 1

Analysis of variance results of sweep net samples, mean square values for site (McCreaddie vs. Crosby), proximity to water (< 5, 35, or 75 feet) date sampled (July 21 or August 16) and the interaction of these factors.

	df	Lygus	Grasshoppers	Spiders
Site (S)	1	1081**	5.6**	138.9**
Proximity (P)	2	141	1.3	3.6
Date (D) sampled	1	325**	5.6**	0.1
S * P	2	67	0.5	3.8
S * D	1	317**	3.6*	8
P * D	2	30	1.1	12.8
S * P * D	2	28	1.1	20.4*
Error	60	40	0.7	5.2

*/ significant at p<0.05, **/ significant at p<0.01

Pitfall Traps

Pitfall trap ANOVA results between site and proximity to water's edge determined that proximity to the water's edge was not significant (Table 3). This finding permitted us to pool all samples from each site in a comparative analysis between the two sites for arthropod abundance surveys. The three main arthropod types we captured in the pitfall traps were ground beetles, grape leafhoppers, and spiders.

Ground Beetles

Population of ground beetles was significantly (p<0.05) greater at the Crosby site than at the McCreaddie site (Table 4). On average we captured nearly 16 ground beetles per trap at the McCreaddie site compared to about 5 at the Crosby site.

Grape Leafhoppers

Grape leafhopper populations were detected at the Crosby site and not at the McCreaddie site (Table 4).

TABLE 2

Mean square values for site by sample date and Lygus, grasshopper, and spider population estimates using a sweep-net sampling technique.

		Lygus (±SE)		Grasshoppers (±SE)		Spiders (±SE)	
	df	21-Jul	16-Aug	21-Jul	16-Aug	21-Jul	16-Aug
Site	1	1284**	113.7**	9.0**	0.11ns	40.1**	106.7**
Error	34	74	7.8	1.2	0.26	4.4	7.12
Crosby		12.0±2.7a	3.6±0.9a	1.3±0.3a	0.3±0.1	3.3±0.6a	3.9±0.9a
McCreaddie		0.1±0.1	0	0.3±0.1	0.2±0.1	1.2±0.3	0.4±0.2

**/ Significant at *p* <0.01

a/ Population abundance at Crosby site was significantly greater (*p* <0.01) than at McCreaddie site on the respective sample dates in pairwise *t* -tests.

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Buffer Zone Research, cont.

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TABLE 3

Analysis of variance results of pitfall trap samples, mean square values for site (McCreaddie vs. Crosby) and proximity to water (< 5, 35, or 75 feet) and the interaction of these factors .

	df	Ground Beetles	Grape Leafhoppers	Spiders
Site (S)	1	1111.1**	87.1**	981.8**
Proximity (P)	0.2	258.7	8.4	31.4
S * P	0.2	162.7	8.4	26
Error	3	170.8	5.4	52.6

*/ Significant at p <0.05, **/ Significant at p <0.01

Spiders

Population abundance of spiders was significantly greater (p<0.01) at the McCreaddie site then the Crosby site. In contrast to the sweep-net samples in which crab spiders were the main type of spider caught, the main spider type captured in the pitfall traps were jumping spiders (Table 4).

Other Arthropods

Stinkbugs

Substantial populations of stinkbugs were detected in the sweep-net samples at both field sites. However, different species were captured at each site. Southern green stinkbugs were captured at the Crosby site at an average of 0.33 and 0.44 bugs per sweep on 21 July and 16 August respectively. Consperse stinkbugs were captured at the McCreaddie site at an average of 0.11 and 0.22 bugs per sweep on 21 July and 16 August respectively. No consperse stinkbugs were captured at the McCreaddie site and no southern green stinkbugs were captured at the Crosby site. Both of these stinkbug species are of concern to tree fruit producers in Washington State.

Generalist Predators

Several generalist predators were also observed at both field sites. These included ladybird beetles, minute pirate bugs, and big-eyed bugs. There were no statistically significant differences between sample sites, but populations of these three generalist predators tended to be greater at the Crosby site than the McCreaddie site.

Discussion

Lygus bugs were the main insect pest detected in our surveys. Lygus are native pests to the western United States. Table 5 details the agronomic crops on which Lygus are considered an economic pest in the Pacific Northwest (2) and Table 6 lists some of Lygus' many hosts.

We believe that the greater abundance of exotic flowering weedy plants at the Crosby site enabled Lygus to persist in greater populations there than at the McCreaddie site, where the dominant plant type was bunchgrass. Our results support our hypothesis that improperly maintained riparian buffer strips--those with no weed control whatsoever--will result in increased abundance of generalist pests like the Lygus bug.

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TABLE 4

Mean square values for ground beetle, grape leafhopper, and spider population estimates using a pitfall trap over three days (21-24 July).

	df	Ground Beetles (±SE)	Grape Leaf-hoppers (±SE)	Spiders (±SE)
Site	1	1111**	87.1**	982**
Error	3.4	17.5	5.8	5
Crosby		15.83±4.2[a]	3.11±0.8[b]	2.83±0.3[c]
McCreaddie		4.72±1.3	0	13.28±2.3

*/ Significant at p <0.05; **/ Significant at p <0.01; a/ Population abundance at Crosby site was significantly greater (p <0.05) than at McCreaddie site on the respective sample dates in pairwise t-tests; b/ Population abundance at Crosby site was significantly greater (p <0.005) than at McCreaddie site on the respective sample dates in pairwise t -tests; c/ Population abundance at Crosby site was significantly smaller (p <0.005) than at McCreaddie site on the respective sample dates in pairwise t -tests.

Buffer Zone Research, cont.

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TABLE 5

Crops with controls recommended for Lygus in the Pacific Northwest Insect Control Handbook.

Dry beans
Lima beans
Snap beans*
Lentils*
Potatoes*
Sugar beets
Strawberries*
Caneberries
Spinach
Apples*
Peaches
Pears*
Apricots*
Prunes
Plums
Several vegetable seed crops
Forage crop seeds (alfalfa)*

***/ Crops commercially produced within one mile of Crosby and/or McCreaddie site.**

Grape leafhoppers have been observed inhabiting alternative host plants in central Washington, but the range of alternate hosts has not been determined (1). It was interesting for us to observe grape leafhoppers at the Crosby site and not the McCreaddie site. Since the grape leafhoppers were captured in the pitfall traps it is difficult for us to determine the plant species with which they were associated. However, we can note that a wine grape vineyard was directly adjacent to the McCreaddie site, but not the Crosby site where the leafhoppers were actually captured.

Ground beetles are effective generalist predators in several agricultural systems. It was not surprising to observe substantial populations had developed in these riparian buffer zones. Their presence, along with an increased abundance of other generalist predators, could prove to be a positive influence on pest control in adjacent agricultural production fields.

Conclusion

It is readily apparent that agricultural producers will have to be proactive in the vegetation management of riparian buffer zones on their property to prevent infestations of pests like Lygus. We hope to expand our efforts this coming summer season to help identify plant types that could have a positive effect on populations of beneficial arthropods without promoting populations of pest arthropods.

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TABLE 6

Common weed hosts for Lygus.

Wild radish
Mustards
Chickweed
Filaree
Redmaids
Shepherdspurse
Lupines
Burclover
Canada thistle
Curly dock
Smartweed
Knotweed
Lambsqurters
Pigweed
Common groundsel
Pineappleweed
Kochia
Perennial pepperweed

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Herbicide Tolerant Genes, Part 2
Giddy 'bout Glyphosate

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

Over the past eight months, I've been using these pages to examine the science behind transgenic crops in light of public perception of the dangers of these technologies. In March, April, May, and June's issues, I looked at insecticidal genes, namely, the *Bacillus thuringiensis* (Bt) genes that have been incorporated into certain production crops. In September, I turned to focus on crops that have been engineered to contain herbicide-tolerant genes—products like Roundup Ready (RR) corn, soybeans, cotton, and canola. In that essay, I laid out the scientific principles behind the transgenic technology, and addressed three concerns about herbicide-tolerant crops, namely:

- whether engineered RR genes have unintended effects on other plant genes or traits;
- whether plant metabolism is sufficiently affected to produce new toxic proteins or allergens; and
- whether RR crops are nutritionally equivalent to traditionally bred crops.

These three concerns are similar to those expressed regarding the insect-resistant Bt transgenic crops. But herbicide-tolerant crops face another hurdle for public acceptance. If acres of corn and soybeans are bulletproof to glyphosate (Roundup), won't wholesale aerial spraying ensue? And won't that make us all sick? Some claim we just don't know enough about glyphosate. When industry advocates claim we do, the frequent retort is, "Yeah, that's what they said about DDT."

I'm willing to bet most people who cite Rachel Carson's *Silent Spring* (3) and its landmark indictment of DDT never actually read the book; if they had, they would have seen its references to scientific articles about DDT's hazards dating back to the late 1940s and 1950s, at least 15 years before *Silent Spring*'s publication. Similarly, an incredible amount of information has been collected about glyphosate over the last 20 years (7, 9, 14,15, 17).

Of course critical analyses of the scientific literature have never stopped scary pronouncements about doom on certain websites. The following concerns about glyphosate use have repeatedly appeared on a number of environmental advocacy group (EAG) websites. The concerns seem to be a recycling of a lot of information in a pesticide factsheet that appeared in the Northwest Coalition for Alternatives to Pesticides' (NCAP's) *Journal of Pesticide Reform* (4).

- Glyphosate and its formulation, Roundup, cause systemic toxicity.
- Glyphosate is hazardous to workers.
- Glyphosate causes mutations and cancer.
- Glyphosate adversely affects reproduction.
- Glyphosate poses ecological hazards to soil microorganisms, invertebrates, fish, and wildlife.
- Hazard will increase significantly due to widespread use of glyphosate on transgenic crops.
- The data used by the EPA to determine glyphosate's hazards can't be trusted because it comes from industry.

Let's take a look at these concerns in light of the volumes of available data.

Framework for Assessing Safety

The above laundry list of concerns could apply to any chemical used at work or at home and released into the environment. Some of them are true. For example, at some doses glyphosate does cause systemic toxicity (i.e., adverse effects on internal organs and physiological systems). But knowing that tells us nothing about the probability of real-life adverse effects from using glyphosate and from inadvertent exposures like spray drift. To determine the validity of EAG concerns and aid a decision about safety, glyphosate and its formulation Roundup must be judged in the context of a risk assessment procedure.

Risk assessment consists of four basic information-gathering activities:

1. characterization of hazards;
2. determination of the relationship between dose and response;
3. assessment of exposure; and
4. integration of the above information to characterize risk (i.e., probability of an adverse effect).

As will be shown, many of the concerns expressed by EAGs over pesticide use stem from myopic attention to

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hazard characterization without integrating dose-response relationships for specific biological effects and real-world exposures. Determining whether exposure to a pesticide poses a high or low risk under specific conditions is as much dependent on what regulatory agencies "feel" is an acceptable risk (a social decision) as it does on the magnitude of exposure (measured or otherwise estimated).

Dose Makes the Poison

EPA characterizes risk of adverse health effects by comparing estimated pesticide exposures to its Reference Dose (RfD). The RfD, which is expressed as milligrams of pesticide per kilogram of body weight per day (mg/kg/day), is defined as an exposure with reasonable certainty of no harmful effects after a single (acute) or lifetime daily (chronic) exposure. The hazard characterization process is very important to development of the RfD. Knowing the dose at which an effect occurs is as important as characterizing the effect itself. EAGs are fond of pointing out that glyphosate and other pesticides cause illness with symptoms like nausea, vomiting, and depressed blood enzymes. What they don't tell you are the doses that cause no harm.

When a compound is of very low toxicity, like glyphosate, a lot of it can be fed to rodents before they keel over and die. Short of death, however, some serious injury can occur. For example, glyphosate causes death to 50% of rats tested at an oral dose above 5000 mg/kg (17) (Table 1, oral LD_{50}). To put that exposure into perspective, consider that vitamin A has a body-weight-adjusted LD_{50} of nearly 2000 mg/kg, table salt (sodium chloride) has an LD_{50} of about 3500 mg/kg, and the caffeine in coffee and soft drinks has an LD_{50} of about 200 mg/kg. In short, glyphosate is not a very potent toxin, whether exposure occurs by ingestion or by skin contact (Table 1, dermal LD_{50}).

