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

IR-4: Developing and Delivering Pest Management Solutions for Minor Crop Producers

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

Minor crops are major business. They yielded over $31 billion in United States sales in 1997, according to the National Agricultural Statistics Service (NASS). The Washington State Department of Agriculture (WSDA) reports that Washington's sales for this period were $5.6 billion, ranking our state 15th in total agricultural production among all U.S. states and territories. But with respect to minor crops, Washington is really a major player, ranking second only to California.

What Is a "Minor Crop?"

Under the Food Quality Protection Act (FQPA) of 1996, "minor crops" are defined as crops for which fewer than 300,000 acres are devoted for production nationally. Most crops are minor crops.

What Constitutes "Minor Use?"

"Minor use" of a pesticide includes application of a pesticide to a minor crop as well as limited pesticide application to a major crop for a regional pest or localized pest outbreak. The bottom line is economics: use of a pesticide is "minor" when the sales realized on the volume applied on a specific crop/site do not warrant the expense that would be incurred by a registrant to obtain registration for that particular use.

Several factors contribute to the lack of economic incentive for pesticide registrants to register or re-register pesticides on minor crops:

- Most minor crops have limited pesticide sales potential.
- Government mandated re-registration of existing pesticides and individual state registration requirements impose an additional clerical and economic burden on registrants.
- As patents for pesticide ingredient chemistries are time-limited, registrants of older compounds may be disinclined to invest in re-registration for an older chemistry that is or could be manufactured and distributed by other vendors.

The Minor Use Problem and the IR-4 Solution

As registrants shy away from minor use registrations for economic reasons, the variety of pesticides available for application on minor crops dwindles. This is

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referred to as the "minor use problem." To increase the availability of crop protection chemistries for minor crop producers, the Interregional Research Project No. 4 (IR-4 Project) was established in 1963. IR-4 is a federal/state/private cooperative that aspires to obtain clearances for pest control chemistries on minor crops. Over time, the mandate of IR-4 has grown to include the encouragement of clearances for less ecologically disruptive pest controls including bacteria, viruses, fungal and bacterial extracts, fermentation products, pheromones, and plant growth regulators. These biological control strategies have become instrumental in the development and success of Integrated Pest Management (IPM) systems.

What Does IR-4 Do?

IR-4 prepares and submits petitions to the Environmental Protection Agency (EPA) requesting tolerances or exemptions for pest control products on minor crops. (The IR-4 program does not conduct research on dairy, poultry, livestock, or aquacultural products.)

Who Pays for It?

IR-4 is funded by the United States Department of Agriculture Cooperative State Research, Education and Extension Service (USDA CSREES) and the USDA Agricultural Research Service (USDA-ARS), with substantial additional support from chemical companies and commodity organizations. In 1999, USDA-CSREES provided $8.99 million and USDA-ARS provided $2.1 million in funding. In Washington State, WSU provides support for the State Liaison Representative (me), for a Field Study Director (Ron Wight), for an Analytical Chemist (this position is currently open at Washington State University's Food and Environmental Quality Lab, see p. 18), and for our permanent and seasonal support staff.

How Does IR-4 Work?

Step 1: Initiation of an Idea via PCR

Anyone can make pesticide needs known to IR-4. Once a project is selected for research, IR-4 will conduct all necessary research and prepare the tolerance petition for review and approval by EPA. The entire process generally takes four to five years to complete.

To initiate the process, an interested party would contact the appropriate state liaison representative (SLR). I am the SLR for Washington. The other Western Region SLRs are listed on the opposite page. The SLR provides the interested party with a Pesticide Clearance Request (PCR) form. The PCR form details the information required by IR-4 to process a request, such as target crop, target pest(s), and pesticide or biopesticide under consideration. Providing as much information as possible and working closely with the SLR can potentially save time in the review process.

Steps 2, 3, 4: PCR Review, Registrant Contact, EPA Review

Each PCR is reviewed by Regional Coordinators and forwarded with supporting data to IR-4 Headquarters, housed within Rutgers University at the New Jersey Agricultural Experiment Station in New Brunswick (**http://www.cook.rutgers.edu/~ir4**). IR-4 then determines if required data on product chemistry, toxicology, and environmental fate have already been obtained by the product registrant and whether these data have been accepted by the EPA. If so, IR-4 drafts a letter to the product registrant outlining the proposed use and the data available to support that use. IR-4 offers the registrant the opportunity to conduct the research necessary to obtain a clearance; the registrant must support the process and agree to properly label for the new use. EPA then conducts another review to identify additional data requirements.

Step 5: IR-4 Workshop and Priority Ranking

Following this review process, if IR-4 determines that a project is researchable, it is reviewed at an IR-4 workshop consisting of minor crop experts from across the country. Dr. Bob Parker (WSU Weed Scientist), Lyle Birch (USDA-ARS representative), and I represented Washington State at this year's workshop August 25–27 in Denver, Colorado. This annual national workshop consists of three single-day

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workshops devoted to entomology, plant pathology, and weed science respectively. Each discipline-based workgroup ranks all researchable projects as a high (A or B), medium (C), or low (D) priority project. Other designations include categories 10 and 01, the former being those projects the workgroup agrees should be abandoned, and the latter being those for which all continuing research will be conducted and funded by the registrant (IR-4 will only be responsible for assembling and submitting the petition to EPA).

Under the enthusiastic leadership of IR-4 Director Dr. Bob Holm, A-priority projects are targeted for completion within thirty months. B-priority projects can be worked on if some level of additional support is given by the requesting region, state, commodity organization, or registrant. Category C and D projects basically "sit in the hopper" for now; these projects are deemed researchable, but lack sufficient resources and/or support for completion at this time.

A list of those projects relevant to the Pacific Northwest that were prioritized as A (highest), B (high), or 10 (abandoned) is provided on pages 5–9. For the sake of space, items ranked C, D, and 01 were not included.

Step 6: Research Program Established

Following the prioritization workshop, a National Research Planning meeting is held to develop a proposed research program for the following season. First consideration is given to completing ongoing projects. Beyond that, project selection takes into consideration:

- residue analysis capabilities of the IR-4 laboratories,
- availability and capacity of field support, and
- support from private commodity or registrant sponsors.

Step 7: Field and Lab Research

The Western Regional Field Coordinators and federal liaison representatives contract with state, federal, or private agricultural researchers to conduct the field phase of the testing program. In this phase, plant safety and performance data is gathered and crop samples are collected for residue analysis in the laboratory phase. Laboratories affiliated with IR-4 are located at state agricultural experiment stations, universities, and federal analytical facilities.

IR-4 Contact Personnel

SLR	State	Phone#	Fax#
John Palumbo	Arizona	(520) 782-3836	(520) 782-1940
Margaret Reiff	California	(530) 752-7633	(530) 752-2866
Sandra McDonald	Colorado	(970) 491-6207	(970) 491-3862
Ronda Hirnyck	Idaho	(208) 364-4046	(208) 364-4035
Reeves Petroff	Montana	(406) 994-3518	(406) 994-6029
Richard Lee	New Mexico	(505) 646-2888	(505) 646-8085
Jeff Jenkins	Oregon	(541) 737-5993	(541) 737-5001
Howard Deer	Utah	(435) 797-1602	(435) 797-1601
Doug Walsh	Washington	(786) 786-9287	(509) 786-9370
Mark Ferrell	Wyoming	(307) 766-5381	(307) 766-5549
Regional Field Coordinator			
Ron Hampton	U.C. Davis	(530) 752-7633	(530) 752-2866

All IR-4 research—field and laboratory—is carried out according to Good Laboratory Practice (GLP) requirements mandated by EPA. This includes a research outline, or protocol, developed by a study director at IR-4 Headquarters. Protocols must be reviewed and approved by commercial registrants. The research protocol includes directions for use based on information supplied by the requestor and agreed upon by the chemical registrant. The research process is inspected by IR-4 quality assurance personnel to validate compliance. The number of field trials required by EPA varies considerably by crop and that crop's production geography. For example, typically sixteen field trials are required to produce adequate samples for magnitude-of-residue studies for apples. Five of these studies must be conducted in either eastern Washington, Oregon, or Idaho. The other nine sites need to be

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in other apple-producing regions of the United States. For pineapples, usually eight field trials are required, but obviously all the trials must be conducted in Hawaii.

The field samples are then analyzed in the laboratory for residue-level variation. Levels vary between field trials and between various geographic locations. For example, the persistence of a herbicide can vary substantially between geographic regions due to abiotic factors (e.g., weather) and biotic factors (e.g., soil organic matter content).

Steps 8 & 9: EPA Petition, Evaluation/Results
After the magnitude-of-residue analyses are complete, the study director at IR-4 headquarters assembles all the required data and submits it in the form of a petition to EPA. A positive evaluation by EPA results in publication in the federal register of notice to establish a tolerance.

To date, IR-4 has obtained tolerances for over 300 clearances on more than 100 minor crops in the Pacific Northwest. The IR-4 Project is the main fulcrum for pesticide registration on minor crops in Washington State.

What Can Growers and Others Do?

Washington State minor-crop producers and commodity representatives should review the list of crop chemical combinations following. If a project important to you is prioritized as a B, and you wish to work toward elevating that project's status, please contact me directly. In Washington State, we have some leverage through commodity group support and additional funding support from the Washington State Commission on Pesticide Registration (WSCPR) to enable projects to be elevated to A priority on the regional level, thereby expediting the completion of research and registration.

Individuals or groups wishing to initiate review of a particular crop-chemistry combination not already ranked or underway can also contact me. I will provide a Pesticide Clearance Request Form as described above. New PCRs will be considered for prioritization and subsequent research in the next review cycle.