One of the tricks that EAGs use to make glyphosate and other pesticides look very hazardous is to recite the litany of hazards from Material Safety Data Sheets (MSDS). The MSDS is meant to provide workers with information about the potential hazards when handling chemicals in comparatively pure or highly concentrated forms. Workers face the greatest risk of being excessively exposed to concentrated pesticide formulations. The MSDS is misused when its stated hazards are used to characterize biological effects from exposure to environmental levels of pesticide residues (5).

How High Can You Go?

The information in the MSDS comes from the manufacturers' databases of toxicity studies. Glyphosate testing for systemic toxicity is an excellent example of the cliché "at some dose everything is a poison." In a subchronic toxicity study, rats were fed daily for three months a diet containing 0, 1000, 5000, or 20000 ppm of glyphosate. At a concentration of 20000 ppm, glyphosate would constitute 2% of the total weight of the diet! Based on the amount of food the rats ate each day and their body weights, the average dose to both males and females was 0, 74, 361, and 1445 mg/kg/day.

In subchronic toxicity tests, just about every organ system and physiological parameter you can imagine are examined for changes relative to a non-dosed group of rodents or dogs. At the highest dose tested (1445 mg/kg) in the glyphosate subchronic test some males, but not females, had pancreatic lesions. Also, levels of blood urea nitrogen and an enzyme called serum alkaline phosphatase were elevated compared to non-dosed animals. Serum phosphorus and potassium were elevated in all dose groups and glucose was elevated in the mid- and high-dose groups.

TABLE 1

Acute toxicity and potential for eye and skin irritation of glyphosate, some of its formulated products, and the surfactant POEA (modified from 17).

Test Material	Oral LD50 (mg/kg)	Dermal LD50 (mg/kg)	Inhalation LC50 (mg/L)	Eye Irritation	Skin Irritation
glyphosate	4392	5600	not tested	mild	slight
Roundup (41% glyphosate + 15% POEA)	>5000	>5000	3.18	severe	slight
Roundup T/O (18% glyphosate + 7% POEA)	>5000	>5000	>5.7	moderate	nil
Ready to Use (1% glyphosate + 0.4% POEA)	>5000	>5000	>8.9	slight	nil
POEA	1200	1260	not tested	corrosive	severe

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Giddy 'bout Glyphosate, cont.

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The ion and glucose elevations are not necessarily an adverse toxicological effect; rather, they could be related to the chemical properties of the diet when an organic acid like glyphosate is added at such a high concentration. Such effects of diet composition were hypothesized to be responsible for salivary gland lesions in rats fed doses between 200 and 3300 mg/kg (17). Only the parts of the salivary gland responsible for secretions stimulated by acid foods (think citrus products) were affected, suggesting that the high concentrations of glyphosate substantially changed the pH of the food. Such an effect is best described as a physical irritation rather than a toxicological effect, especially when no other systemic effects were observed (17).

TABLE 2

No Observable Adverse Effect levels (NOAELs) for glyphosate, its metabolite AMPA, and the Roundup surfactant POEA (15, 17).

Toxicity Endpoint	No Observable Adverse Effect Level (NOAEL, mg/kg/day)		
	Glyphosate	AMPA	POEA
Subchronic Systemic	209	263	36
Chronic Systemic	409	>2.8	-
Developmental	175	400	300
Reproductive	694	>4.2	-
Carcinogenicity[1]	Negative	Negative	Negative
Endocrine Disruption[2]	Negative	Negative	Negative
Neurotoxicity	Negative	Negative	Negative
EPA Reference Dose[3]	2	-	-

[1]EPA has classified glyphosate as class E, non-carcinogenic for humans.

[2]Glyphosate was tested in an in-vitro assay and found negative for the ability to interact with estrogen receptors; the findings for AMPA and POEA are based on the lack of any endocrine modulation effects in developmental studies and two- or three-generation reproduction studies.

[3]The reference dose (RfD) was set by EPA based on an NOAEL of 175 mg/kg for maternal toxicity in a developmental toxicity study; no effects on fetal development were noted at doses of 1000 mg/kg.

Ironically, the effects noted in the subchronic toxicity studies were not observed in the same species of rat fed for two years doses of 0, 101, 410, and 1062 mg/kg. In this chronic toxicity study, effects were seen only at the high dose, and they consisted of a comparative decrease in body weight, increased incidence of cataracts and lens abnormalities (males only), decreased urinary pH, and increased liver weight (17). Although the high dose didn't kill the rats, it was a substantial percentage of the LD_{50}.

Together with information from tests for eye and skin irritancy of glyphosate, the observations from the subchronic and chronic toxicity studies would be incorporated into an MSDS. But neither the MSDS nor the NCAP article mention there was a dose at which no effect occurred (called the NOAEL or No Observable Adverse Effect Level, Table 2). To put the magnitude of the 409 mg/kg chronic toxicity NOAEL in perspective, if glyphosate was pelleted as is regular strength aspirin (350 mg per tablet), then 82 tablets could be consumed each day without effect. Obviously, that is not something you want to try at home.

Other types of effects, including neurotoxicity and developmental and reproductive toxicity, are also studied at extremely high doses administered to rats daily for long periods of times. Always bear in mind that the doses are chosen to be below lethal levels yet to be high enough to cause a definitive effect. For regulatory purposes, at least one dose should be low enough to not cause any effect.

The NOAELs from a variety of glyphosate toxicity tests are shown in Table 2. Despite the high doses fed to rodents, glyphosate was not neurotoxic nor did it adversely affect fetal development or reproductive performance. These latter two tests are probably the most sensitive way to test for effects on the endocrine system because they are geared to detecting subtle changes in hormonal modulation and a variety of endocrine-sensitive endpoints (2). If glyphosate were a so-called "endocrine disrupter," then reproductive physiology and fetal development would likely have been affected.

What about Worker Poisonings?

Several interesting tidbits regarding human glyphosate exposures have been repeated on EAG websites. Citing statistics from California, the authors have ranked glyphosate third in number of worker exposures reported to health authorities. However, when normalized for the number and amount of applications, glyphosate incidences fall out of the top ten. Furthermore, complaints were often recorded in one of several categories of

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Giddy 'bout Glyphosate, cont.

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likelihood of cause and effect. Many recorded cases fell into the category of suspected illness, but little evidence was gathered to confirm such classification and whether glyphosate exposure had actually occurred (17).

The vast majority of the complaints about glyphosate relate to skin and eye irritation (15). As discussed beginning on page 10, the surfactants in any kind of product can be irritating, but such an effect is a physical injury, not systemic toxicity.

Pharmacokinetics—The Secret Behind Glyphosate's Low Toxicity

The secret to understanding why dose makes the poison is pharmacokinetics, a fancy word for describing what happens to a chemical and how fast it happens after we are exposed. To understand the toxicity of a pesticide, we need to understand its basic chemistry and answer the following questions:

- How much is absorbed via skin and intestines?
- How fast is the chemical distributed in the body?
- How quickly is the chemical detoxified?
- How quickly is it eliminated from the body?
- What is the nature of the metabolic products?

EAG websites like to portray glyphosate as an organophosphate (OP) compound (it has one phosphorous atom in it) because this links it to the controversial OP insecticides infamous for their effects on the nervous system. The formal chemical name of glyphosate, N-phosphono methylglycine tells the real story—glyphosate is actually an amino acid related chemically to glycine, one of the amino acids synthesized by our body. One of the known environmental breakdown products of glyphosate is AMPA (aminomethyl phosphonic acid), which is eventually broken down by microbes into glycine. Because AMPA residues may be in food, we also need to understand how the body processes this metabolite.

Glyphosate and AMPA are poorly absorbed by the skin and intestine. Studies with human skin preparations and live monkeys indicate that at most 2% of a dermal dose actually enters the body (16). The lack of glyphosate penetration of the skin allows it to be easily washed off with soap and water. After oral exposure, the intestine can absorb less than 35% of the glyphosate dose.

Of the dose of glyphosate or AMPA that makes it into the blood, nearly 99% of it is excreted in the urine within 24 hours (16). For oral doses, most of the elimination is in the feces, largely because glyphosate is so poorly absorbed across the intestines.

Although plants and soil microorganisms have the ability to degrade glyphosate to AMPA, mammals don't. Thus far, no one has been able to find any biotransformation products of glyphosate in mammalian tissue. At reasonable exposure levels, glyphosate seems not to be capable of interacting with any mammalian enzymes or physiological receptors. In short, animals lack the EPSPS enzyme that glyphosate inhibits in plants (6), disrupting their ability to make aromatic amino acids.

TABLE 3

Aggregate exposure (mg/kg/day) of children (1 – 6 years old) to glyphosate, the metabolite AMPA, and the Roundup surfactant POEA (modified from 17).

Type of Exposure	Glyphosate		AMPA		POEA	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Dietary	0.058	0.058	0.01	0.01	0.026	0.026
Drinking Water	0.001	0.001	0.001	0.001	0.001	0.001
Application	0	0	0	0	0	0
Re-entry	0.026	0	0	0	0.065	0
Spray Drift	0.538	0	0	0	0.9	0
Aggregate (sum of all types)	0.623	0.059	0.011	0.011	0.992	0.027
Aggregate[1] (10X dietary exposure)	1.145	58.1	0.105	0.105	1.226	0.261

[1]To account for increased usage of glyphosate products on Roundup Ready crops, this aggregate exposure was also calculated, assuming a very conservative 10x more dietary exposure.

Cranky Concerning Cancer

"It causes cancer" is an old battle cry applied by EAGs in opposition to the use of nearly

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Giddy 'bout Glyphosate, cont.

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every pesticide. The EPA wrangled for many years about how to classify the carcinogenic potential of glyphosate. In two-year rodent dietary exposure studies with daily doses ranging to well over 1000 mg/kg/day, occasional tumors would be found, but they were not dose related. In other words, animals at the lower doses would have tumors that animals at the higher doses did not. When an effect is noted without a relationship to dose, toxicologists usually dismiss it as random chance. After all, animals not fed glyphosate also develop tumors occasionally. After an independent panel under the auspices of the EPA's Scientific Advisory Panel reviewed one of the more perplexing studies, EPA finally classified glyphosate in Group E: "Evidence of non-carcinogenicity for humans" (15).

Nevertheless, making the circuit around EAG websites this past year was the proclamation that new evidence showed glyphosate causes cancer. The "new" evidence was an epidemiological study in Sweden linking increased risk for non-Hodgkin's lymphoma (NHL) to glyphosate use (8). A negative critique of the study has already been published (1). The data and conclusions of the Swedish study bear examination to illustrate how easy it is to mischaracterize the results of epidemiological studies with pesticides and their general unreliability for risk assessment.

First, the Swedish study's data showing an association between NHL and glyphosate was based on self-reporting of pesticide use among the study population. The subjects, who developed NHL during 1987-1990, were interviewed during 1993-1995 about pesticide use that may have occurred as long as 40 years ago. The vast majority of interviewees had used the subject pesticides between the 1970s and 1980s. These types of subject surveys are common but they depend on recall of activities perhaps a decade or more earlier. When the subjects were deceased, their next of kin were requested to provide the exposure history.

A second problem with the Swedish study is that the conclusions ignored the fact that the association between glyphosate use and incidence of NHL was not even statistically significant. The key word is association, because epidemiology studies of chemicals cannot tell us anything about cause and effect.

Finally, the Swedish study ignores the very low potential of glyphosate to penetrate the skin even if a worker was exposed (11, 16). Furthermore, glyphosate has failed to produce dose-related tumors in experimental animals, and numerous studies of its mutagenic potential have failed to even prove it is a mutagen or can cause chromosomal aberrations (14, 15, 17). In short, the Swedish study made faulty conclusions that were not supported by the available data.

Rabid Regarding Reproduction

Until recently, epidemiology studies like the one from Sweden have focused almost solely on linking pesticides with cancer. Today, however, endocrine disrupters are demanding equal attention. Epidemiological studies of pregnancy outcome (for example, miscarriages, preterm births) and chemical exposure are being increasingly reported. Despite glyphosate not showing any evidence of effects on fetal development nor reproduction over three generations in rodent studies, one epidemiology study of reproductive outcome among couples living on farms in Ontario, Canada, has been invoked as the "smoking gun" for causing pregnancy problems (4, 13).