For more information on IR-4 in Washington State, contact State Liaison Representative Dr. Doug Walsh at Washington State University's Irrigated Agriculture Research and Extension Center(WSU IAREC) in Prosser: ***dwalsh@tricity.wsu.edu*** *or (509) 786-2226.*

Dr. Walsh commends his colleagues, Bob Parker and Lyle Birch from Washington, Bob McReynolds and Joe De Francesco from Oregon, Ronda Hirnyck from Idaho, Sandra McDonald from Colorado, Jim Adaskaveg and Harry Agamalian from California, John Palumbo from Arizona, and Margaret Reiff and Ron Hampton from IR-4 Western Regional Headquarters for the objective and positive cooperation exhibited in prioritizing projects of regional importance to Western U.S. agriculture at the workshop in Denver.

Status of IR-4 Projects: HERBICIDES

A=Highest • B=High, requires additional support • 10=Abandoned

Crop	Active Ingred.	Priority	Trade Name	Use
Apple	bentazon	B	PILARGRAN	Selective postemergent control of many broadleaf weeds and cyperaceae (sedges).
Apple	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Apple	triclopyr	10	REMEDY	Systemic herbicide for control of woody plants/broadleaf weeds on rights-of-way, forests, industrial sites, turf, permanent grass pastures, rangeland, non-irrigation ditchbanks.
Apple	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Asparagus	azafenidin	A	MILESTONE	Broad-spectrum preemergent residual herbicide.
Bean (lima)	sulfentrazone	B	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Bean (snap)	glyphosate	10	ROUNDUP	Nonselective postemergent herbicide.
Beet (sugar)	dimethenamid	B	FRONTIER	Weed control of annual grasses, broadleaf weeds, yellow nutsedge in corn, dry beans, sorghum, soy.
Beet (sugar)	endothall	B	ACCELERATE	Pre/postemergent herbicide, defoliant, desiccant, aquatic algicide, growth regulator.
Blueberry	azafenidin	A	MILESTONE	Broad-spectrum preemergent residual herbicide.
Blueberry	thiazopyr	B	VISOR	Control of annual and perennial broadleaf weeds, including crabgrass and nutsedge.
Broccoli	carfentrazone-ethyl	10	AIM	Postemergent use on corn and rice for broad-spectrum control of broadleaf weeds and a wide range of winter annuals and mustards.

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Status of IR-4 Projects: HERBICIDES, cont.

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Crop	Active Ingred.	Priority	Trade Name	Use
Broccoli	metolachlor	B	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Cabbage	halosulfuron	10	PERMIT	Pre/postemergent control of annual broadleaf weeds and nutsedge in corn, grain sorghum, turf.
Caneberry (blackberry)	oxyfluorfen	B	GOAL	Selective herbicide for control of certain annual broadleaf and grassy weeds.
Caneberry (raspberry)	thiazopyr	B	VISOR	Control of annual and perennial broadleaf weeds, including crabgrass and nutsedge.
Carrot	ethephon	10	CERONE	Plant growth regulator, as ethylene generator.
Cherry	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Cherry	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Cherry	triclopyr	10	REMEDY	Systemic herbicide for control of woody plants/broadleaf weeds on rights-of-way, forests, industrial sites, turf, permanent grass pastures, rangeland, non-irrigation ditchbanks.
Clover	2,4-DB	B		
Clover (seed)	imazamox	B	RAPTOR	Control of annual grasses and some broadleaf weeds for use on soybeans.
Collard	oxyfluorfen	10	GOAL	Selective herbicide for control of certain annual broadleaf and grassy weeds.
Corn (sweet)	dicamba & diflufenzopyr	B	CLARITY	Control of annual and perennial broadleaf weeds.
Corn (sweet)	flufenacet	B	AXIOM	Soil-applied control of annual grasses and certain dicot weeds in various crops.
Cucumber	diquat	10	REWARD	Contact herbicide, desiccant.
Cucumber	ethephon	10	CERONE	Plant growth regulator, as ethylene generator.
Cucumber	metolachlor	10	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Daikon	fluroxypyr-meptyl	A	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Dill	sethoxydim	A	POAST	Selective postemergent control of annual and perennial grasses in field crops.
Endive	paraquat	10	HERBOXONE	Contact herbicide, desiccant.
Filbert	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Filbert	ethephon	B	CERONE	Plant growth regulator, as ethylene generator.
Flax	clopyralid	B	STINGER	Herbicide for polygonaceae, compositae, and leguminosae.
Flax	picloram	10	TORDON	Systemic herbicide for wide variety of deep-rooted broadleaf weeds and woody plants. Most grasses are resistant.
Flax	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Flax	sulfentrazone	B	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Flax	quizalofop	10	PILOT	Postemergent grass weed control in broadleaf crops.
Flax	trifluralin	10	TREFLAN	Selective preemergent herbicide.
Greens (mustard)	carfentrazone-ethyl	10	AIM	Postemergent use on corn and rice for broad-spectrum control of broadleaf weeds and a wide range of winter annuals and mustards.
Greens (mustard) - plant back	metolachlor	B	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Greens (mustard) - weeds	metolachlor	10	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Kale	metolachlor	10	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Kiwifruit	thiazopyr	B	VISOR	Control of annual and perennial broadleaf weeds, including crabgrass and nutsedge.
Leek	bromoxynil	A	MERIT	Selective contact herbicide with limited systemic activity for postemergent control of annual broadleaf weeds.
Lettuce (head & leaf)	paraquat	10	HERBOXONE	Contact herbicide, desiccant.
Lettuce (head)	clethodim	A	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Mint	asulam	10	MARLOX	Postemergent herbicide in sugarcane.
Mint (peppermint)	diuron	10	DIREX	Effective against emerging and young broadleaf and grass weeds as well as mosses; suitable for both selective and total weed control.
Mustard (seed)	quizalofop	B	PILOT	Postemergent grass weed control in broadleaf crops.
Okra	sethoxydim	A	POAST	Herbicide for polygonaceae, compositae, and leguminosae.
Onion (green)	paraquat	10	HERBOXONE	Contact herbicide, desiccant.
Onion (green)	dimethenamid	A	FRONTIER	Weed control of annual grasses, broadleaf weeds, yellow nutsedge in corn, dry beans, sorghum, and soybeans.
Parsley	napropamide	10	DEVRINOL	Selective herbicide for several grass and broadleaf weeds.
Pea (succulent)	metribuzin	B	CONTRAST	Controls a large number of grass and broadleaf weeds infesting agricultural crops.
Peach	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Peach	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Peach	glyphosate	B	ROUNDUP	Nonselective postemergent herbicide.
Peach	triclopyr	10	REMEDY	Systemic herbicide for control of woody plants/broadleaf weeds on rights-of-way, forests, industrial sites, turf, permanent grass pastures, rangeland, non-irrigation ditchbanks.
Pear	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Pear	triclopyr	10	REMEDY	Systemic herbicide for control of woody plants/broadleaf weeds on rights-of-way, forests, industrial sites, turf, permanent grass pastures, rangeland, non-irrigation ditchbanks.
Pear	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Pepper (bell)	clomazone	A	MERIT	Broad-spectrum herbicide for control of annual grasses and broadleaf weeds.
Pepper (bell)	diquat	10	REWARD	Contact herbicide, desiccant.
Pepper (non-bell)	clomazone	B	MERIT	Broad-spectrum herbicide for control of annual grasses and broadleaf weeds.
Pepper (non-bell)	halosulfuron	B	PERMIT	Pre/postemergent control of annual broadleaf weeds and nutsedge in corn, grain sorghum, turf.
Plum	fluroxypyr-meptyl	B	STARANE	Postemergent foliar application for control of broadleaf weeds in cereals.
Plum	clethodim	B	PRISM	Systemic postemergent herbicide for control of annual and perennial grasses.
Plum	triclopyr	10	REMEDY	Systemic herbicide for control of woody plants/broadleaf weeds on rights-of-way, forests, industrial sites, turf, permanent grass pastures, rangeland, non-irrigation ditchbanks.

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Status of IR-4 Projects: HERBICIDES, cont.

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Crop	Active Ingred.	Priority	Trade Name	Use
Potato	halosulfuron	A	PERMIT	Pre/postemergent control of annual broadleaf weeds and nutsedge in corn, grain sorghum, turf.
Potato	sulfentrazone	B	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Potato (white)	dimethenamid	A	FRONTIER	Control of annual grasses, broadleaf weeds, yellow nutsedge in corn, dry beans, sorghum, and soybeans.
Pumpkin	ethephon	10	CERONE	Plant growth regulator, as ethylene generator.
Pumpkin	metolachlor	10	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Pumpkin	sulfentrazone	B	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Pumpkin (no plastic in rows)	metolachlor	A	DUAL	preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Radish	sethoxydim	A	POAST	Selective postemergent control of annual and perennial grasses in field crops.
Radish, Daikon, Turnip	bensulide	B	PREFAR	Preemergent control of annual grasses.
Safflower	ethalfluralin	B	SONALAN	Selective preemergent herbicide; preplant incorporated for soybeans, sunflowers, dry beans, peanuts, and dry peas.
Safflower	thifensulfuron-methyl	A	PINNACLE	Selective postemergent broadleaf and weed control in soybeans.
Safflower	tribenuron-methyl	10	EXPRESS	Selective postemergent broadleaf weed control in wheat, barley.
Squash	ethephon	10	CERONE	Plant growth regulator, as ethylene generator, to promote maturity.
Squash	ethephon	B	CERONE	Plant growth regulator, as ethylene generator, to promote flowering.
Squash	metolachlor	B	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.
Squash (summer)	diquat	10	REWARD	Contact herbicide, desiccant.
Squash (winter)	sulfentrazone	A	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Strawberry	sulfentrazone	A	AUTHORITY	Controls broadleaf and grass weed species including ALS resistant weeds in soybeans, sugarcane, tobacco, and several species of turfgrass.
Strawberry	oxyfluorfen	A	GOAL	Selective herbicide for control of certain annual broadleaf and grassy weeds.
Strawberry	naptalam	10	NAPTRO	Controls broadleaf weeds on cucurbits, vine crops, and nursery stock.
Strawberry	pendimethalin	B	PROWL	Selective herbicide.
Strawberry	triasulfuron	B	AMBER	Preemergent in wheat to control many broadleaf and grassy weeds; postemergent in wheat, barley, and fallow to control many broadleaf weeds.
Sunflower	glyphosate	A	ROUNDUP	Nonselective postemergent herbicide.
Sunflower	imazamox	B	RAPTOR	Control of annual grasses and some broadleaf weeds for use on soybeans.
Swiss Chard	clopyralid	B	STINGER	Herbicide for polygonaceae, compositae, and leguminosae.
Tomato	diquat	10	REWARD	Contact herbicide, desiccant.
Watermelon	metolachlor	10	DUAL	Preemergent and preplant incorporated weed control in corn, soybeans, peanuts, grain sorghum, potatoes, pod crops, cotton, safflower, and woody ornamentals.

Status of IR-4 Projects: INSECTICIDES

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Crop	Active Ingred.	Priority	Trade Name	Use
Apple	imidacloprid	A	ADMIRE	Soil, seed, or foliar treatment; highly systemic; controls sucking insects. (Apple maggot flies)
Apple	malathion	10	MALIXOL	Insecticide for aphids, spider mites, scale insects, and other chewing, sucking insects attacking fruits, vegetables, ornamentals, and stored products. (Sweet potato weevil)
Bean	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Bean (dry)	bifenthrin	B	BRIGADE	Broad-spectrum insecticide, miticide, termiticide.
Bean (dry)	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Bean (dry)	zinc phosphide	B	PROZAP	Rodenticide; use as bait for control of rats, mice, ground squirrels, prairie dogs, voles, moles, and gophers.
Bean (lima)	cyromazine	A	CITATION	Insect growth regulator; controls leafminers in chrysanthemums.
Bean (snap)	buprofezin	A	APPLAUD	Persistent larvicide against mealybugs, rice planthoppers, scales, and whiteflies.
Bean (snap)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Beet (sugar)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Blueberry	metaldehyde	A	META	Molluscicide; apply as a bait for slugs and snails; highly selective molluscicide with no reported effects on non-target organisms.
Blueberry	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Blueberry	pirimicarb	10	PIRIMOR	Selective aphicide for both organophosphate-resistant and non-organophosphate-resistant strains. Acts by contact, translaminar, systemic action, vapor.
Blueberry (highbush)	imidacloprid	B	ADMIRE	Soil, seed, or foliar treatment; highly systemic; controls sucking insects.
Blueberry (highbush)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Broccoli	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Broccoli	pyrethrins	10	PRENTOX	Contact insecticide used extensively. (Lepidoptera (loopers), lygus bugs, beetles)
Broccoli	thiodicarb	10	LARVIN	Insecticide; ovicide active against major Lepidoptera pests.
Cabbage	cyfluthrin + tebupirimfos	A	AZTEC	Granular, soil-applied in a band.
Cabbage	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.

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Status of IR-4 Projects: INSECTICIDES, cont.

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Crop	Active Ingred.	Priority	Trade Name	Use
Cabbage	cyfluthrin	10	BAYTHROID	Foliar insecticide controls chewing and sucking insects on various crops. (Grasshoppers, Lep. larvae)
Cabbage	naled	10	TRUMPET	Insecticide, acaricide for numerous crops. (Diamondback caterpillar)
Caneberry	imidacloprid	B	ADMIRE	Soil, seed, or foliar treatment; highly systemic; controls sucking insects.
Caneberry (raspberry)	abamectin	A	AGRI-MEK	Insecticide; miticide.
Caneberry (raspberry)	metaldehyde	A	META	Molluscicide; apply as a bait for slugs and snails; highly selective molluscicide with no reported effects on non-target organisms.
Caneberry (raspberry)	bifenazate	B	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Caneberry (raspberry)	pirimicarb	10	PIRIMOR	Selective aphicide for both organophosphate-resistant and non-organophosphate-resistant strains. Acts by contact, translaminar, systemic action, vapor.
Carrot	thiamethoxam	A	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Carrot	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Carrot	pirimicarb	B	PIRIMOR	Selective aphicide for both organophosphate-resistant and non-organophosphate-resistant strains. Acts by contact, translaminar, systemic action, vapor.
Celery	malathion	10	MALIXOL	Insecticide for aphids, spider mites, scale insects, and other chewing, sucking insects attacking fruits, vegetables, ornamentals, and stored products.
Cherry	thiamethoxam	A	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Cherry	bifenazate	B	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Cherry	buprofezin	B	APPLAUD	Persistent larvicide against mealybugs, rice planthoppers, scales, and whiteflies.
Cilantro	bifenthrin	A	BRIGADE	Broad-spectrum insecticide, miticide, termiticide.
Collard	diflubenzuron	10	DIMILIN	Wide range of leaf-feeding insects. (Lepidoptera larvae)
Collard	permethrin	10	PRELUDE	Insecticide, termiticide, wood preservative. (Aphids, Lepidoptera larvae)
Cucumber	bifenazate	A	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Endive	esfenvalerate	10	HALMARK	Broad-spectrum insecticide.
Filbert	malathion	10	MALIXOL	Insecticide for aphids, spider mites, scale insects, and other chewing, sucking insects attacking fruits, vegetables, ornamentals, and stored products.
Flax	malathion	10	MALIXOL	Insecticide for aphids, spider mites, scale insects, and other chewing, sucking insects attacking fruits, vegetables, ornamentals, and stored products. (Grasshoppers)
Grape	pyriproxyfen	B	KNACK	Effective on a wide range of arthropod pests; controls whitefly on cotton; insect growth regulator.
Greens (mustard)	cyfluthrin	B	BAYTHROID	Foliar insecticide controls chewing and sucking insects on various crops. (Grasshoppers, Lep. larvae)
Greens (mustard)	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Onion (dry bulb)	thiamethoxam	A	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Onion (dry bulb)	abamectin	B	AGRI-MEK	Insecticide, miticide. (Pea leafminer, thrips)
Onion (dry bulb)	fipronil	B	REGENT	Controls Coleoptera, Lepidoptera, Diptera, Homoptera, Isoptera, and Thysamoptera. Systemic activity, unique mode of action with longterm residual.
Pea (dry)	thiamethoxam	A	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Pea (dry)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Pea (edible podded)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Pea (succulent)	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Pea (succulent)	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Peach	spinosad	B	SUCCESS	Broad spectrum of worm control through contact and ingestion activity.
Peach	buprofezin	B	APPLAUD	Persistent larvicide against mealybugs, rice planthoppers, scales, and whiteflies.
Peach	pirimicarb	B	PIRIMOR	Selective aphicide for both organophosphate-resistant and non-organophosphate-resistant strains. Acts by contact, translaminar, sytemic action, vapor.
Peach	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Pear	pyrethrins + PBO	10	PRENTOX	Contact insecticide used extensively. (Lepidoptera (loopers), lygus bugs, beetles)
Pepper (bell & non-bell)	bifenazate	A	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Plum	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Radish	thiamethoxam	A	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Radish	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Spinach	thiamethoxam	B	ACTARA	Broad-spectrum activity against soil-dwelling, sucking pests and some chewing pests. Effective against aphids, whiteflies, thrips, leafhoppers, and certain beetles.
Spinach	zinc phosphide	10	PROZAP	Rodenticide; use as bait for control of rats, mice, ground squirrels, prairie dogs, voles, moles, and gophers.
Squash (summer)	bifenazate	A	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Strawberry	methoxyfenozide	B	INTREPID	Only controls Lepidoptera larvae. Better on budworm/bollworm, leafminer, and diamondback moth.
Sweet Potato	cyfluthrin + tebupirimfos	B	AZTEC	Granular, soil-applied in a band.
Sweet Potato	malathion	B	MALIXOL	Insecticide for aphids, spider mites, scale insects, and other chewing, sucking insects attacking fruits, vegetables, ornamentals, and stored products. (Sweet potato weevil)
Tomato	bifenazate	A	FLORAMITE	Insecticide for control of mites, including eggs and motiles. Safe on predator mites.
Tomato	bifenthrin	B	BRIGADE	Broad-spectrum insecticide, miticide, termiticide.
Tomato (GH)	bifenthrin	A	BRIGADE	Broad-spectrum insecticide, miticide, termiticide.
Tomato (GH)	imidacloprid	A	ADMIRE	Soil, seed, or foliar treatment; highly systemic; controls sucking insects.
Tomato (GH)	pyriproxyfen	A	KNACK	Effective on a wide range of arthropod pests; controls whitefly on cotton; insect growth regulator.
Watermelon	cyfluthrin	B	BAYTHROID	Foliar insecticide controls chewing and sucking insects on various crops. (Grasshoppers, Lep. larvae)

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IR-4: Minor Crop Solutions, cont.