This Canadian reproduction study suffers from the same problems as the attempts to link glyphosate use with NHL—namely subject recall of distant exposures and failure to consider the low absorption potential of glyphosate. The results depicted in the NCAP glyphosate fact sheet that showed an increased rate of miscarriages in association with glyphosate exposure were misinterpreted (4). In fact, the correct risk parameter to examine, the odds ratio, was ignored, probably because it leads to the proper conclusion that an association between pregnancy outcome and glyphosate exposure was not statistically significant.

Silly Over Surfactants

One of the ironies of a compound with toxicity as low as exhibited by glyphosate is that more attention is paid to its formulation. In fact, organizations like NCAP have been screaming for a long time about the toxicity of inert ingredients in pesticide formulations. Mammalian and ecotoxicology studies of Roundup formulations and some of their more prominent inerts have been comparatively well studied. The most common inert in

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Giddy ’bout Glyphosate, cont.

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

Roundup is a surfactant called POEA (polyethoxylated tallow amine, a.k.a. polyoxyethyleneamine). POEA is added to Roundup formulations at a concentration of approximately one-third that of glyphosate.

Surfactants are added to pesticide formulations both to help solubilize the active ingredient in water as well as to help “spread” the spray droplets across a leaf surface for better coverage. Surfactants come in all sizes, shapes, and chemistries but all of them have several properties in common. For example, they all reduce the surface tension of water and they can disrupt the lipid layer of biological membranes. We are exposed to surfactants everyday, unless you refrain from hand washing, hair shampooing, and dealing with dirty dishes.

As is true of any substance, surfactants at high enough doses can cause some nasty effects. However, POEA seems to be nearly as innocuous to mammals as glyphosate itself. The acute oral LD_{50} has been estimated to be as low as 1200 mg/kg (17). One source applied a mathematical technique to the toxicity data for Roundup itself and estimated the acute oral LD_{50} may be 40,000 mg/kg (14)!

An oral dose to rats of 324 mg/kg body weight (4500 ppm in diet) caused intestinal irritation, decreased food consumption, weight gain, and some alteration in serum hematological parameters (17). However, a dose of 36 mg/kg was without adverse reactions. The adverse response at the highest dose is typical for any surfactant because these types of chemicals can irritate tissues by disrupting membranes. Relative to the potential for exposure (whether dietary or from spray drift), even the NOAEL dose is unrealistically extreme, especially considering the exposure was given daily for 90 days. Assuming that POEA made it into the body via oral exposure or by skin absorption, its chemical nature indicates it would be metabolized into short-chain carboxylic acids (17), smaller molecules that would enter into the body’s normal respiratory metabolism pathways. Thus, it is not surprising that POEA has exhibited no reproductive, developmental, neurotoxic, or endocrine system toxicity in subchronic feeding studies (17).

The ability of surfactants to irritate tissue is well illustrated by comparing glyphosate’s classification as an eye or skin irritant with that of its formulations containing the surfactant POEA (Table 1, page 7). Note that the acute oral and dermal toxicity of glyphosate and its formulated products are similar, but each has a different potential for eye and skin irritation. Glyphosate itself causes mild to slight irritation of eye and skin tissue. In contrast, POEA is extremely irritating to dermal tissues. Consequently, formulated glyphosate is also irritating, but the severity declines as the concentration of POEA decreases.

Irritating properties of Roundup have been compared to baby shampoo, dishwashing detergent, and household liquid cleaner. Roundup and the baby shampoo were similar in irritation potential, and each was less irritating than the detergent and cleaner (12).

The Missing Link— Exposure Assessment

A key element lacking in every EAG website on pesticides that I visit is exposure assessment. If hazard characterization and dose-response relationships definitively show there are NOAELs for any effect, then logically we would ask, “How much are we exposed to in the real world?”

Before the Food Quality Protection Act (FQPA), EPA only estimated our total exposure to pesticide residues in the diet. Now, EPA must also consider exposure to residues in water and from home use. EPA’s findings about glyphosate were issued in 1993 in a Re-registration Eligibility Decision Document (RED) (15). At that time, EPA assumed all the residues in food were at the level of the tolerance. Tolerances, although they are legal limits for maximum residues, grossly overestimate food residues. Nevertheless, EPA found that exposure to glyphosate at the time was at maximum 2% of the RfD. Anything under 100% of the RfD makes the EPA happy, and the agency has no problems with renewing a pesticide’s registration.

Recently, an aggregate exposure assessment was conducted for glyphosate that essentially reached the same conclusion as the EPA’s 1993 RED (17). Elements of this aggregate assessment for acute and chronic exposure are shown in Table 3. Note that in the aggregate assessment water and occupational exposures

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Giddy 'bout Glyphosate, cont.

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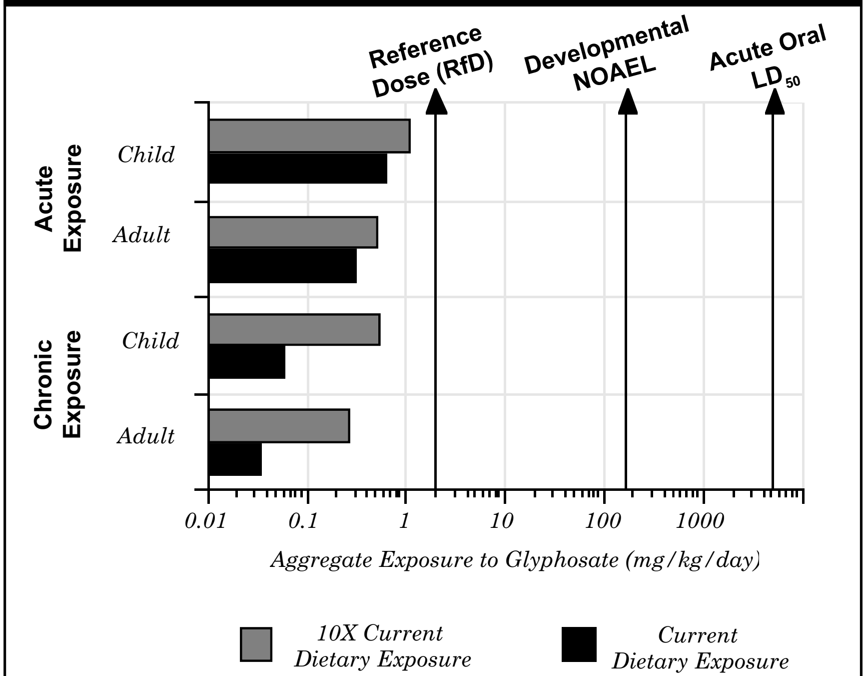
were included. Also, the exposure assessment covered the only relevant plant metabolite of glyphosate, AMPA, and the surfactant, POEA. The surfactant was assumed to be present as a residue in the same proportion that it occurred in the Roundup formulation.

I decided to modify the published aggregate assessment by assuming in the acute exposure scenario that a person would be accidentally exposed directly to the pesticide spray at a maximum rate of application (4 kg glyphosate per hectare). To make things interesting (and, arguably, more conservative), I assumed the person was naked and his or her whole body was under the spray boom.

To further spice up the exposure assessment and address concerns that increased use of glyphosate on Roundup Ready corn and beans would significantly increase pesticide residues (10), I increased dietary exposure by tenfold. The dietary exposure was also changed to reflect EPA's assumptions that all crops have glyphosate residues at the level of the tolerance. In contrast to the popular EAG claim that Monsanto requested an increase in the soybean glyphosate tolerance to accommodate its Roundup Ready technology, the tolerance was 20 ppm long before commercialization of Roundup Ready crops and remains so today (15). Also, the idea that residues in our diet would increase tenfold is kind of crazy considering that most of the increased use of glyphosate would be on crops that are largely fed to livestock before it makes its way to our tables. Given the rapid excretion of glyphosate and lack of storage in tissues (pharmacokinetics!), the possibility of exposure via residues in meat is very remote.

FIGURE 1



Graphical characterization of risk from glyphosate exposure. The exposure assumes the adult works as a glyphosate applicator, and both the adult and child may be acutely exposed directly to spray drift as bystanders. The 10X dietary exposure assumes that increased use of glyphosate on RR crops will increase dietary residues. Note that all exposure bars are below the EPA RfD of 2 mg/kg/day, indicative of a reasonable certainty of no harm from glyphosate exposure.

The maximum exposure on a bad day when a child playing next to a cornfield would be accidentally oversprayed with glyphosate was estimated to be 0.6 mg/kg (Table 3, page 9). Daily (chronic) exposures would be far less. POEA exposures would be a little higher, but nothing to worry about as most surfactants have similar toxicological properties and we use them every day at home. Note that assuming dietary exposure is tenfold higher due to an increase in glyphosate residues on RR crops raises acute aggregate exposure slightly less than twofold but chronic exposure by tenfold. This big difference is because the imaginary spray drift incident represents the largest proportion of the acute exposure.

But Is It Safe?

Now for the risk assessment finale—how do you characterize the probability that an adverse effect might occur from these estimated glyphosate exposures? At this point, the hazards of glyphosate, as represented by the NOAELs, are integrated with the estimated exposures. If exposure were substantially below the NOAELs, preferably by a factor of at least 100, then toxicologists world-

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Giddy ’bout Glyphosate, cont.

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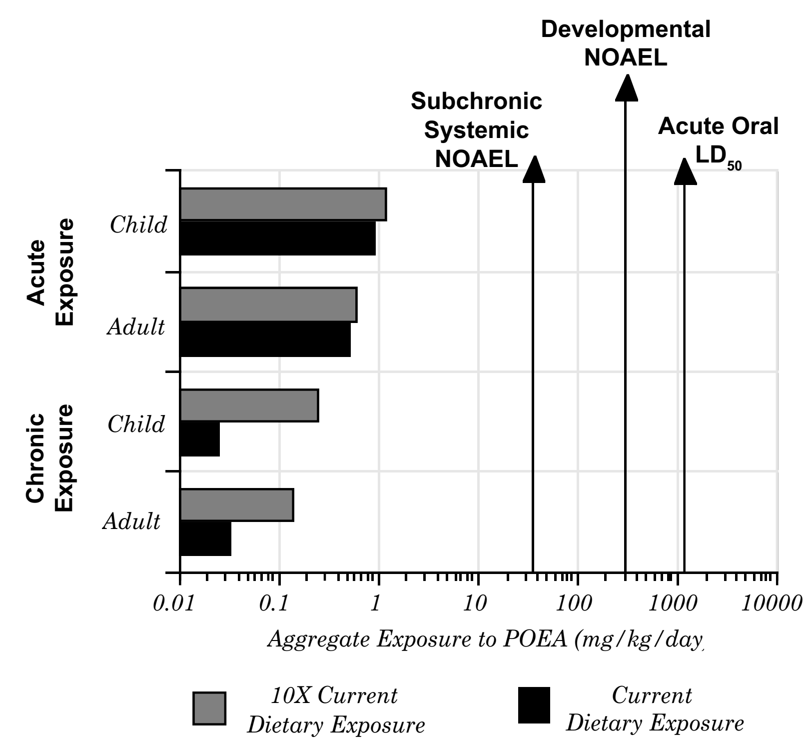
FIGURE 2



Graphical characterization of risk from exposure to the Roundup surfactant POEA. A reference dose (RfD) has not been developed for POEA, but note that most exposures are from 15 to 100 times lower than the NOAEL for the most sensitive toxicological endpoint, subchronic systemic toxicity.

wide would agree that there is a reasonable certainty of no harm from glyphosate exposure. To put it more bluntly, the stuff should be considered safe!

In Figures 1 and 2, I’ve integrated the hazard characterization for glyphosate and POEA with their estimated levels of exposure. Note that for glyphosate, all exposures to a subject child and adult population are comfortably below the RfD that is already 100-fold lower than the most sensitive toxicological endpoint (i.e., the one with the lowest NOAEL). No RfD has been established for POEA, but my extreme estimates of exposures are at least fifteenfold below the NOAELs.

Beware of Ad Hominem Attacks

After perusal of a number of EAG websites I concluded that glyphosate, given its incredibly low toxicity, its inability to be absorbed by the skin, its rapid elimination, and absence of any toxicologically significant long-term effects, was a particular challenge to critique. So, when you can’t fight the argument on the data, it’s time to pull out the ad hominem attacks. EAGs masterfully impugn the credibility of the toxicological data on chronic toxicity by suggesting to readers that industry data is all that’s out there and it’s not trustworthy (4). NCAP goes one step further by deriding the quality of the glyphosate data with a historical recitation about two contract companies in the late 1970s and early 1980s that were accused and convicted of falsifying data about a number of pesticides, including glyphosate. (By the way, all of the studies were redone and resubmitted for EPA review.)