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

Status of IR-4 Projects: FUNGICIDES

A=Highest • B=High, requires additional support • 10=Abandoned

Crop	Active Ingred.	Priority	Trade Name	Use
Apple (PH)	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Apple (PH)	fenhexamid	B	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Basil	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Bean (Lima)	dimethomorph	B	ACROBAT	Control for downy mildew, late blight, *Phytophthora, Plasmopara, Pseudoperonospora, Bremia,* and *Peronospora.*
Blueberry	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Blueberry	Bacillus subtilis	B	SERENADE	Biological fungicide, inoculant; controls *Phytophatora, Alternaria* and other pathogens.
Broccoli	Bas 500	A	Bas 500	Controls *Alternaria,* downy mildew, leaf blights.
Broccoli	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Broccoli	dimethomorph	B	ACROBAT	Control for downy mildew, late blight, *Phytophthora, Plasmopara, Pseudoperonospora, Bremia,* and *Peronospora.*
Cabbage	Bas 500	A	Bas 500	Controls *Alternaria,* downy mildew, leaf blights.
Cabbage	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Cabbage	dimethomorph	B	ACROBAT	Control for downy mildew, late blight, *Phytophthora, Plasmopara, Pseudoperonospora, Bremia,* and *Peronospora.*
Caneberry	harpin	B	MESSINGER	Controls bacterial leaf spot, bacterial wilt, bacterial blight, and certain fungal diseases.
Caneberry	mefenoxam + copper	B	RIDOMIL GOLD COPPER	Foliar or soil with curative and systemic properties. Controls soilborne diseases caused by *Phytophthora* and *Pythium* spp., in many crops; foliar disease caused by oomycetes such as downy mildew and late blight. Used in combination with fungicides of diffe
Caneberry (blackberry)	DCNA	10	BOTRAN	Active against *Botrytis,* brown rot, *Rhizopus, Sclerotinia sclerotiorum.*
Caneberry (raspberry)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Carrot	cyprodinil + fludioxonil	A	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Carrot	fludioxonil	B	MAXIM/ SCHOLAR	Protects against *Fusarium, Helminthosporium, Rhizoctonia, Aspergillus, Alternaria, Ascochyl, Pyrenophora, Tilletia, Sclerotinia,* and *Septoria.*
Cherry (PH)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Coriander	propiconazole	B	ORBIT	Used for powdery mildew, rusts, smuts, *Pyrenophora, Septoria, Cercospora, Cercosporidium, Ascochyta, Pseudocercosporela, Mycosphaerella, Fusicladium, Gaeumannomyces, Monilinia, Clasterosporium, Helminthosporium* and related genera, *Kabatiella, Ceratocystis*
Ginseng	chlorothalonil	B	BRAVO	Fungicide.
Greens (mustard)	Bas 500	A	Bas 500	Controls *Alternaria,* downy mildew, leaf blights.
Greens (mustard)	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Greens (mustard)	dimethomorph	B	ACROBAT	Control for downy mildew, late blight, *Phytophthora, Plasmopara, Pseudoperonospora, Bremia,* and *Peronospora.*
Kiwifruit	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Kiwifruit (PH)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Lettuce (head & leaf)	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Lettuce (head & leaf)	myclobutanil	B	RALLY	Controls powdery mildews, rusts, apple scab, brown rot, shothole, cherry leaf spot, and grape black rot.
Lettuce (head & leaf)	zoxamide	B	GAVEL	Control of foliar phycomycetes and *Albugo.* Also protectant against oomycete fungi. Will be mixed with mancozeb for greater broad-spectrum activity.
Lettuce (head & leaf)	mefenoxam + maneb	10		Downy mildew.
Lettuce (head)	Bas 500	A	Bas 500	Controls *Alternaria,* downy mildew, leaf blights.
Lettuce (leaf)	Bas 500	A	Bas 500	Controls *Alternaria,* downy mildew, leaf blights.
Mint	myclobutanil	A	RALLY	Controls powdery mildews, rusts, apple scab, brown rot, shothole, cherry leaf spot, and grape black rot.
Parsley	cyprodinil + fludioxonil	B	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Pea (edible podded)	chlorothalonil	10	BRAVO	Fungicide. (Ascochyta leafspot)
Pea (succulent)	fosetyl-al	B	ALIETTE	Controls *Phytophthora, Alternaria,* and downy mildew.
Pea (succulent)	chlorothalonil	10	BRAVO	Fungicide. (Leafspots, powdery mildews)
Pea (succulent)	hymexazol	10	TACHIGAREN	Systemic soil fungicide. Use as a soil drench, soil incorporation, or seed pelleting and dressing for damping-off caused by *Fusarium, Aphanomyces, Pythium, Corticium,* etc. Agent to improve root growth and cold resistance of crop seedlings.
Peach (PH)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Pear	sodium tetrathiocarbonate	A	ENZONE	Water-soluble soil fumigant for management of plant parasitic nematodes, various soilborne pathogens and other soil pests.
Pear (PH)	cyprodinil + fludioxonil	A	SWITCH	Seed treatment for use on cereals, oil seed rape, peas, potatoes, maize, rice, vegetables. Controls both seedborne diseases and foliar diseases such as *Alternaria* and *Botrytis.*
Pear (PH)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.

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IR-4: Minor Crop Solutions, cont.

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

Status of IR-4 Projects: FUNGICIDES, cont.

A=Highest • B=High, requires additional support • 10=Abandoned

Crop	Active Ingred.	Priority	Trade Name	Use
Pepper (bell & non-bell)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Pepper (bell & non-bell)	Bas 500	B	Bas 500	
Pepper (bell & non-bell)	fenamidone	B	RPA 407213	Foliar protectant and curative activity against oomycete fungi. Also effective against ascomycetes and *Alternaria.* Inhibits electronic transport.
Pepper (bell & non-bell)	fenbuconazole	B	INDAR/ENABLE	Controls against powdery mildew, rusts, apple scab, brown rot, cotton ball, mummyberry, smuts, bunts, *Cladosporium, Myclosphaerella, Cercospora, Septoria, Rhizoctonia, Pyrenophora, Helminthosporium* & related genera, and a *Colletotrichum* sp. in turf.
Pepper (bell & non-bell)	myclobutanil	B	RALLY	Controls powdery mildews, rusts, apple scab, brown rot, shothole, cherry leaf spot, and grape black rot.
Pepper (bell & non-bell)	propamocarb hydrochloride	B	BANOL	Systemic fungicide for control of oomycete diseases by soil and foliar application in ornamentals, vegetables, and other crops.
Pepper (bell & non-bell)	maneb	10	MANOX	Controls early and late blights on potatoes, tomatoes, and other diseases of field crops, onions, tobacco, ground nuts, sugar beets, fruits, and vegetables. *(Botrytis cinerea, Alternaria* spp.)
Plum (PH)	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea* , brown rot, *Sclerotinia sclerotiorum* of lettuce.
Spinach	zoxamide	A	GAVEL	Control of foliar phycomycetes and *Albugo.* Also protectant against oomycete fungi. Will be mixed with mancozeb for greater broad-spectrum activity.
Spinach	fludioxonil	B	MAXIM/ SCHOLAR	Protects against *Fusarium, Helminthosporium, Rhizoctonia, Aspergillus, Alternaria, Ascochyl, Pyrenophora, Tilletia, Sclerotinia,* and *Septoria.*
Squash (summer)	fenamidone	B	RPA 407213	Foliar protectant and curative activity against oomycete fungi. Also effective against ascomycetes and *Alternaria.* Inhibits electronic transport.
Strawberry	dodine	10	MELPREX	For use on vegetables and fruits to control scab, leaf spot, bacterial leaf spot, foliar diseases, leaf blight, peach leaf curl, and blossom brown rot.
Strawberry	kresoxim-methyl	10	STROBY	Active against powdery mildew, *Fusarium,* eyespot, blotch, rust, *Septoria,* and scab in cereals, pome fruits, grapes, vegetables, and ornamentals.
Strawberry	myclobutanil	10	RALLY	Controls powdery mildews, rusts, apple scab, brown rot, shothole, cherry leaf spot, and grape black rot.
Sunflower	azoxystrobin	B	QUADRIS	Broad spectrum of pathogens of fungi: *Cladosporium, Venturia, Botryosphaeria, Mycosphaerella, Pyrenophora, Puccinia, Pyricularia, Plasmopara, Guignardis, Pseudopeziza, Alternaria, Sphaerotheca, Erysiphe, Leveillula, Septoria, Pythium, Uncinula, Didymella, Sclerotium, Colletotrichum, Mycosphaerella, Phytophthora, Rhynchosporium, Rhizoctonia,* etc.
Tomato	fenhexamid	A	ELEVATE	Non-systemic protectant fungicide that is effective against *Botrytis cinerea,* brown rot, *Sclerotinia sclerotiorum* of lettuce.
Turnip (roots & tops)	mefenoxam	B	RIDOMIL GOLD	Foliar or soil with curative and systemic properties. Controls soilborne diseases caused by *Phytophthora* and *Pythium* spp., in many crops; foliar disease caused by oomycetes such as downy mildew and late blight.
Walnut	Bacillus subtilis	B	SERENADE	Biological fungicide, inoculant; controls *Phytophthora, Alternaria,* and other pathogens.

AEN Y2K Subscription Reminder

This is the time of year to start thinking about renewing your *Agrichemical and Environmental News* subscription for next year. The subscription fee remains at $15 per year for 12 riveting issues, which merely covers the costs of printing and mailing. Web access remains free; the URL is www2.tricity.wsu.edu/aenews. For a hard copy, send your check, made out to WSU, to

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Using GPS
to Study Environmental Exposures to Pesticides and Nitrates

Norm Herdrich, PNASH Outreach Coordinator

Global Positioning Systems (GPSs) are becoming increasingly popular tools. These systems use satellites to obtain data that help hikers, boaters, automobile drivers, and others determine location. Now researchers are trying to learn whether GPS technology can assist them in learning more about environmental exposures.

Dr. Beth Mueller, an epidemiologist from the Fred Hutchinson Cancer Research Center and the University of Washington, is working with Sarah J. Ryker, a geographer/water quality specialist with the United States Geological Survey (USGS) in Tacoma, to determine whether GPS can be used along with more traditional research tools to determine exposures to pesticides and nitrates. This study is part of a pilot program funded by the Pacific Northwest Agricultural Safety and Health Center (PNASH) at the University of Washington.

Health departments conduct routine surveillance to determine whether levels of contaminants in drinking water and air are within established public health standards. Disease surveillance systems have also been established as part of state and national efforts to monitor the incidence of various diseases and conditions including cancer and birth defects. Mueller and Ryker are attempting to determine how such health data might be linked to geographically specific exposure data to understand better how exposure might be related to health and disease.

Pursuant to the overall purpose of linking exposure to health, two specific short-term goals have been established:

❶ Determine whether the appropriate geographic coordinates of target locations can be obtained as part of an epidemiologic study.

❷ Link these coordinates to geographically referenced environmental data.

For this study, the researchers selected a sample of addresses in rural and urban locations. They then attempted to determine the latitude and longitude coordinates for each test address.

One goal of this project was to determine whether individuals trained as field staff of an epidemiologic study would be able to obtain coordinates for the target addresses. Three researchers were dispatched to obtain the latitude and longitude for each target location with a hand-held GPS unit. They drew maps of their proximity to the target building, they described the local weather features, and they located possible obstacles such as trees, mountains, or tall buildings (such elements have the potential to interfere with the ability of the GPS to connect with the satellites). Based on photographs and descriptions provided by the study geographer, they also attempted to include in their diagram any well housings present near the building.

Ryker entered the latitude and longitude coordinates for the study addresses into a Department of Health Geographic Information Systems (GIS) water-quality information database. The database contains nitrate and pesticide level information for public supply wells in Washington. These data were collected from routine Department of Health tests and from USGS studies.

The geographer developed a program to extract the identity of all public supply wells within a two-mile radius of each coordinate. Since part of the project was to determine the yield of various perimeters around the target location, the program was repeated to locate all wells within a 15-mile radius as well. The next step in the process (currently underway) consists of using a Washington State Department of Health water quality database to determine nitrate levels during the last two decades for each relevant well. Ultimately, these data will be analyzed to answer several questions:

- How many public supply wells were located within a 2- and 15-mile radius of each address?
- What is the range of nitrate levels measured in

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Using GPS, cont.

Norm Herdrich, PNASH Outreach Coordinator

wells within a selected radius?

◆ How much time elapsed between the earliest and most recent nitrate level assay for each site?

◆ Is additional information, such as the name of the water or utilities company or visual inspection of the target location for a well head, available or useful?

Existing public health data may be an economical component in the evaluation of potential health outcomes from environmental exposures. The extent to which researchers can capitalize on existing geographically referenced databases for large-scale epidemiologic studies, however, depends on the answers to questions such as those addressed in this study. Mueller and Ryker's current work will help to determine how well the existing data and the geographic coordinates answer stated objectives, and to gain an understanding of the linkages between the various data sets. The researchers hope their work will provide the basis for future studies of potentially adverse heath outcomes associated with environmental exposures.

Dr. Mueller can be reached at **bmueller@fhcrc.org**.

The Pacific Northwest Agricultural Safety and Health Center, funded by NIOSH, is one of nine such centers in the United States. The Center's mandate is to study occupational health and safety issues in farming, forestry and fishing in the four Region X states of Idaho, Washington, Oregon and Alaska. Dr. Richard Fenske is the Center Director, Dr. Matthew Keifer is Co-Director, and Sharon Morris is Associate Director. Adrienne Hidy is the Center's Administrator, and Marcy White is the Program Coordinator.

*This article was prepared by Norm Herdrich, PNASH Outreach Coordinator. To obtain additional information, he can be contacted at (509) 926-1704, or e-mail him at **normh@u.washington.edu**.*

Pesticide Container Recycling

Washington Pest Consultants Association organizes an annual series of collection dates and sites for empty pesticide containers. Dates and locations are subject to change; confirm with a telephone call to the number listed in the table before participating. For general questions, or if you are interested in hosting an event at your farm, business, or in a central location in your area, contact Clarke Brown at (509) 965-6809 or Roger Ours at (509) 930-6950.

CONTAINER CRITERIA:

Rinsed—no residue

Majority of foil seal removed from spout (small amount remaining on rim OK)

Clean and dry, inside and out, with no apparent odor

Hard plastic lids and slip-on lids removed

Half-pint, pint, quart, one, and two-and-a-half gallon containers accepted whole

Five-, 30-, and 55-gallon containers accepted whole if lids and bails removed

DATE	TIME	LOCATION	CONTACT	PHONE
10/13	8am-3pm	Othello Airport	Mark Conner	(509) 488-2921
10/14	8am-10am	Western Farm Svc, Waterville	John Massey	(509) 838-5007
	Noon-2pm	Western Farm Svc, Coulee Cty		
	3pm-Finish	The Crop Duster, Ephrata	Martin Shaw	(509) 754-3461
10/18	8am-11am	Wilbur Airport	Greg Leyva	(509) 647-2441
			Dennis Buddrius	(509) 647-5394
	1pm-4pm	Davenport Airport	Lee Swain	(509) 725-0011
10/19	8am-Noon	Western Farm Svc, Rosalia	John Massey	(509) 838-5007
	1pm-3pm	McGregor's Colfax	Joel Fields	(509) 397-4691
10/20	8am-10am	B&R Aerial, Connell	Chris Eskildsen	(509) 234-7791
	Noon-3pm	Air Trac, Pasco	Gerald Titus	(509) 547-5301
10/25	9am-3pm	Snipes Mtn Transfer Station*	Mark Nedrow	(509) 574-2472
10/26	8:30am-3pm	Terrace Hts Landfill, Yakima*		
10/27	1pm-4pm	Kilmer Crop Dusting, Warden	Terry Kilmer	(509) 349-2491
10/28	9am-Noon	T Dent Aviation, Moses Lake	Tom Dent	(509) 765-6926

*Cardboard accepted at these locations.

Attack on the Male—Part III
Bad Brains and Bad Kids

Dr. Allan S. Felsot, Environmental Toxicologist, WSU

Insomnia can be a drag when it causes you to surf television channels while lying restlessly in your bed. But once in a blue moon, a gem sparkles through that glowing haze like a diamond in the rough. One slumberless night, while watching the *Arts & Entertainment* channel, I was surprised to learn that teenagers in the 1950s were berated for their wildness and violent ways. The cause? The amorality of the motorcycle culture, exemplified by participants in the bike clubs popping up all over the United States. As a college student in the tumultuous late 1960s, I vividly recalled the seeming chaos of love-ins and not-so-peaceful antiwar demonstrations being blamed on sex, drugs, and rock and roll.

My thoughts drifted to the tragic news of this year. Headlines and television were dominated by school shootings and hate crimes. Parents seem bombarded daily by stories of failing schools and failing kids. Increasing numbers of our children can't pay attention because of a syndrome called attention deficit hyperactivity disorder (ADHD) or some other related brain disorder. Kids are being increasingly dosed with medication to calm them and help them pay attention.

While the love of motorcycles has not been invoked to explain the trials and tribulations of today's troubled teens, just about everything else has. One pundit after another has dragged out and blamed violent music lyrics and movies, child abuse, parental neglect, and school's failure to post the Ten Commandments. Each putative cause has been debated ad nauseum on the infotainment shows and in newspaper editorials.

Amidst all the blame, the print media quickly discovered another hypothesis lying dormant within the covers of Theo Colborn's *Our Stolen Future* (6). Referring to hormonally active agents (HAAs), which are chemicals that can disrupt the endocrine system, Colborn asked, "To what extent have scrambled messages contributed to what we see happening around us—the reproductive problems seen among family and friends, the rash of learning problems showing up in our schools, the disintegration of the family and the neglect and abuse of children, and the increasing violence in our society?"

The Hypothetical Link Between Bad Brains and Bad Behavior

As I described in a previous *AENews* essay (Issue No. 139, September 1997), the endocrine system is linked as in a computer network with the immune and nervous systems. Proper growth and development of the fetal brain relies on signals from various hormones, including the sex steroid hormones (estrogen and testosterone) and the thyroid hormones (known as thyroxine, T4, and triiodothyronine, T3) (3). Both types of hormones cross into cells from the blood, move into the nucleus, and then bind to a receptor protein. The protein is essentially linked to the cells' DNA, and when bound by the hormone, eventually causes the synthesis of proteins necessary for cell growth and differentiation of function.

The fetal brain is particularly rich in T3 receptors compared to the adult brain. Thus, like the sex steroid hormones, thyroid hormones play an important role in neural growth and synapse (junctions between nerve cells) formation, the synthesis of neurotransmitters (chemicals transmitting nerve signals across synapses) and their receptors, and the normal development of behavior and learning abilities. Any stress, whether nutritional, chemical, or pathological, that affects the levels of thyroid hormones in the fetus, could potentially affect normal brain development. For example, a dietary deficiency of iodine in early development causes hypothyroidism (low production of thyroid hormone) and leads to a type of mental retardation known as cretinism (8). Hypothyroidism can be induced in fetal rats by exposure of mothers to a thyroid gland toxin called propylthiouracil. The offspring exhibit auditory and motor function deficits (10).

Evidence that Synthetic Chemicals Can Alter Thyroid Hormone Levels

Processes that rely on thyroid hormones during brain development can be disrupted by several mechanisms (4). Normally, T3 and T4 are carried in the blood by transporter proteins. A T3 or T4 mimic might affect hormone availability to brain cells by attaching to the transporter proteins, thereby blocking binding of the real hormones. A thyroid hormone mimic could enter a cell, bind to the thyroid receptor and thereby either

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block (antagonize) the action of the natural hormone or turn on (agonize) the receptor. A third possibility is that a hormone mimic might increase the activity of a special enzyme in the liver that reduces the blood level of T4.