The EAGs somehow forget to inform readers about the Good Laboratory Practices (GLP) standards promulgated into statutory law back in the early 1980s under the auspices of FIFRA (Federal Insecticide, Fungicide, and Rodenticide Act). Under GLP, every bit of data collected by a company doing research to support pesticide registration requirement is subject to auditing by the EPA.

Next...Ecological Concerns

Despite the plethora of data attesting to safety, I suspect attacks on the integrity of researchers (even university faculty!) will continue. In upcoming issues of *AENews*, I will risk my good reputation as I continue to examine concerns about genetically engineered herbicide tolerant plants, including their impact on non-target organisms (e.g., wildlife) and their potential to “leak genes” to other plants, thereby creating “superweeds.”

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Giddy 'bout Glyphosate, cont.

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

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2001 Subscription Reminder

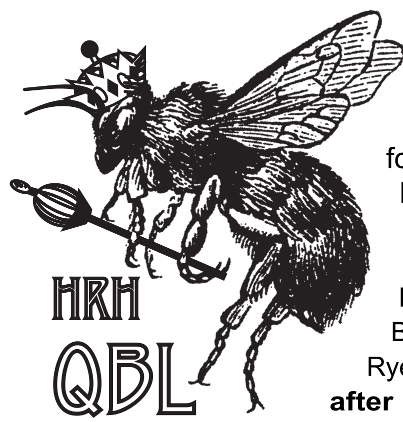
Now is the time to renew your *Agrichemical and Environmental News* subscription for next year. Renewals received by 30 November 2000 will ensure uninterrupted service into 2001. The subscription fee is still only $15 per year for twelve issues. Send your check, made out to WSU, to **Sally O'Neal Coates, AENews Editor, Pesticide Information Center, WSU Tri-Cities, 2710 University Drive, Richland WA, 99352-1671.** Please include **full name and address** of newsletter recipient. Should you require an invoice, just let us know by phoning (509) 372-7378.

Keep these issues of *AENews* coming—respond today!

Call It Confusing, Call It Contradictory, Call It a Non-Anom Nominee

Jane M. Thomas, Pesticide Notification Network Coordinator

Yes, you've caught me. I have been grubbing around in the files once again—a very un-Queenly activity for one of my lofty fame. Paper cuts and ink smudges and I WON'T discuss the grease from the file drawer rollers. Such is the price I pay as I muck around looking for lousy label examples. I sink to this only because I haven't yet been appointed by the U.S. Environmental Protection Agency (EPA) as the Queen Bee of Labels (QBL) (see "If I Were the Queen of Labels," *AENews* No. 169, May 2000). And, yes, as much as it pains me, I will keep this up until I hear from EPA, until there are some RULES in place for pesticide labels, or until you-know-where freezes over—whichever comes first. (Oooh, did you feel that chill?)



The result of my recent foray is my discovery that we need a New and Improved Non-Anom category. (ED. NOTE: A "Non-Anom" is QBL's award for particularly pathetic and aggrievedly awful pesticide labels. See "QBL II," *AENews* No. 171, July 2000.) This new distinction will encompass those labels that seem bent on leading pesticide users astray. So, with a small fanfare, I announce…the **Down the Garden Path** Non-Anom.

There are several ways that pesticide labels can be written or revised so as to lead pesticide users astray. Take, for example, Special Local Needs (SLN) registration WA-780061. This SLN provides for the use of Rozol Pellets for the control of orchard mice. Originally, this document stated that it was for use in pome and stone fruit orchards. At some point it was revised to read, "for use in apple, apricot, cherry, peach, pear, prune, and plum orchards." Nary a nectarine in the new directions. A tiny error, you say? Not if you are a grower of nectarines, say I! The omission, as it turned out, was inadvertent, and Washington State Department of Agriculture (WSDA) provided a happy ending to the story by quickly revising the SLN to include nectarine once again. (An electronic copy of the revised SLN is posted on the Pesticide Notification Network's web page at **http//www.pnn.wsu.edu**).

While this example serves to illustrate the Royal Intent behind the **Down the Garden Path** award, it does not hold a candle to the following example send in by Lee Barigar of WSDA's Yakima office. It would appear that some label authors are determined to incriminate pesticide users.

Riverdale's MCPA 4-Amine (EPA registration number 228-143) is labeled for use on grasses grown for seed. Towards the back of the label, in the tank mix directions, the label contains the following:

> For grasses grown for seed, such as Bermudagrass, Bluegrass, Fescue, and Ryegrass, **application must be made after the grass seed crop begins to joint.** For the best performance, make applications when weeds are in the two to four-leaf stage and rosettes are less than two inches across. Use the higher level of listed ranges when treating more mature weeds or dense vegetative growth. Apply 1/2 to 2 pints of Banvel Herbicide with 1 to 2 pints of MCPA-4 Amine per acre. (emphasis added)

In Washington there are three Banvel herbicide labels registered for use. BASF and MicroFlo both register a Banvel Herbicide and BASF also registers Banvel SGF Herbicide. All three labels contain the following statement in their Grass Seed Crop use directions: **"Do not apply after the grass seed crop begins to joint."** If one were to follow Riverdale's instructions, one would be in BIG trouble. And the Royal One does not find this amusing. Frankly, it seems that pesticide users gladly shoulder the weight for responsible and safe pesticide use and they don't need the additional burden of dealing with misleading or flagrantly wrong pesticide application directions. Perhaps some time on the rack might straighten out this label. (Alas, my Royal wRath is showing.)

Speaking of Riverdale, they also are featured this month in the **Most Confusing Language** category. The label in question is their Sodium Salt of MCPA

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QBL Confusing, cont.

Jane M. Thomas, Pesticide Notification Network Coordinator

(registration number 228-199). The following note is found under the use directions for Small Grains (wheat, barley, rye, oats):

> Note: For small grains, flax, and sorghum application, do not forage, or graze, meat animals on treated areas within seven days of slaughter.

That seems straightforward. One might think this indicates that Sodium Salt of MCPA is labeled for use on sorghum. Not so. Nowhere else on the label is sorghum mentioned. A call to Riverdale revealed that this note was probably left over from an old label revision that wasn't properly edited. One wonders:

- Do registrants assume that no one reads their labels?
- Do the registrants themselves read their labels?
- Is just one stint on the rack sufficient?

If EPA would Just Do It and appoint me to my rightful position, I would get some RULES (and some dungeon devices) put in place and these grievous gaffes would be controlled.

In an upcoming issue, I shall reveal (in a disturbingly graphic presentation) how not all pesticide label confusion is caused by the verbiage thereon. Stay tuned for an all-new Non-Anom category yet to be named. **Lousy Label Layout? Form follows function?** Or perhaps, simply, **Graphics Count, too?** I swoon with the possibilities. 

Her Royal Highness the Queen Bee of Labels (HRH QBL, a.k.a., Jane M. Thomas) presides over the Pesticide Notification Network (PNN) at WSU's Pesticide Information Center at (509) 372-7493 or ***jmthomas@tricity.wsu.edu****. If you are calling from the EPA with a job offer, you may contact the Queen at home, any time of the day or night.*

Pesticide Applicator Training Courses

Washington State University provides pre-license and recertification training for pesticide applicators. Pre-license training provides information useful in taking the licensing exam. Recertification (continuing education) is one of two methods to maintain licensing. (The other is retesting every five years.)

For more detailed information, visit the website at

http://pep.wsu.edu/

	EASTERN WASHINGTON			WESTERN WASHINGTON		
	Date	City	Facility	Date	City	Facility
PRE-LICENSE	Jan. 16, 17, 18	Pasco	Doubletree	Jan. 2, 3, 4	Vancouver	WSU Vancouver
	Jan. 22, 23, 24	Yakima	Conv. Center	Jan. 9, 10, 11	Tacoma	Pac Lutheran U
	Jan. 30, 31 Feb. 1	Pullman	University Inn (Moscow)	Feb. 6, 7, 8	Kirkland	Lake WA Tech College
	Feb. 6, 7, 8	Spokane	Valley Doubletree	Mar. 13, 14, 15	Puyallup	WSU Puyallup Allmendinger Ctr
	Feb. 13, 14, 15	Moses Lake	Conv. Center	Mar. 27, 28, 29	Bellingham	Whatcom Comm. College
RECERTIFICATOIN	Nov. 7, 8	Pasco	Doubletree	Nov. 13, 14	Lynnwood	Edmonds Comm. College
	Nov. 8 SPANISH	Pasco	Doubletree	Jan. 3, 4	Vancouver	WSU Vancouver
	Jan. 17, 18	Pasco	Doubletree	Jan. 10, 11	Tacoma	Pacific Lutheran University
	Jan. 23, 24	Yakima	Conv. Center	Jan. 18, 19	Lynnwood	Edmonds Comm. College
	Jan. 25, 26	Wenatchee	Doubletree	Jan. 29, 30	Lacey	St. Martin's Coll. Worthington Ctr.
	Jan. 30, 31	Pullman	University Inn Moscow	Feb. 1, 2	Des Moines	Highline Comm. College
	Feb. 7, 8	Spokane	Valley Doubletree	Feb. 7, 8	Kirkland	Lake WA Tech. College
	Feb. 14, 15	Moses Lake	Conv. Center	Feb. 13, 14	Port Orchard	Givens Comm. Center
	SPECIAL WORKSHOPS include Integrated Plant Health Jan. 23-25, Puyallup; Conifer/Christmas Tree Jan. 29, Lacey; and Commercial Applicator Feb 9, Spokane			Mar. 8, 9	Seattle	UW Ctr. For Urban Hort.
				Mar. 27, 28	Bellingham	Whatcom Comm. College

Pushing the Envelope
Of Analytical Detection Levels

Dr. Vincent Hebert, Analytical Chemist, WSU

In last month's *AENews* (No. 174, October 2000), two articles referred to recently publicized damage to nursery and garden plants that was traced to the presence of clopyralid and picloram in commercial compost. These two persistent picolinic acid herbicides were eventually detected at very low concentrations in the compost, levels so low they were not detected in initial pesticide residue screenings.

A situation such as this provides an excellent opportunity to discuss progress in analytical detection levels and the practical application of technologies for higher levels of detection. In the article "Compost Quality: New Threats from Persistent Herbicides," Dr. David Bezdicek and colleagues explained that methods used by Washington State Department of Agriculture's (WSDA's) analytical testing facility and another laboratory didn't provide sufficient sensitivity for detecting the herbicides that resulted in observable plant damage. Subsequent testing at Washington State University (WSU) in Pullman indicated that tomato damage was probably occurring for picloram at concentrations slightly greater than 1 part per billion (ppb). The 1 ppb no observable effects level (NOEL) determined in these studies was 20X lower than what these analytical laboratories could detect. As a result, the WSU Department of Crop and Soil Science took preventative steps to stop commercial release of contaminated compost by instituting highly sensitive plant bioassay testing procedures. These testing procedures can spot the presence of picolinic acid herbicides at extremely low parts per billion concentrations, thus ensuring the sale of damage-free composting materials to nurseries and home gardens.

Evolution of Detection Limits

At first glance, from an analytical perspective, the detection limits of the two laboratories cited in Dr. Bezdicek's article seemed rather high. As far back as 1973, the literature reports 5-ppb sensitivity for detection of picloram in soil (1). That's respectively about 12X and 4X more sensitive than reported by the two analytical laboratories performing the above compost analyses. And the 1973 figures were acquired using "old technology" analytical instrumentation.

Since the early 1970s, the envelope has been pushed significantly farther when it comes to analytical detection. This is due both to improved instrumentation and improved cleanup methodologies. A "clean" sample in this case refers to one in which interfering compounds are extracted so that the target analyte is more "visible" to the instrumentation. In general terms, detectability has been reduced from the low part-per-million range to, in many cases, the low part-per-trillion range.

Practicality and Intent

So, why were the clopyralid and picloram detection levels so high? It boils down to practicality and the intent of the initial detection project.

The intent of the analytical method employed by WSDA and the other lab was to determine the maximum concentration of certain pesticide residues that are legally permitted to remain in our food supply. This is an enormous job, with tremendous scope. In order to ensure that our food supply is safe and that pesticides are below acceptable food safety tolerance levels, the WSDA pesticide laboratory routinely tests a wide variety of raw agricultural commodities, processed foods, and animal feeds for as many as 290 pesticides and their respective metabolites (2). The only way that this many pesticides can be routinely monitored is through the use of multi-residue methods (MRMs).

MRMs are designed to analyze a multitude of pesticides simultaneously, using very few analytical steps. A number of MRMs have been developed that can segregate and quantitate pesticides with similar physical and chemical properties (e.g., molecular size, volatility, polarity, acidity) (3). MRMs are extremely practical, valuable tools for assuring food safety. Moreover, the cost to perform MRM analyses is generally reasonable. Unfortunately, these methods may not be well suited when greater analytical sensitivity is desired. The trade-off with MRMs is simply that individual analyte sensitivity must be sacrificed for the sheer number of pesticides that can be evaluated in a single run.

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Pushing the Envelope, cont.

Dr. Vincent Hebert, Analytical Chemist, WSU

Needle in a Haystack

In specific cases, the targeted limit of detection for a particular pesticide may be appreciably less than can be achieved by MRMs (e.g., a detection limit at or below the 1 ppb NOEL for picolinic acid herbicides in compost). An analytical lab and its client then must choose (or develop) individual methods that can take greater advantage of the unique physical and chemical properties of the pesticide for isolation from the environmental matrix (in this case, the compost) and its subsequent enrichment onto an adsorbent/partitioning media. After isolation, other cleanup steps may be required to achieve the desired level. Also, the analyst may have to selectively modify the pesticide molecule making it more amenable to instrument quantitation, especially when using gas chromatography. Knowing the pesticide's physio- chemical properties, an analyst can then choose an instrument detection device that best fits a client's needs for sensitivity, selectivity, and quantitation—for "pulling the needle out of the haystack."

Routine multi-residue screening procedures should be the first course of action when assessing the possibility of a pesticide contamination in the environment. These evaluations can be performed quickly and inexpensively, and they are usually sensitive enough to identify most potential problems. In the specific case of picolinic acid herbicides, MRMs were not sensitive enough to identify concentrations in compost that could cause a phytotoxic response in vegetables and ornamentals. Bioassays are one method of pushing the detection level envelope; development of specialized trace-level methods is another. The drawback to developing rugged trace-level pesticide residue methods is that the process can take appreciable time and can also be quite expensive. Depending upon the importance of the detection issue at hand, development of specialized methods to achieve greater analytical sensitivity may be appropriate.

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Guzman v. Amvac Ruling

Implications for Agrichemical Industry

Agrichemical and Environmental News **Staff**

On 24 August 2000 the Supreme Court of the State of Washington ruled on two points relevant to the agrichemical industry. In layman's terms, it was determined

❶ a safe alternative product may be admissible as evidence in testimony against an alleged unsafe product, and

❷ while pesticide benefits can outweigh risks, this is not always the case, therefore each pesticide must be judged on its own risks and merits.

The case, Guzman v. Amvac, involved three men who worked for Mattawa apple growers in 1993. They were suing the manufacturer (Amvac Chemical Corporation) and the distributor (Wilbur-Ellis Company) of a product (phosdrin) for money damages for medical care and compensation for permanent disability. Representatives for the plaintiffs included Earthjustice Legal Defense Fund and Trial Lawyers for Public Justice, whose goals included making a statement about marketing and promoting pesticides considered dangerous, as well as compensating the particular workers injured in this case.

Guzman v. Amvac, cont.

Agrichemical and Environmental News **Staff**

Background

Before 1993, a pesticide called phosphamidon was used in eastern Washington orchards, including the subject orchards in Mattawa, to control aphid infestation. When phosphamidon's registration was not renewed by Amvac, the growers switched to phosdrin. Amvac had fast-tracked phosdrin's emergency registration through Washington State Department of Agriculture (WSDA) for this use.

In July 1993, the orchard workers (who had been using phosdrin) were admitted to local hospitals and treated for organophosphate exposure. Phosdrin use in Washington was temporarily suspended by WSDA on August 30, 1993. On June 30, 1994, Amvac requested cancellation of phosdrin's registration. Phosdrin can no longer be used in the United States.

Comparing Products in Court

The first question posed in the 24 August 2000 proceedings was whether a plaintiff may rely upon an alternative product to show that a challenged product's risks outweigh the adverse effects of using an alternative design. In short, the court answered "yes" to this question.

In Guzman v. Amvac, the plaintiff claimed they should be able to rely on another product (in this case, phosphamidon) to establish that the challenged product (in this case, phosdrin) could have been designed in a safer manner. Amvac felt that phosphamidon was an irrelevant comparison, as it was not commercially available.

In the end, the court determined that a plaintiff may satisfy the requirement of showing an adequate alternative design by demonstrating that other products can more safely serve the same function as the challenged product.

"Unavoidably Unsafe?"

The second question is whether a pesticide can be designated "unavoidably unsafe" under the law, a status which grants it certain immunity from liability.

The State of Washington has adopted elements of the Restatement (Second) of Torts, including section 402A, which establishes strict liability for "(o)ne who sells any product in a defective condition unreasonably dangerous to the user." This same section provides for an exception to strict liability in the case of "unavoidably unsafe" products—products known to cause harm but also known to offer great benefit. The most obvious examples relate to medicine (e.g., pharmaceuticals with side effects, treatments such as chemotherapy). The language explaining this exception is known as "Comment K."

In the Guzman v. Amvac proceedings, it was determined a pesticide may indeed be covered by Comment K if its utility outweighs the risks posed by its use.

Blanket Immunity

A corollary question associated with the determination of unavoidably unsafe and exception to liability is that of blanket immunity for a class of products. For example, the court has ruled that Comment K now applies to all prescription drugs. Pharmaceuticals no longer need to be evaluated on a case-by-case basis for exemption. They have a blanket immunity as unavoidably unsafe, with recognized benefits that outweigh the risks when administered by a learned intermediary.

The question arises as to whether pesticides should enjoy the same immunity as a class of products. The court held that blanket immunity should not apply, saying such immunity would remove manufacturers' incentive to strive for safer pesticides, since they could never be made entirely safe. Further, they held that Comment K was especially applicable to medical products, and that a user of pesticides (or distributor, or consultant, or other involved party) ought not be analogous to a physician as the learned intermediary between manufacturer and end user. The court determined that product-by-product approach to the application of Comment K is warranted in the case of pesticides.

Details of the Guzman v. Amvac decision can be found on-line through late November at **http://www.courts.wa.gov/opinions**.

IR-4 Priorities Set for 2001

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

Over 150 individuals participated in the Interregional Research Project #4 (IR-4) Food Use Workshop in Orlando, Florida, on September 12 through 14, 2000. Most attendees were scientists, either with the U. S. Department of Agriculture (USDA) or the land grant university system. Also in attendance were representatives from industry—mostly chemical and/or biotech companies. Several commodity groups and food processors also participated. The workshop was an open forum that encouraged discussion. Pesticide company representatives served primarily as a resource for information on their companies' specific candidate compounds and for determining if their respective companies would support a requested use for the product. They have a limited role in setting actual project priorities.

The workshop was divided into three days, each focused on a specific crop protection category. September 12 was devoted to plant pathology, September 13 to entomology, and September 14 to weed science and plant growth regulators. Representatives of each discipline reviewed the submitted crop-chemistry combinations and from them prioritized twelve as category A for residue testing, four as A for efficacy or performance testing, thirty as B for residue testing, and thirty as B for efficacy. IR-4 commits itself to starting projects prioritized as A the following field season. B priority projects are considered important and, if given substantial regional and/or industry support, can be upgraded to A priorities. Unfortunately, labor and financial resources are limited, so most projects are assigned a C priority, which means they sit on the books as potential projects with very little likelihood of being worked on by IR-4 in the coming year. Projects that do not appear feasible due to regulatory intervention or lack of registrant support are dropped permanently from the books.

Washington State agricultural producers are empowered by access to the Washington State Commission on Pesticide Registration (WSCPR). Requests for funding to upgrade IR-4 projects that would benefit Washington State agricultural producers are seriously considered and often approved by the WSCPR. (See related article "WSCPR Funding Shifts" in *AENews* No. 173, September 2000. WSCPR website is **http://www.wscpr.org**.)

Unified on the Western Front

In keeping with the past, the Western Region for IR-4 was well represented and unified in prioritizing our common pest control needs. Ron Hampton, our Western Regional Coordinator, served as "Fearless Leader" for the Western Region during the workshop. I represented Washington State for plant pathology and entomology and my USDA colleagues Rick Boydston and Lyle Birch represented Washington State for weed science. Bob McReynolds and Joe DeFrancisco represented Oregon for all three disciplines. Ronda Hirnyck and Sandra McDonald represented Idaho and Colorado, respectively, for all three disciplines. California was represented by Jim Adeskaveg for plant pathology and by Richard Smith and Steve Fennemore for weed science. Industry was represented by Ray Rato, a private grower from California, and Byron Phillips. Byron is a new member of the administrative team of the Washington State Tree Fruit Research Commission. He was able to convey the needs of Pacific Northwest tree fruit producers to me and my other university or USDA colleagues. To all of these individuals I owe a hearty "thank you" for a job well done!

Efficacy Trials: A New Wrinkle

Since its inception in the 1960s, IR-4 has become synonymous with residue studies. In a significant departure from the past, IR-4 has begun to prioritize and fund efficacy/performance trials. For insecticides and fungicides, this usually means "Did the agent control the bug or disease?" For herbicides, it usually means "Did the agent kill the target weed?" and "Did the agent harm the crop through phytotoxicity?" Crop-chemistry combinations being evaluated for efficacy/performance are designated "PERF" in the accompanying tables.

Personally, my feelings are somewhat mixed about this change in mandate and focus by IR-4. My major concern is how will this new priority detract from the

...continued on next page

IR-4 2001 Priorities, cont.

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

original mandate of completing magnitude-of-residue trials? Yet I do understand the dilemma faced by IR-4 study directors: there IS a shortage of pesticide efficacy data, particularly on minor crops.

Following are several of the many reasons for the lack of available efficacy data.

Academic Priorities

Publication of pesticide efficacy information has been relegated to a status of “not being worth the time it takes to write up” both within academic departments and within professional societies. I personally publish the results of my field trials in the Entomological Society of America’s *Arthropod Management Tests* as a service to other pest management professionals. However, I guarantee that most academics don’t bother.

Proprietary Research

In the past, university-based researchers conducted more crop protection research. Today, companies do much of their pesticide screening in-house or with private consultants. The results are often not published in a public forum.

Commodity Group Competition

Commodity groups fund research, but they, too, generally want to keep the information they develop in-house. This is understandable, as research is expensive. Why should those who pay release their information to regional or international competitors?

Cost Cutting

A common misconception is that agrichemical companies are filthy rich. The rash of corporate mergers and a rush from multinationals to spin off their ag products divisions should be enough to dispel that myth. Paying researchers can prove costly to cash-strapped ag chemical companies, especially for the minor-minor crops.

So, for better or worse, efficacy projects are now being conducted by IR-4.

Explanation of Priority Tables

Tables outlining the A and B priorities begin on page 22. Note that categories shift as Bs are upgraded and as the result of other factors, so the actual number of crop-chemistry combinations listed in these tables may not match the numbers given above. The tables were accurate to the best of my knowledge at the time this newsletter went to press. The most up-to-date classification of projects should be available on the IR-4 website at **http://pestdata.ncsu.edu/ir-4**.

The “Requirements” column explains, in abbreviated form, the number and location of trials to be conducted. Most numbers refer to the IR-4 region. Numbers with a slash between them mean “either/or,” and numbers following a hyphen indicate multiple trials. In the first example in the first table on page 22, APPLE (PH), FLUDIOXONIL, 1/2 5 10 11-2, the post-harvest (PH) application of fludioxonil to apples will be tested once in either Region 1 or 2, once in Region 5, once in Region 10, and twice in Region 11.

A map showing regions 1 through 12 is provided on page 25. (Region 13, Hawaii, is not shown.) The Pacific Northwest falls in Regions 11 and 12. Region 11 is Washington and Oregon east of the Cascades, plus Idaho; Region 12 is western Washington and Oregon and part of California’s north coast.