Biochemical studies with specific polychlorinated biphenyl compounds (PCBs), DDT and its metabolites, and the herbicides alachlor and acetochlor showed no binding to thyroid receptors nor transporter proteins. However, metabolites of PCBs called hydroxylated PCBs (PCB-OH) that are found in blood were capable of binding the receptor (4). Metabolites of PCBs called methylsulfone-PCBs that are found in breast milk have been shown to reduce thyroid hormone levels in rats (13). Feeding maternal rats commercial mixtures of PCBs known as Arochlors reduces thyroid hormone levels in fetal rat brain (17) and blood (11). Infant rats born to Arochlor-exposed mothers suffer hearing and behavioral deficits (11).

Studies with rodents rely on feeding very high levels of PCBs. For example, behavioral and auditory deficits were observed when pregnant rats were fed 4 or 8 milligrams of Arochlor per kilogram of body weight per day (mg/kg/d) but not 1 mg/kg/d (11). Average human exposure to PCBs in food, air, and water has been estimated to total 0.3 mg/year (7). Assuming a woman weighed 60 kg, the average total PCB intake would only be 0.000014 mg/kg/d!

Linking Human Behavioral Deficits to PCBs

Human PCB intake seems too miniscule to cause any effects on a developing fetus. Nevertheless, on several occasions children have been exposed to extraordinarily high levels of PCBs. In Japan during 1968 and Taiwan during 1979, rice contaminated by PCB-laced cooking oil caused notable symptoms in over a thousand people (21). Babies born to exposed mothers in Taiwan were monitored for adverse health effects through age 10 (5). Exposed children exhibited greater tendency for emotional or behavioral disorders and slightly more hyperactivity compared to unexposed children. The estimated average intake of PCBs over an eight-month period was 1 gram (12). Thus, we could estimate a female weighing 60 kg to have been exposed to a dose of PCBs in contaminated cooking oil equivalent to 0.07 mg/kg/d. This exposure was lower than levels known to cause effects in rats, but dioxin-like compounds with endocrine disrupting effects had also formed during cooking.

Fish are the source of most PCBs in the average human diet (7). A group of children born to women eating large amounts of fish from the Great Lakes has been monitored for over eleven years. Children with the highest levels of prenatal (i.e., fetal) exposure to PCBs were three times as likely as children with the least exposure to have lower average IQ scores (a difference of 6.2 IQ points), and twice as likely to be at least two years behind in reading comprehension (15). The results mimicked behavioral deficits measured in the exposed group at earlier ages (14), but pertinently, a clear threshold in PCB exposure was observed. To wit, no effects were observed unless mother's milk had greater than 1.25 ppm of PCBs. Thus, similar to the rat studies, effects were related to dose.

Infant PCB exposure is greatest through breast-milk feeding. Yet a review of all studies attempting to link PCB exposure in food to behavioral deficits in children paradoxically reveals that only exposure during pregnancy could be associated with an effect (18). Thus, the good news is that breastfeeding did not influence the cognitive and behavioral scores. The data also show the importance of reducing chemical exposures during pregnancy.

Is There A Pesticide Connection?

Few pesticides have been examined for their effect on children's cognitive and behavioral development. The National Academy of Sciences (18) concluded that DDT, which is stored in body fat and breast milk, did not seem to have any adverse effects on young children. Nevertheless, the Food Quality Protection Act (FQPA) reflects public concern that pesticides may be harming children more than adults. This concern was raised a notch this spring by the headline "Study Links Pesticides to Brain Damage in Kids" (16). This alarming

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headline was generated by a press release from the University of Wisconsin concerning a study published in the journal Toxicology and Industrial Health by one of its faculty members (19, hereinafter referred to as the TIH study). The study purportedly found that endocrine, immune, and behavior changes occurred in mice exposed via drinking water to low doses of mixtures of an insecticide (aldicarb), herbicide (atrazine), and nitrate. The study was hailed as a significant breakthrough proving the cumulative effect of low doses of agrochemicals in mixtures.

Given the fast-paced nature of newspaper reporting, no one expects journalists to scrutinize scientific reports with the same zeal they use to dissect a politician's life. Given the importance of the TIH study's conclusions, however, it should be judged on its own merits rather than interpreted through newspaper accounts.

The TIH study's experimental design was quite comprehensive in attempting to study all possible combinations of aldicarb, atrazine, and nitrate mixtures. Contrary to how the dosing was presented in the media, the concentrations tested were not characteristic of groundwater contamination, nor were they at the regulatory maximum contaminant levels. In fact, the concentrations in water were 10 parts per billion for aldicarb and atrazine, and 28 parts per million for nitrate-nitrogen. While these are some of the lowest doses ever tested, such levels are unrealistically high according to the United States Geological Survey (USGS) National Water Quality Assessment (NAWQA) database (**http://water.wr.usgs.gov/pnsp/allsum/#gw**). This fact alone should not detract from the TIH study, however, because most toxicological testing is done at excessively high dosing levels.

When Data Meet Statistics

The TIH study measured numerous toxicological endpoints including body weight, spleen weight, thyroid hormone levels, plaque cell formation (immune system effect), and aggressive behavior in male mice. Each test was repeated up to nine times over a five year period and then subjected to a statistical analysis to determine whether the results were due to the chemical exposures or to random chance.

TABLE 1

Ratio of the number of experiments with calculated statistically significant outcomes relative to the total number of experiments conducted in the TIH study (19).

Chemical Exposure	Number of Significant Tests Relative to Total Number of Tests			
	Spleen Weight	Thyroid Hormone	Aggression Score	Plaque Assay
aldicarb (ald)	1/7	1/9	0/6	1/8
atrazine (atz)	0/7	0/9	0/6	1/8
nitrate (N)	0/7	0/9	1/6	0/8
ald-atz	1/7	0/9	0/6	2/8
ald-N	1/7	0/9	0/6	2/8
atz-N	0/7	1/9	1/6	3/8
ald-atz-N	0/7	1/9	1/6	0/8

In laboratory studies, an analysis of variance is the accepted statistical test for determining the probability that a toxicological parameter measured in a population of animals is due to the chemical exposure as opposed to random chance. In other words, the experimenter tests a hypothesis that some chemical either causes no adverse effect (known as the null hypothesis) or that it does cause an effect. For each test, multiple animals are exposed to a given dose of chemical. Individual animals will differ in their responses, but distribution of responses (variance) and the average response for any exposure can be calculated. Using the variation in responses, the experimenter will then calculate the probability that the measured response to chemical exposure did not occur by chance alone. Any measurement in controlled laboratory experiments having less than a 5% probability of occurring by random chance is considered statistically significant. In this case, the experimenter would reject the null hypothesis (the chemicals had no effect) and conclude that exposure caused a significant adverse response.

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If You Can't Prove the Hypothesis, Just Ignore the Statistics

For each individual experiment, the TIH study tabulated the probability that the measured effects were not due to chance variations alone. When the probability was less than 5%, the study concluded that exposure to the contaminated water caused the responses measured. With few exceptions, no significant difference in responses between dosed animals and controls (animals not exposed) resulted when single chemicals were mixed in water. In other words, of the twenty-seven possible single chemical exposure experiments, almost none met the test for statistical significance.

Amazingly, the statistical analyses for all possible combinations of mixtures also showed very few significant differences (Table 1). For example, in nine separate experiments where thyroid hormone level was measured, only one test with mixtures was statistically significant. In fact, most of the studies couldn't even meet the test for significance at a probability level of 20% or greater, yet alone 5%. The inconsistent and random nature of the results is further illustrated by close examination of the plaque-forming cell assay results. One out of eight experiments showed statistical significance when exposure was to aldicarb or atrazine alone. Three or fewer were significant with each possible binary mixture. Paradoxically, no significant effects were observed at all when exposure to all three was tested.

The overwhelming lack of statistically significant differences in the TIH study should have led to a conclusion that the measured effects of single and multiple chemical exposures were at best inconclusive. Nevertheless, the study's lead author was quoted in the Los Angeles Times as saying "Data suggest that we may be raising a generation of children with learning disabilities and hyper-aggression."

Positive Trends

The statement made to the press echoes the hypothesis propounded in *Our Stolen Future* (6). Such a broad hypothesis is unlikely to be ever proven true or false. However, insights about the validity of the hypothesis can be gleaned by looking at trends. While the media screams about declining test scores and violent behavior among U.S. youth, recent statistical trends reveal a different picture. IQ scores have been going up in industrialized countries since the 1940s (2). Crime, which is overwhelmingly committed by males under twenty-four years of age, has declined for the seventh straight year (9). New evidence suggests that ADHD may be overdiagnosed because it cannot be tested by physical means and its diagnosis essentially boils down to an "educated guess" (1).

Thus far, only laboratory experiments with PCB have made a credible link between HAAs and behavior. The mechanism seems to involve alterations in thyroid hormone levels in fetal rats. Studies of extraordinarily high levels of human exposure to PCBs seem provocative, but they do not support a conclusion that average dietary levels of PCBs have had measurable adverse effects. No credible study has linked neonatal or infant exposure of environmental levels of pesticide residues to mental deficits in rats. Nor do global trends in intelligence measurements support the hypothesis that HAAs are affecting human mental abilities.

PCBs were first commercialized in 1929, long before we could measure them; indeed, before water quality was regulated. By the 1950s, anyone living in an urban area would have been exposed to PCBs. PCBs were finally banned in the late 1970s. Since that time, the amounts stored in our body fat have been steadily declining along with the levels of banned pesticides like DDT (20).