Also on page 25, I’ve excerpted the Priority A crop-chemistry combinations most relevant to the Pacific Northwest and provided a bit of information about each.

For further information about IR-4, the tables, upgrading B priorities to A’s, or other issues in this article, contact your state’s IR-4 Liaison Representative. For Washington State, that’s me, Doug Walsh, at (509) 786-2226 or **dwalsh@tricity.wsu.edu**. For Oregon, it’s Jeff Jenkins at Oregon State University, (541) 737-5993 or **jenkinsj@ace.orst.edu**. For Idaho, it’s Ronda Hirnyck at the University of Idaho, (208) 364-4046 or **rhirnyck@uidaho.edu**. For other states, see the IR-4 directory on the Internet at **http://pestdata.ncsu.edu/ir-4/prodir.cfm**.

IR-4 2001 Priorities, cont.

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

"A" PRIORITY FUNGICIDES

COMMODITY	PESTICIDE	REQUIREMENTS
APPLE (PH)	FLUDIOXONIL	1/2 5 10 11-2
ASPARAGUS	TEBUCONAZOLE	2 5-2 10-3 11-2
BEAN (DRY)	CYPRODINIL + FLUDIOXONIL	5-5 7 8 9 10 11
BEAN (LIMA)	CYPRODINIL + FLUDIOXONIL	2-4 5 10-2 11
BEAN (SNAP)	CYPRODINIL + FLUDIOXONIL	1 2 3 5-3 10 11
CELERY	BAS 500	3-2 5 10-5
CITRUS (PH)	AZOXYSTROBIN	3-2 10-3
CITRUS (PH)	FLUDIOXONIL	3-2 10-3
FILBERT	TRIFLUMIZOLE	12-4
KIWIFRUIT	FLUDIOXONIL	10-3
LETTUCE (HEAD & LEAF)	CYPRODINIL + FLUDIOXONIL	1 2 3-2 5 10-8 12
SPINACH	BAS 500	1 2-2 6-2 9 10-2
BASIL	CYPRODINIL + FLUDIOXONIL	PERF
CANEBERRY (BLACKBERRY)	AZOXYSTROBIN	PERF
CANEBERRY (RASPBERRY)	AZOXYSTROBIN	PERF
CHIVES	AZOXYSTROBIN	PERF
TURNIP (ROOT & TOP)	AZOXYSTROBIN	PERF

"B" PRIORITY FUNGICIDES

COMMODITY	PESTICIDE	REQUIREMENTS
APPLE (PH)	FENHEXAMID	1/2 5 10 11-2
BEAN (DRY)	CYPRODINIL + FLUDIOXONIL	1 5-5 7-2 8 9 10 11
BEAN (LIMA)	DIMETHOMORPH	2-5
BEET (SUGAR)	MYCLOBUTANIL	Pending Mfg. Response
CANEBERRY (RASPBERRY)	MEFENOXAM + COPPER	5 10 11/12-3
CANTALOUP	QUINOXYFEN	2-2 5 6-2 10-4 12
CANTALOUP	CYPRODINIL + FLUDIOXONIL	2-2 5 6-2 10-4 12
CHERRY	FERBAM	1-2 5-4
GINSENG	FENHEXAMID	5-4
GRAPE	FERBAM	1 5
GREENS (MUSTARD)	MYCLOBUTANIL	2-2 3 4 5 6-2 10-2
LETTUCE (HEAD & LEAF)	CYPRODINIL + FLUDIOXONIL	HEAD:1/2 3 10-6; LEAF:1/2 3 10-6
LETTUCE (HEAD & LEAF)	ZOXAMIDE	HEAD:1/2 3 10-6; LEAF:1/2 3 10-6
PARSLEY	CYPRODINIL + FLUDIOXONIL	3 5 10 12
PEPPER (BELL & NON-BELL)	MYCLOBUTANIL	2-3 3-3 5 6-2 10-3
PLUM	FERBAM	5-2
WATERCRESS	TEBUCONAZOLE	3-3

"B" PRIORITY FUNGICIDES, cont.

COMMODITY	PESTICIDE	REQUIREMENTS
GINSENG	CAPTAN	Pending Mfg. Response
PEPPER (BELL & NON-BELL)	QUINOXYFEN	Pending Mfg. Response
PISTACHIO	BENOMYL	Pending Mfg. Response
POMEGRANATE	FENHEXAMID	Pending Mfg. Response
POMEGRANATE	FLUDIOXONIL	Pending Mfg. Response
RHUBARB	CHLOROTHALONIL	Pending Mfg. Response
ALMOND	BAS 516	PERF
ARUGULA	AZOXYSTROBIN	PERF
BASIL	SERENADE	PERF
BEAN	BAS 510	PERF
BEET (GARDEN)	BAS 516	PERF
BLUEBERRY	BAS 516	PERF
BROCCOLI	AZOXYSTROBIN	PERF
CABBAGE	AZOXYSTROBIN	PERF
CANEBERRY	BAS 516	PERF
CARROT	BAS 516	PERF
CELERIAC	AZOXYSTROBIN	PERF
CELERY	BAS 516	PERF
CHICORY (ROOT)	AZOXYSTROBIN	PERF
CHIVES	SERENADE	PERF
EGGPLANT	AZOXYSTROBIN	PERF
GREENS (MUSTARD)	AZOXYSTROBIN	PERF
HORSERADISH	AZOXYSTROBIN	PERF
LETTUCE (HEAD & LEAF)	ACIBENZOLAR	PERF
LETTUCE (HEAD & LEAF)	BAS 516	PERF
MAYHAW	KRESOXIM-METHYL	PERF
ONION	BAS 516	PERF
PEPPER (BELL & NON-BELL)	FENAMIDONE	PERF
PERSIMMON	COPPER HYDROXIDE	PERF
RADISH	BAS 516	PERF
SPINACH	BAS 516	PERF
STONE FRUITS	BAS 516	PERF
STRAWBERRY	SERENADE	PERF
STRAWBERRY	HARPIN	PERF
STRAWBERRY	BAS 516	PERF
SWISS CHARD	AZOXYSTROBIN	PERF
TOMATO	BAS 516	PERF
TURNIP (ROOT & TOP)	BAS 516	PERF

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IR-4 2001 Priorities, cont.

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

"A" PRIORITY INSECTICIDES/ACARICIDES

COMMODITY	PESTICIDE	REQUIREMENTS
APPLE	CHLORPYRIFOS	1-3 2 5-2 9 10 11-4
BARLEY	THIAMETHOXAM	11-5
BEAN (SNAP)	CYROMAZINE	1 2-2 3 5-3 10 11
BLUEBERRY	THIAMETHOXAM	1 2-4 5-3 12
CHERRY	BIFENAZATE	SWEET: 5-2 10-2 11-2 12; SOUR: 1 5-4 9 11
CHERRY	THIACLOPRID	SWEET: 5-2 10-2 11-2 12; SOUR: 1 5-4 9 11
GRAPE	ACETAMIPRID	1-2 10-8 11-2
GRASSES (PASTURE)	SPINOSAD	2-2 10-2 12
PEACH	THIACLOPRID	1 2-4 5 6 10-4
PEAR	BUPROFEZIN	1 10-3 11-4
PLUM	THIACLOPRID	5 10-5 12
TOMATO (GH)	BUPROFEZIN	Three trials anywhere
GREENS (MUSTARD)	CYFLUTHRIN	PERF
PEPPER (BELL)	THIAMETHOXAM	PERF
SPINACH	CYFLUTHRIN	PERF
SPINACH	THIAMETHOXAM	PERF

"B" PRIORITY INSECTICIDES/ACARICIDES

COMMODITY	PESTICIDE	REQUIREMENTS
ALFALFA	SPINOSAD	1 5-4 7 9 10 11
ALMOND	PROPYLENE OXIDE	10-5
APPLE	BUPROFEZIN	1-4 2-2 5-2 9 10 11-5
BASIL	METHOXYFENOZIDE	2 3 10
BASIL	THIAMETHOXAM	2 3 10
BEAN (DRY)	BIFENTHRIN	1 5-5 7-2 8 9 10 11
BEAN (DRY)	METHOXYFENOZIDE	1 5-5 7-2 8 9 10 11
BEET (GARDEN)	BIFENTHRIN	1 3 5-2 6 12
BLUEBERRY	FENPROPATHRIN	1 2-4 5-3 12
BROCCOLI	FIPRONIL	1 6 10-5 12
CANEBERRY	BIFENAZATE	1 2 5 12-3
CARROT	BIFENTHRIN	3 5 6-2 10-4 11
CHERRY	BUPROFEZIN	SWEET: 5-2 10-2 11-3 12; SOUR: 1 5-5 9 11

"B" INSECTICIDES/ACARICIDES, cont.

COMMODITY	PESTICIDE	REQUIREMENTS
CHIVES	METHOXYFENOZIDE	2 3 10
CHIVES	THIAMETHOXAM	2 3 10
CRANBERRY	EMAMECTIN	1-2 5-2 12
GRAPE	PYRIPROXYFEN	1-2 10-8 11-2
GRASSES (SEED CROP)	METALDEHYDE	12-3
MAYHAW	BIFENTHRIN	4-3
ONION (DRY BULB)	PYRIPROXYFEN	1 2 5 6 8 10-2 11 12
PEA (DRY)	BIFENTHRIN	1 5/7-2 11-3
PEA (DRY)	METHOXYFENOZIDE	5/7-2 11/12-3
PEANUT	DIFLUBENZURON	2-8 3 6-2 8
PECAN	PROPYLENE OXIDE	2 4 6 8
TURNIP GREENS	METHOXYFENOZIDE	2-2 4 5 6
ALMOND	BIFENAZATE	Pending Mfg. Response
CANEBERRY	THIAMETHOXAM	Pending Mfg. Response
FLAX	DELTAMETHRIN	Pending Mfg. Response
GRAPE	BIFENTHRIN	Pending Mfg. Response
GRAPE (RAISIN)	PROPYLENE OXIDE	Pending Mfg. Response
SPINACH	ZETA-CYPERMETHRIN	Pending Mfg. Response
STRAWBERRY	THIAMETHOXAM	Pending Mfg. Response
TURNIP (ROOT & TOP)	ZINC PHOSPHIDE	Pending Mfg. Response
TURNIP GREENS	DIFLUBENZURON	Pending Mfg. Response
CARROT	FIPRONIL	PERF
CELERIAC	METHOXYFENOZIDE	PERF, Pending Mfg. Response
PECAN	THIAMETHOXAM	PERF
SWEET POTATO	MALATHION	PERF
TOMATO	ABAMECTIN	PERF
TOMATO (GH)	BIFENAZATE	PERF, Pending Mfg. Response

Numbers in the "Requirements" column refer to the region and number of trials to be conducted. See explanation in preceding article. A map showing regions is on page 25.

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IR-4 2001 Priorities, cont.

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

"A" PRIORITY HERBICIDES/REGULATORS

COMMODITY	PESTICIDE	REQUIREMENTS
APPLE	FLUROXYPYR	1-4 2-2 5-3 9 10 11-5
BROCCOLI	SULFENTRAZONE	1 6 10-4 12
CANTALOUP	PARAQUAT	2 5 6-2 10-4
CUCUMBER	PARAQUAT	2-3 3 5-2 6 10
GREENS (MUSTARD)	SULFENTRAZONE	2-2 3 4 5 6 10-2
HOP	CLETHODIM	11/13-3
ONION	FLUMIOXAZIN	1 5-2 6 8 10-2 11 12
ORANGE	NAA	10-4
PEAR	FLUROXYPYR	1 10-3 11-4
PEPPER (BELL & NON-BELL)	CARFENTRAZONE-ETHYL	BELL:2-2 3-2 5 6 10-2, NON-BELL: 2 3 6 10
SQUASH (SUMMER)	PARAQUAT	1 2-2 3 5 6 10 11
TURNIP (ROOT & TOP)	DIMETHENAMID-P	2-2 5 6 10
BEET (GARDEN)	DIMETHENAMID-P	PERF
BROCCOLI	PYRIDATE	PERF
CABBAGE	PYRIDATE	PERF

"B" PRIORITY HERBICIDES/REGULATORS

COMMODITY	PESTICIDE	REQUIREMENTS
ALMOND	ETHEPHON	10-5
APPLE	BENTAZON	1-3 2 5-2 9 10 11-4
APPLE	ISOXABEN	1-3 2 5-2 9 10 11-4
APPLE	CLETHODIM	1-3 2 5-2 9 10 11-4
BLUEBERRY	CLETHODIM	1 2-3 5-3 12
BROCCOLI	CLOMAZONE	1 6 10-5 12
CANEBERRY (RASPBERRY)	CLETHODIM	1 5 10 12-2
CANTALOUP	SETHOXYDIM	2 5 6 10-3
CARROT	GLYPHOSATE	2 3 5 6 10-3
CHERRY	CLETHODIM	5-2 10-2 11-2
CRANBERRY	TRICLOPYR	1/2-2 5-2 11
CUCUMBER	SETHOXYDIM	2-2 3 5-2 6
DANDELION	PRONAMIDE	2 3
ONION (GREEN)	DIMETHENAMID-P	2 3 6 12
PEA (SUCCULENT)	SULFENTRAZONE	SHELLED: 1/2 5-4 11-2 12; EDIBLE POD: 2 10-2
PEACH	CLETHODIM	1 2-3 4 5 6 10-3
PERSIMMON	THIAZOPYR	3 10 13
PLUM	CLETHODIM	5 10-4 12
POTATO	FLUMIOXAZIN	1-2 2 3 5-4 9 10 11-6

"B" HERBICIDES/REGULATORS, cont.