After a night of thinking about kids' behavior, I finally did fall peacefully asleep. My optimism about the future inspired me to give my kid a big hug in the morning. I know he is a lot smarter than I am, but I'm still not going to buy him a motorcycle any time soon.

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Pesticide Emergency Handbook Available

Purdue University Cooperative Extension Service has produced a 112-page handbook, *Pesticides and Planning for Emergencies: Prevention, Reaction, and Response,* designed for commercial industries such as lawn services, golf courses, aerial applicators, and commercial agriculture enterprises. See it on-line at

http://www.agcom.purdue.edu/AgCom/Pubs/PPP/PPP-44.pdf
or http://www.btny.purdue.edu/PPP

or order a copy ($30) from the Media Distribution Center at (888) 398-4636, Media.Order@ces.purdue. edu; or Purdue University, Agriculture Communication Services, Media Distribution Center, 301 S. 2nd Street, Lafayette, IN 47901-1232.The full-color publication offers advice, instruction, and recommendations on anticipating emergencies, evaluating your worksite, and responding to emergent situations. Included are do-it-yourself worksheets and checklists for hazard assessment, monthly inspections (fire extinguishers, exit signs, first aid kits), chemical inventory, and emergency telephone contacts. Companion piece PPP-45, *Quick Response Emergency Plan*, (not available on the Internet) can be ordered for $5.

News You Can Use

Collected Information for AENews *Readers*

EPA Schedule for Actions on Organophosphates

	RISK ASSESSMENT	BEGIN RISK MGMT. PROPOSAL
Oct. thru Dec. 1999	Acephate, Dimethoate, Disulfoton, Ethyl Parathion, Methamidiphos, Oxydemeton methyl, Phosmet, Phostebupirim, Pirimiphos methyl, Tetrachlorvinphos	Chlorethoxyfos, Ethoprop, Fenamiphos, Methidathion, Naled, Phorate, Pirimiphos methyl, Propetamphos, Temephos, Terbufos, Tetrachlorvinphos, Tribufos
Jan. thru Mar. 2000	Dichlorvos, Fenitrothion	Acephate, Dimethoate, Disulfoton, Ethyl Parathion, Methamidiphos, Oxydemeton methyl, Phosmet, Phostebupirim
April thru June 2000	Chlorpyrifos, Chlorpyrifos methyl, Coumaphos, Malathion, Mevinphos, Phosalone, Trichlorfon	Chlorpyrifos, Chlorpyrifos methyl, Coumaphos, Dichlorvos, Fenitrothion, Trichlorfon
July thru Sept. 2000	Diazinon	Dicrotophos, Diazinon, Malathion, Mevinphos, Phosalone

Source: EPA website, http://www.epa.gov/oppsrrd1/op/actionops.htm

WSDA & EPA On-Line

Washington State Dept. of Agriculture

HOME PAGE
http://www.wa.gov/agr/

Environmental Protection Agency

HOME PAGE
http://www.epa.gov/

OFFICE of PESTICIDE PROGRAMS
www.epa.gov/pesticides

Pesticide Safety Program
http://www.epa.gov/pesticides/safety

Pesticide Applicator Training Courses

Washington State University offers PRE-LICENSE courses (for those who do not have a license and need one) and RECERTIFICATION courses (for those who need to renew their current licenses). Fees are $35 per day if postmarked 14 days before the program, otherwise $50 per day. This fee DOES NOT include WSDA license test fee, which ranges from $25 to $170; for information on testing and fees, contact WSDA at (360) 902-2020 or http://www.wa.gov/agr/test/pmd/licensing/index.htm. Recertification courses offer 6 credits per day. FOR MORE INFORMATION or REGISTRATION: (509) 335-2830, pest@cahe.wsu.edu or http://pep.wsu.edu.

1999 "LAST CHANCE" RECERTIFICATION COURSES
Pasco Nov. 1 & 2 • Pasco Español Nov. 2 • Lynnwood Nov. 15 & 16

2000 Recertification Courses

Eastern Washington	Western Washington
Pasco, Jan 12 & 13	Vancouver, Jan 5 & 6
Yakima, Jan 20 & 21	Tacoma, Jan 12 & 13
Pullman, Jan 25 & 26	Lynnwood, Jan 20 & 21
Moses Lake, Jan 27 & 28	Port Orchard, Jan 26 & 27
Wenatchee, Feb 1 & 2	Lacey, Jan 31 & Feb 1
Spokane AG, Feb 14	Highline, Feb 3 & 4
Spokane, Feb 16 & 17	Mount Vernon, Feb 9 & 10
DEALER MANAGER RECERTIFICATION COURSE Colfax (Eastern WA) Jan 14 Moses Lake (Ea. WA) Jan 18 Puyallup (Western WA) Feb 15	Kirkland, Feb 16 & 17
	Tacoma, Mar 1 & 2
	Seattle, Mar 16 & 17

2000 Pre-License Courses

Eastern Washington	Western Washington
Pasco, Jan 11, 12, 13	Vancouver, Jan 4, 5, 6
Yakima, Jan 19, 20, 21	Tacoma, Jan 11, 12, 13
Pullman, Jan 24, 25, 26	Lacey, Jan 31, Feb 1, 2
Wenatchee, Jan 31, Feb 1, 2	Mount Vernon, Feb 8, 9, 10
Spokane, Feb 15, 16, 17	Kirkland, Feb 15, 16, 17
Spokane Agricultural Private Applicator License Mar 25	Tacoma, Feb 29, Mar 1, 2
	Tacoma Aquatics, Mar 1
INTEGRATED PLANT HEALTH MANAGEMENT Puyallup, Jan 25-27 3 days, 15 credits, $150	Puyallup, Mar 28, 29, 30
	Puyallup Apr 4, 11, 18, 25 (Special 4-day course)

Notice of Vacancy

FEQL Seeks Analytical Chemist

Washington State University

Description: Tenure track, twelve-month appointment, research/extension (80/20) position in the Department of Entomology. Assistant/associate professor rank; salary commensurate with experience and qualifications. Effective date July 2000.

General Information: The mission of the Food and Environmental Quality Lab (FEQL) is to (a) analyze pesticide residues in the environment and on crops, (b) investigate the environmental chemistry and toxicology of pesticides, and (c) provide environmental information about pesticides and pest control to the private and public sector. The FEQL analytical laboratory is located at the WSU Tri-Cities Branch Campus, and is one of several research and teaching laboratories. The facility is equipped with a benchtop GC-MS/MS, GC/LC-MS, and several GCs and HPLCs. There is also instrumentation for radiochemical and ELISA assays. The lab operates under a set of Standard Operating Procedures developed according to FIFRA GLP guidelines.

The successful applicant will be a team member of the FEQL Program and will work collaboratively with an environmental toxicologist, environmental/agrichemical education specialist, pesticide impact assessment program liaison, and pesticide education coordinator. FEQL team members collaborate with several state agencies, including agriculture, health, ecology, and labor. The person hired will work closely with the national and regional IR-4 programs and private laboratories. Interactions are encouraged with other faculty in the Department of Entomology as well as with crop protection specialists throughout the state, including those stationed at the WSU Research and Extension Centers in Prosser, Puyallup, Vancouver, Mt. Vernon and Wenatchee. Opportunities also exist for interactions with scientists at the Department of Energy's Battelle Pacific Northwest Laboratories in Richland.

Duties/Responsibilities: The person hired will develop a research program to study residues of agricultural chemicals in foods and the environment. In collaboration with IR-4, FEQL, and other WSU personnel, the successful candidate will be responsible for:

- developing analytical methods for detecting conventional, alternative, and biorational chemical residues in agricultural commodities and the environment;
- providing federal and state agencies and clientele groups residue data required for registration and re-registration of conventional, alternative, and biorational pesticides critical to crop production with emphasis on minor crops as part of the IR-4 program; and
- mentoring and supporting graduate student training.

The person hired will develop an extension program and be responsible for:

- providing outreach on issues related to agricultural chemical residues in foods and the environment to federal and state agencies, and agricultural commodity groups, food processors, and other clientele groups; and
- participating on the editorial board and contributing to *Agrichemical and Environmental News*, a monthly newsletter.

Education and Experience

Required Qualifications: A Doctorate Degree in analytical chemistry, biochemistry, environmental chemistry, or relevant field; knowledge and experience in the development of analytical methods and analysis of chemical residues in foods, especially pesticides; experience and ability to operate and maintain laboratory instrumentation, including gas and high pressure liquid chromatographs and bench-top mass spectrometry systems; demonstrated ability in written and oral communications; demonstrated ability to effectively interact with diverse clientele groups.

Desired Qualifications: Knowledge of FDA and EPA analytical methods and GLP regulations; ability to acquire external funding; familiarity with agricultural systems and food processing; experience with graduate student or intern training; experience in supervising personnel; experience working on team projects; ability to develop and meet timelines/deadlines; experience with handling producer and public concerns about pesticide-related issues; and experience with handling budgets.

Screening & Application: Screening of applications will begin November 15, 1999, and will continue until a suitable candidate is found. Submit a letter of application addressing specific required and desired qualifications and research interests, current transcripts and vitae, and have three letters of reference sent to Carol Ramsay, Chair, Analytical Chemist Search Committee, Department of Entomology, PO Box 646382, Washington State University, Pullman, WA 99164-6382; ramsay@wsu.edu, 509-335-5504, fax 509-335-1009.

WSU is an equal opportunity/affirmative action educator and employer. Members of ethnic minorities, women, Vietnam-era or disabled veterans, persons of disability and/or persons age 40 and over are encouraged to apply. WSU employs only U.S. citizens and lawfully authorized non-U.S. citizens. All new employees must show employment eligibility verification as required by the U.S. Immigration and Naturalization Service. Accommodations for applicants who qualify under the Americans with Disabilities Act are available upon request.