COMMODITY	PESTICIDE	REQUIREMENTS
SWISS CHARD	CLOPYRALID	1/2 11/12-3
TOMATO (GH)	UNICONAZOLE	1 2 3-2 5 10-7
BEAN (DRY)	FLUMIOXAZIN	Pending Mfg. Response
CHERRY	AVG	Pending Mfg. Response
CORN (SWEET)	OXYFLUORFEN	Pending Mfg. Response
GREENS (MUSTARD)	DIMETHENAMID-P	Pending Mfg. Response
ONION (DRY BULB)	GLYPHOSATE	Pending Mfg. Response
PEACH	AVG	Pending Mfg. Response
PEACH	DIURON	Pending Mfg. Response
PEAR	ISOXABEN	Pending Mfg. Response
PEPPER (BELL & NON-BELL)	SULFENTRAZONE	Pending Mfg. Response
PLUM	AVG	Pending Mfg. Response
POTATO	PROHEXADIONE CALCIUM	Pending Mfg. Response
SPINACH	FLUROXYPYR	Pending Mfg. Response
TOMATO	CARFENTRAZONE-ETHYL	Pending Mfg. Response
BEET (GARDEN)	DIMETHENAMID-P	PERF
BEET (GARDEN)	METOLACHLOR	PERF
CABBAGE, CHINESE (BOK CHOY)	CLOPYRALID	PERF
CABBAGE, CHINESE (NAPA)	CLOPYRALID	PERF
CANEBERRY (BLACKBERRY)	OXYFLUORFEN	PERF
CAULIFLOWER	PYRIDATE	PERF
COLLARD	CLOPYRALID	PERF
CRANBERRY	CHLORIMURON ETHYL	PERF
KOHLRABI	CLOPYRALID	PERF
RUTABAGA	DIMETHENAMID-P	PERF
SQUASH	METOLACHLOR	PERF

Numbers in the "Requirements" column refer to the region and number of trials to be conducted. See explanation in preceding article. A map showing regions is on page opposite.

IR-4 2001 Priorities, cont.

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

Category A (Top Priority) Crop-Chemistry Combinations
Relevant to Washington State and/or the Pacific Northwest

Plant Pathology (Fungicides)

Fludioxonil on apples for post-harvest application. This use pattern would target decay organisms such as *Penicillium*, *Mucor*, and *Botrytis* and would increase storage and shelf life for apples. **Tebuconazole on asparagus** has proven effective for control of rust in tests conducted in Michigan. **Cyprodinil and fludioxonil on beans (dry, lima, and snap)** for control of white mold *(Sclerotinia sclerotiorum)* and gray mold *(Botrytis cinerea)*.

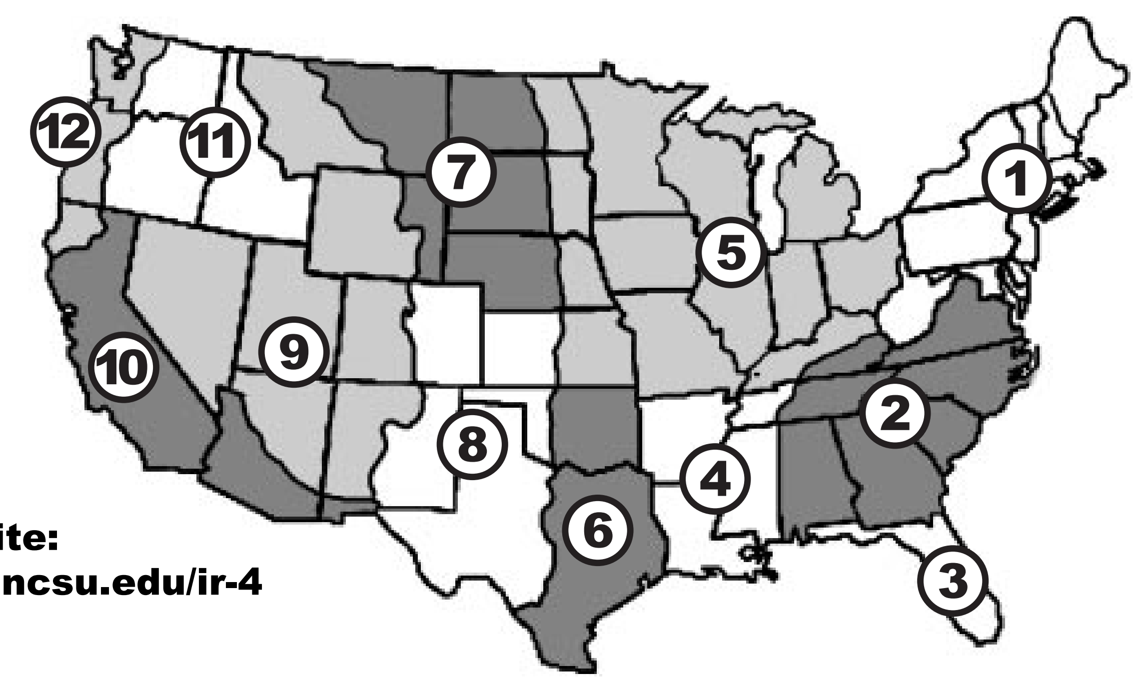
Entomology (Insecticides/Acaricides)

Chlorpyrifos on apples specifically as a trunk spray. Its major intent on apple is for dogwood borer in Michigan. However, this application is post-bloom, and Byron Phillips from the WSTFRC contends that Pacific Northwest apple producers could use this treatment for woolly aphid control on root suckers. **Thiamethoxam on barley.** This second-generation neonicotinyl insecticide is effective against aphid pests. **Cyromazine on snap beans** is effective against dipteran leafminer pests. **Thiamethoxam on blueberry** is effective on aphid pests. **Bifenazate on cherries** is an acaricide that controls spider mites. **Thiacloprid on cherries.** Thiocloprid is a second-generation neonicotinyl insecticide that has a broad spectrum of activity on aphids, leafhoppers, etc. Its primary use in Washington would be for cherry fruit fly control. **Acetamiprid on grapes** is directed toward glassy winged sharpshooter in California, but this chloronicotinyl insecticide will also kill Pacific Northwest leafhopper species on grapes. **Spinosad on grass (pasture and seed)** is a reduced-risk insecticide mainly for use here on cutworm and armyworm. **Thiacloprid on peach** is a second-generation, broad-spectrum, neonicotinyl insecticide. Its primary use in Washington would be for green peach aphid control. **Buprofezin on pear** is an insect growth regulator that inhibits chitin synthesis in homopteran insect pests. Its primary use in Washington would be for pear psylla control.

Weed Science (Herbicides/Growth Regulators)

Fluroxypyr on apple and pear provides post-emergent control of broadleaf weeds including Kochia and nightshade. **Flumioxazin on onions** provides pre-emergence broadleaf control and residual soil activity with low application rate.

IR-4 REGIONS



For further information on IR-4, see their website: http://pestdata.ncsu.edu/ir-4

Precision Forestry

Making Progress in Washington State

Doug St. John, Associate Director, Precision Forestry Cooperative

The Precision Forestry Cooperative was founded as part of the Advanced Technology Initiative (ATI) funded by the Washington State Legislature in its most recent biennial budget. ATI creates "expertise clusters" composed of faculty and professional staff selected to work collaboratively with the private sector to leverage research into direct economic benefits. The University of Washington's College of Forest Resources, in collaboration with the UW College of Engineering, created the Precision Forestry Cooperative to conduct pioneering research in forest production, management, and manufacturing at a new scale of resolution and accuracy with the goal of producing economic and environmental benefits.

What is Precision Forestry?

Precision forestry is an aggregation of systems designed to advance the technology used in managing forests. This is accomplished through collaborative research and the employment of scientific data and processes to support forest management decision-making. The overall objective of precision forestry is to increase the value of products and services from forests.

Specifically, the Precision Forestry Cooperative in Washington will collaborate with private landowners, harvesters, manufacturers, public agencies, and the general public to investigate and develop tools and processes to provide the greatest return on forest products and services to Washington State for the least cost. Parties interested in exploring projects with the Precision Forestry Cooperative can contact the Associate Director. The cooperative's Executive Board approves projects and sets research priorities.

Economic Importance

The forest products industry is a major contributor to Washington's economy. Depending upon how the statistics are broken down, it is the second or third largest manufacturing sector in the state, behind aerospace and on a par with agriculture.

In order to use forest products wisely, producers and manufacturers need high quality, detailed information upon which to base decisions. Public interest in protection of resources has led to new rules about forest harvesting; many of the regulations require precise information and extensive documentation. When harvesting near a riparian area, for example, the size, species, and number of trees needed for a buffer area must be known. This information can be used to calculate the number, size, and species of trees that can be harvested.

Development of the Cooperative

Dr. Jim Fridley led the start-up of the Precision Forestry Cooperative. The cooperative has formally expanded its activities into four areas:

- Decision Support Systems (led by Bruce Lippke),
- Data Collection & Monitoring (led by Gerard Schreuder),
- Engineering Components (led by Jim Fridley), and
- Silvicultural and Ecological Engineering (led by Bruce Larson).

Dr. Schreuder and Dr. Larson share the management of the cooperative. Doug St. John began as Associate Director in support of the cooperative in July.

The following specific projects are underway through the Precision Forestry Cooperative.

LIDAR Data Collection and Evaluation

Light Detection And Ranging (LIDAR) is a laser-based, remote-sensing system for scanning the forest from an aircraft. The Precision Forestry Cooperative acquired LIDAR data for a specific research area near Olympia. The data is now being evaluated and methods are being developed to extract precision topographic, riparian, and vegetation information. Preliminary results appear very promising and indicate that precision data collection over large areas may be possible in the near future.

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Precision Forestry, cont.

Doug St. John, Associate Director, Precision Forestry Cooperative

Radio Frequency Identification of Trees
The technology to identify individual trees by radio frequency is close to a reality. Radio Frequency Identification, or RFID, is an inexpensive technology similar to theft security systems for retail goods. Industry has been looking for practical applications for RFID such as aiding in documentation of certified wood products.

Forest Visualization for Design Planning
Using specialized software and databases about the trees in a forest, computer synthesized images can be generated to explore and communicate the predicted appearance of forests under a variety of management options. The Precision Forestry Cooperative is investigating this technology for application possibilities.

The Precision Forestry Cooperative is located at the College of Forest Resources, University of Washington, Box 352100, Seattle, WA 98195. Results of research conducted by the cooperative are available to the public through a variety of channels, including their website (**http:// www.cfr.washington.edu/cfrweb/pfc**) and the First International Precision Forestry Symposium, to be held on the University of Washington campus June 18 and 19, 2001. To receive future announcements concerning the symposium, contact Megan O'Shea at (206) 543-9744 or **moshea@u.washington.edu**.

*Precision Forestry Cooperative Associate Director Doug St. John can be reached at (206) 685-1556 or **stjohnd@u.washington.edu**.*

Pest of the Month: Rodents

Jack Marlowe, President, Washington State Pest Control Association

Norway rats, roof rats, and house mice are known as “commensal” rodents, meaning they “feed from the table,” or coexist, with man. Each species has been imported to the United States from Asia or Europe.