Dear Aggie

Providing answers to the questions you didn't know you wanted to ask

In contrast to the usually more sober contributors to the Agrichemical and Environmental News*, Dear Aggie deals light-heartedly with the peculiarities that cross our paths and helps decipher the enigmatic and clarify the obscure. Questions may be e-mailed to Dear Aggie at* ***dearaggy@tricity.wsu.edu****. Opinions are Aggie's and do not reflect those of WSU.*

Dear Aggie

In news from Europe, I've noted a lot of opposition to genetically engineered crops that have pesticide genes in them. I know that the gene for the toxic protein from the microbial insecticide **Bacillus thuringiensis** ***(Bt) has been cloned into corn and potatoes. While people in Europe seemed concerned about potential hazards of this genetically engineered pesticidal protein, I don't sense there is any concern about the Bt sprays, even though the sprays contain the same protein. Bt spray is a certified organic pesticide, so it must be safe to humans, right?***

Signed,
Microbially Confused

Dear Microbially Confused,

The Europeans do seem hot and bothered about genetically engineered crops. Aggie can't figure out if they are going through some ethical and moral epiphany about genetic tinkering or if they are really worried about health hazards.

Until recently, Aggie pooh-poohed worrying about Bt products, sprayed or engineered. But a double whammy of new reports indicate that Bt, a bacterium naturally found nearly everywhere in the environment, may be meaner than we think.

Bt spray generally has an excellent safety record with minor exceptions. Large-scale spraying of Bt for control of Asian Gypsy Moth, a pest in forests in the Northwest during the early 1990s, engendered complaints of rash and swelling, nasal inflammation, and exacerbation of asthma. A team of scientists from the University of Cincinnati College of Medicine and the EPA recently reported results from studies of farm workers' immune response to Bt. Farm workers who picked vegetables sprayed multiple times with Bt were monitored and compared to workers of low or no exposure. Workers were tested for exposure to Bt, hypersensitivity to Bt extracts, and production of specific antibodies (known as IgE and IgG) against Bt. The good news was a lack of occupationally related respiratory symptoms among the workers. The bad news was evidence of a greater prevalence of hypersensitivity to Bt among the most highly exposed workers. The researchers concluded, "Exposure to Bt sprays may lead to allergic skin sensitization and induction of IgE and IgG antibodies, or both."

Another report indicated that certain strains of Bt may be outright toxic, not just allergenic. Effective Bt products may be any one of several strains that produce an insecticidal toxin. The Bt spores are used in the insecticidal spray. French scientists have isolated a strain of Bt known as H34 that can kill healthy mice that inhale as few as 108 spores. The mice developed internal bleeding and tissue damage. Mutant Bt spores that don't produce the insecticidal toxin were equally lethal, suggesting that the insecticidal toxin is irrelevant to the adverse effect. A close cousin of Bt, *Bacillus cereus*, produces another type of toxin that ruptures cell membranes. Japanese scientists have shown that at least one Bt strain can produce that same toxin. Bt H34 is not used as an insecticide, but the French researchers reported that some commercial Bt strains also killed mice or caused lung inflammation after the spores were inhaled. A spokesperson representing British organic farmers said that they may have to use masks and take more care when spraying the spores on crops. Ironically, to be certified as an organic pesticide, a substance must not be cytotoxic.

In the innocence of a few months ago, organic farmers' worst complaint about Bt might have been a concern that resistant pests would develop more rapidly with the proliferation of their favorite insecticide in both sprayed-on and cloned-in forms. These recent studies might give them something else to ponder. While Aggie doesn't see organic growers clamoring to remove Bt from their safe list any time soon, the Bt stories do remind one that there is no free lunch.

(Sources: Bernstein et al., 1999, Environmental Health Perspectives, vol. 107, pp. 575-582; New Scientist, May 29, 1999)

PNN Update

Jane M. Thomas, Pesticide Notification Network Coordinator

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

PNN notifications are now available on our web page. To review those sent out in August either access the PNN page via:

Pesticide Information Center On-Line (PICOL) Main Page:
http://picol.cahe.wsu.edu/
or directly:
http://www.tricity.wsu.edu/~mantone/pl-newpnn.html.

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

Federal Register Summary

Jane M. Thomas, Pesticide Notification Network Coordinator

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

In the August 4 Federal Register, EPA announced that two draft science policy papers were available for comment. The documents, "Guidance for the Conduct of Bridging Studies for Use in Acute Dietary Probabilistic Risk Assessments" and "Guidance for the Conduct of Residue Decline Studies for Use in Acute Dietary Probabilistic Risk Assessments," will be available on the web at URL: http://www.epa.gov/pesticides/trac/science/. (Page 42372)

In the August 6 Federal Register, EPA announced the availability of and requested comments on a Pesticide Registration Notice that presents EPA's proposed approach for managing risks from organophosphate pesticides to occupational users. The notice is available on EPA's OPP page (http://www.epa.gov/pesticides/) under the August 6th information. (Page 42943)

In the August 13 Federal Register, EPA announced the availability of the revised risk assessments and related documents for methyl parathion. These documents are available for review on the following URL: http://www.epa.gov/pesticides/op/methyl_parathion.htm. (Page 44219)

In the August 18 Federal Register, EPA announced the availability of the revised risk assessments and related documents for chlorethoxyfos. These documents are available for review on the following URL: http://www.epa.gov/pesticides/op/chlorethoxyfos.htm. (Page 44921)

Tolerance Information

Jane M. Thomas, Pesticide Notification Network Coordinator

Tolerance Information						
Chemical (type)	Federal Register	Tolerance (ppm)	Commodity (raw)	Time-Limited		
				Yes/No	New/Extension	Expiration Date
imidacloprid (insecticide)	8/2/99 page 41804	3.50	watercress (upland)	No	N/A	N/A
		0.50	cucurbit vegetables (Crop Group 9)			
		0.30	tuberous and corm vegetable subgroup			
propiconazole (fungicide)	8/2/99 page 41812	0.20	grain sorghum, grain	Yes	Extension	7/31/00
		1.50	grain sorghum, stover			7/31/00
		20.00	sorghum grain aspirated fractions			7/31/00
		0.50	dry bean			12/31/00
		8.00	dry bean forage			12/31/00
		8.00	dry bean hay			12/31/00
Comment: This action re-establishes time-limited tolerances that expired 7/31/98 or 12/31/98.						
pyriproxyfen (insecticide)	8/2/99 page 41810	0.10	tomatoes	Yes	Extension	12/31/01
Comment: This time-limited tolerance is being extended in response to a request received by EPA to extend the use of pyriproxyfen on tomatoes for this year's growing season due to the continuing emergency situation with whiteflies in southern areas of the U.S.						
azoxystrobin (fungicide)	8/4/99 page 42280	20.00	parsley, dried	Yes	New	12/30/00
		100.00	parsley, fresh			
Comment: These time-limited tolerances are being established in response to EPA granting a Section 18 for the use of azoxystrobin to control Septoria leaf blight in California parsley.						

Tolerance Info, cont.

Jane M. Thomas, Pesticide Notification Network Coordinator

Tolerance Information						
Chemical (type)	Federal Register	Tolerance (ppm)	Commodity (raw)	Time-Limited		
				Yes/No	New/Extension	Expiration Date
flufenacet/fluthiamide (herbicide)	8/6/99 page 42869	1.00	wheat grain	Yes	New	7/31/01
		10.00	wheat forage			
		2.00	wheat hay			
		0.50	wheat straw			
		0.05	meat and fat of cattle, goats, horses, hogs, and sheep			
		0.50	kidney of cattle, goats, horses, hogs, and sheep			
		0.10	mbp of cattle, goats, horses, hogs, and sheep			
Comment: These time-limited tolerances are being established in response to EPA granting Section 18s for the use of this chemical to control ryegrass in Oregon, Washington, and Idaho wheat.						
pyriproxyfen (insecticide)	8/18/99 page 44826	0.20	pears	Yes	Extension	1/31/01
Comment: This time-limited tolerance is being re-established in response to EPA again granting Section 18's for the use of pyriproxyfen on citrus fruit and pears.						
glufosinate-ammonium (herbicide)	8/18/99 page 44829	1.10	canola meal	Yes	New	12/1/99
		0.40	canola seed			
		4.00	sweet corn forage			
		4.00	sweet corn kernels and cobs (husks removed)			
		6.00	sweet corn stover			
Comment: These time-limited tolerances are being established in response to EPA granting Section 18's for the use of glufosinate-ammonium on sweet corn and canola.						
buprofezin (insecticide)	8/23/99 page 45885	0.70	tomato	Yes	Extension	12/31/01
		1.00	tomato paste			
		0.03	milk			
		0.02	meat and fat of cattle, goats, horses, hogs, and sheep			
		0.50	mbp of cattle, goats, horses, hogs, and sheep			
Comment: These time-limited tolerances are being extended in response to EPA again granting Section 18's for the use of buprofezin on tomatoes, citrus, and cotton.						
desmedipham (herbicide)	8/25/99 page 46290	0.20	red beet roots	Yes	Extension	12/31/00
		15.00	red beet tops			
Comment: These time-limited tolerances are being extended in response to EPA again granting a Section 18's for the use of desmedipham on garden beets grown in New York.						
pyridate (herbicide)	8/25/99 page 46292	0.30	peppermint tops	Yes	New	12/31/01
		0.30	spearmint tops			
Comment: These time-limited tolerances are being established in response to EPA granting Section 18's for the use of pyridate on mint in several states.						