Norway rats are heavy-bodied with a blunt muzzle, small ears, and a tail slightly shorter than the body. Roof rats are slender with a pointed muzzle, large ears, and a tail longer than the body. The house mouse is small (2-1/2 to 3-1/2 inches long), with large ears, a tail slightly longer than its body, and a pointed muzzle. Rats can enter a structure though an opening one half inch or greater and mice through an opening as small as one quarter inch.

Rodents are prolific breeders and will produce young all year long. All species are omnivorous and will feed on all types of foodstuffs. Rats require a water source, but the house mouse, while it will drink water, can metabolize water from the food it consumes.

Simple things can be done to help prevent rats and mice from invading your home or business:

- Be sure doors are weatherized. Be sure all outside doors, windows and vents fit snugly, with no gaps, and are kept closed, especially at night. Heat leaking through cracks under and around doors is an inviting beacon. Mice can enter a hole just one-quarter-inch across!
- Repair or replace broken or missing crawlspace vent screens. Broken or missing vent screens provide easy access into crawlspaces. From the crawlspace there are dozens of ways for rodents to enter living areas.
- Be sure your dryer vent has a one-way flapper valve that closes completely. Lint caught around the opening can hold the valve open, allowing entry. It’s a simple matter for a rodent to chew through the vent hose inside.

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Pest of the Month: Rodents, cont.

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- Check for areas on the roof where gaps could provide entry into attic areas. Pay special attention around gables and dormer windows. If gaps exist, screen them off or close them with expanding foam.
- Be sure to secure pet doors at night.
- Clean up fallen fruit or nuts around trees in your yard.
- Don't leave pet food out overnight.
- Keep woodpiles, compost piles and debris as far away from the structure as possible.
- Secure the lids on outside garbage containers.
- Check for holes or gaps around utility lines and pipes where they enter the structure.
- Cut back shrubs, trees and vegetation. These provide food, hiding places, and access to higher areas. Keep plants and shrubs trimmed back at least 12 inches from the outer surface of any building.
- Check porch overhangs and decorative features for accessible voids that can be used as nesting sites.
- Clean up and remove all trash and rubbish, especially near your buildings.

A word about deer mice. Deer mice are native rodents that may carry the disease hanta virus. These rodents do not like to inhabit occupied structures, but they will readily move into unoccupied buildings such as vacation cabins, storage sheds, garages, and crawlspaces, especially during colder months. The virus is found in the droppings, urine, and saliva of the rodents. (Rodents do not have urinary bladders and will dribble urine as they move through their territory.) When cleaning up an area where rodent activity has occurred, wear gloves and wet down the area to be cleaned with a disinfectant solution that states that it will kill virus. Conduct clean-up while the area is wet, taking care not to stir up dust particles, as the hanta virus spreads in such airborne particles. Never touch dead rodents. If a dead rodent must be removed, wet down the area with the disinfectant, place your hand inside a plastic bag, cover the rodent and turn the bag inside out. Seal the bag and immediately remove the rodent to an exterior disposal site. Nesting debris should be handled in a similar manner.

*Jack Marlowe is the owner of Eden Advanced Pest Technologies (**http://edenpest.com**) and current President of Washington State Pest Control Association. He can be reached at (800) 401-9935 or edenapt@olywa.com.*

PNN Update

The Pesticide Notification Network (PNN) is operated by WSU's Pesticide Information Center (PIC) 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 can be viewed on our web page. 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/**.

Should you have questions about the PNN or information on our PICOL page, e-mail PNN Coordinator Jane M. Thomas at **jmthomas@tricity.wsu.edu** or contact Pesticide Information Center Manager Catherine Daniels at **cdaniels@tricity.wsu.edu** or (509) 372-7495.

Federal Register Excerpts

Compiled by Jane M. Thomas, Pesticide Notification Network Coordinator, WSU

In the September 6 Federal Register, EPA announced that the interim risk management decisions were available for three organophosphate pesticides: bensulide, cadusafos, and chlorethoxyfos. Electronic copies of both the full RED text and the fact sheets are available on-line at the following URL: **http://www.epa.gov/oppsrrd1/REDs/**. (Page 54002)

In the September 8 Federal Register, EPA announced that the revised version of the pesticide science policy document "The Use of Data on Cholinesterase Inhibition for Risk Assessments of Organophosphorus and Carbamate Pesticides" was available. This document is available electronically at the following URL: **http://www.epa.gov/pesticides/**. Page 54521)

In the September 20 Federal Register, EPA announced that the companies that hold the pesticide registrations of manufacturing-use pesticide products containing chlorpyrifos have asked EPA to cancel their registrations for these products and to either cancel or amend their registrations for end-use products containing chlorpyrifos. These requests for voluntary cancellation and amendment are the result of a memorandum of agreement earlier signed by EPA and a number of registrants. For a more detailed discussion of this action see PNN notification 2000-252 on the PNN web page at **http://pnn.wsu.edu**. (Page 56886)

In the September 25 Federal Register, EPA announced that it had forwarded to the USDA a draft final rule that would establish a program whereby States and Tribes will develop and implement plans to manage the use of pesticides determined to leach to ground water. The rule identifies four pesticides of concern to be managed under this program initially. The four pesticides can continue to be used if States and Tribes develop plans which will ensure they do not leach to ground water at concentrations that may be harmful to human health and the environment. The rule also designates the four chemicals as Restricted Use pesticides. The restriction prohibits all outdoor use of the pesticides unless used in accordance with a Pesticide Management Plan (PMP) developed by States and Tribes and approved by EPA. If a State or Tribe fails to submit or obtain approval of its PMP by a date 36 months from the effective date of the Rule, users in that State or Tribal land are prohibited from using the pesticide. Under FIFRA, EPA must provide the Secretary of Agriculture with a copy of any regulation at least 30 days before signing it for publication in the Federal Register. The draft final rule is not available to the public until after it has been signed by EPA. (Page 57585)

Tolerance Information

Chemical (type)	Federal Register	Tolerance (ppm)	Commodity (raw)	Time-Limited		
				Yes/No	New/Extension	Expiration Date
difenconazole (fungicide)	9/15/00 pg 55917	0.01	canola seed	No	N/A	N/A
myclobutanil (fungicide)	9/15/00 pg 55921	1.00 1.00	artichoke peppers	Yes	Extension	7/31/02

Comment: With this action EPA is reestablishing these time-limited tolerances that had expired 7/31/00. These time-limited tolerances are being re-established due to the continued need for the use of myclobutanil to control powdery mildew in artichokes and peppers (bell and non- bell) in California and New Mexico.

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Tolerance Info, cont.

Chemical (type)	Federal Register	Tolerance (ppm)	Commodity (raw)	Time-Limited		
				Yes/No	New/Extension	Expiration Date
hexythiazox (insecticide)	9/18/00 pg 56253	3.00	strawberry	Yes	Extension	10/31/02
		0.10	dates			
Comment: These time-limited tolerances are being extended as a result of EPA again granting Section 18 exemptions for the use of hexythiazox to control mites in California and Florida .						
mefenoxam (fungicide)	9/25/00 pg 57550	0.05	canola	Yes	New	12/31/01
Comment: This time-limited tolerance is being established in response to EPA granting a Section 18 exemption for the use of a product containing mefenoxam as a seed treatment to control seed borne diseases in canola.						
bifenthrin (insecticide)	9/27/00 pg 57972	0.05	potatoes	Yes	New	12/31/02
Comment: This time-limited tolerance is being established in response to EPA granting Section 18 exemptions for the use of bifenthrin to control spider mites in Washington and Oregon potatoes.						
clopyralid (herbicide)	9/27/00 pg 57949	0.50	peaches	Yes	New	12/31/02
			nectarines			
Comment: These time-limited tolerances are being established in response to Section 18 requests from DE and NJ for the use of clopyralid to control broadleaf weeds I n orchards as a means to reduce vectoring of the plum pox virus.						
ethametsulfuron-methyl (herbicide)	9/27/00 pg 57966	0.02	canola	Yes	New	12/31/01
Comment: This time-limited tolerance is being established in response to EPA granting Section 18 exemptions for the use of ethametsulfuron-methyl on canola for control of smartweeds in North Dakota and Minnesota.						
glyphosate (herbicide)	9/27/00	see comment		No	N/A	N/A
Comment: In this Federal Register notice, EPA made final both new tolerances and tolerance revisions that had been proposed in the January 10, July 25, and August 14, 2000 Federal Registers. See the September 27 Federal Register, page 57965, for a complete listing of the revised glyphosate tolerances.						
triallate (herbicide)	9/29/00 pg 58375	0.01	sugar beet root	No	N/A	N/A
		0.50	sugar beet top			
		0.20	sugar beet pulp			
propamocarb hydrochloride (fungicide)	9/29/00 pg 58390	0.06	potato	No	N/A	N/A
indoxacarb (insecticide)	9/29/00 pg 58415	1.00	apple	No	N/A	N/A
		3.00	apple, wet pomace			
		0.20	pear			
		5.00	Brassica (head and stem subgroup)			
		10.00	leaf lettuce			
		4.00	head lettuce			
		0.50	fruiting vegetables			
		10.00	sweet corn, forage			
		0.02	sweet corn, kernel + cob with husk removed			
		15.00	sweet corn, stover			
		0.75	fat of cattle, horse, goat, sheep, hog			
		0.03	meat of cattle, horse, goat, sheep, hog			
		0.02	mbp of cattle, horse, goat, sheep, hog			
halosulfuron-methyl (herbicide)	9/29/00 pg 58424	0.50	squash/cucumber subgroup	No	N/A	N/A

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Tolerance Info, cont.

Chemical (type)	Federal Register	Tolerance (ppm)	Commodity (raw)	Time-Limited		
				Yes/No	New/Extension	Expiration Date
hexythiazox (ovicide/miticide)	9/29/00 pg 58437	0.50	apple (see comment)	No	N/A	N/A
		0.80	apple, wet pomace			
		1.00	stone fruit (except plums)			
		0.02	fat of cattle, horse, goat, sheep, hog			
		0.02	mbp of cattle, horse, goat, sheep, hog			
		3.00	strawberry			
Comment: With this action, EPA is increasing the tolerance for residues of hexythiazox on apples.						
flucarbazone-sodium (herbicide)	9/29/00 pg 58364	0.30	wheat forage	Yes	New	11/1/05
		0.10	wheat hay			
		0.05	wheat straw			
		0.01	wheat grain			
		1.50	liver of cattle, horse, goat, sheep, hog			
		0.01	meat of cattle, horse, goat, sheep, hog			
		0.01	mbp of cattle, horse, goat, sheep, hog			
EPA is establishing these tolerances as time-limited. Permanent tolerances may be established after Bayer submits a revised method and additional residue data that measure not only the parent and N-desmethyl metabolite, but also the sulfonamide metabolites of concern.						
dimethomorph (fungicide)	9/29/00 pg 58385	60.00	dried hop cones	No	N/A	N/A
		3.50	grapes			
		6.00	raisins			
		0.50	tomato			
		1.00	tomato paste			
azoxystrobin	9/29/00 pg 58404	0.20	barley bran			
		0.10	barley grain			
		15.00	barley hay			
		4.00	barley straw			
		30.00	coriander, leaves			
		12.00	corn, field, forage			
		0.05	corn, field, grain			
		0.30	corn, field, refined oil			
		25.00	corn, field, stover			
		0.05	corn, pop, grain			
		25.00	corn, pop, stover			
		12.00	corn, sweet, forage			
		0.05	corn, sweet (kernels plus cob with husks removed)			
		25.00	corn, sweet, stover			
		30.00	grain, aspirated grain fractions			
		1.00	onion, dry bulb			
		7.50	onion, green			
		25.00	soybean, forage			
		55.00	soybean, hay			
		1.00	soybean, hulls			
		0.50	soybean, seed			
		30.00	vegetable, leafy, except Brassica, group			
		50.00	vegetable, leaves of root and tuber, group			
		0.50	vegetable, root, subgroup			
		0.03	vegetable, tuberous and corm, subgroup			
		0.03	fat of cattle, horse, goat, sheep (see comment)			
		0.07	mbp of cattle, horse, goat, sheep (see comment)			
Comment: With this action EPA is increasing the tolerances for azoxystrobin in the fat and meat byproducts of cattle, horse, goat, and sheep.						