

# Agrichemical and Environmental News

A monthly report on pesticides and related environmental issues

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## Pesticide Illness Data 1995-1999, Part 2

Jane C. Lee and Bill Mason, Washington State Department of Health

For more than a decade the Washington State Department of Health (DOH) has investigated suspected pesticide-related illnesses. Health care providers are required to report incidents of illness associated with pesticide exposure. From January 1, 1995 through December 31, 1999, DOH investigated 1,818 incidents of pesticide illness, involving 2,246 individuals (Table 1). An incident is a pesticide illness involving one or more individual cases.

DOH classifies the relationship of symptoms to exposure with the following categories:

Possible cases are those in which an exposure was present but ambiguity exists between exposure and reported symptoms. Symptoms may be non-specific and other possible etiologies may be present. Unlikely cases are those in which symptoms are not believed to be due to the reported exposure, but pesticide exposure cannot be ruled out.

Unrelated cases are either those in which no pesticide exposure occurred (e.g., product was a fertilizer) or in where the health effects were determined to be caused by another agent.

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TABLE 1

Annual Number of Pesticide Incidents Investigated by DOH			
Year	Number of Investigations (incidents)	Number of Persons Affected (cases)	Number of Definite, Probable and Possible cases
1995	396	500	213
1996	398	500	233
1997	363	439	212
1998	390	475	213
1999	271	332	140
<b>Total</b>	<b>1,818</b>	<b>2,246</b>	<b>1,011</b>

Definite cases require a high degree of correlation between a pesticide exposure and resulting symptoms (clinical and/or environmental evidence). Probable cases are similar to definite cases, but lack conclusive objective evidence.

AENews welcomes your comments. Please direct them to:

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Asymptomatic cases are those in which exposure occurred but no symptoms resulted.

Unknown cases are those for which insufficient information was available.

**TABLE 2**

Agricultural and Non-Agricultural Definite,  
 Probable, and Possible Cases

Year	Agricultural	Non-Agricultural	Total*
1995	90	123	213
1996	97	136	233
1997	93	119	212
1998	102	111	213
1999	68	72	140
<b>Total</b>	<b>450</b>	<b>561</b>	<b>1,011</b>

\* Limited to cases with illness classified by DOH as definite, probable, or possible due to pesticide exposure.

Of the 2,246 cases, 1,011 (45%) were classified as definite, probable, or possible, based on the relationship between the symptoms and the pesticide exposure (Table 2). This article summarizes cases investigated by DOH that occurred in agriculture. The July 2001 *Agrichemical and Environmental News* (Issue No. 183) summarized non-agricultural cases.

## Separating Agricultural Cases

From 1995 through 1999, DOH received reports of 1,163 cases of suspected pesticide-related illness occurring in the agricultural environment (992 occupational and 171 non-occupational). These occurred among individuals where the application was intended for an agricultural commodity. This includes fruit, field crops, greenhouse, nursery, bulb farms, shellfish, and forest operations. DOH classified 450 of these as definite (98), probable (109), or possible (243). The cases included 353 males and 97 females. Sixty-one percent of the illnesses were male workers aged 18 to 49 (Table 3). Most received medical care for their illness: 204 (45%) at emergency rooms, 54 at physicians' offices, and 110 at walk-in clinics. Two were hospitalized and 80 did not seek medical care.

DOH received 211 reports of agricultural pesticide-related illnesses from the Department of Labor and Industries, 120 from Washington Poison Center, 70 from Washington State Department of Agriculture, and 49 from other sources.

## Geographic Distribution

The 450 cases occurred in 28 of the 39 counties of Washington, with the majority (88%) occurring in eastern Washington. The counties with the most cases were Yakima (132), Grant (62), Chelan (34), Franklin (34), and Okanogan (30).

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**TABLE 3**

Occupational and Non-Occupational Agricultural Cases\*  
 by Age and Sex

Age	Occupational		Non-Occupational		Total
	Female	Male	Female	Male	
0-5	0	0	1	4	5
6-11	0	0	2	6	8
12-17	0	1	1	2	4
18-29	27	132	3	1	163
30-49	33	146	13	12	204
50+	7	30	10	19	66
<b>Total</b>	<b>67</b>	<b>309</b>	<b>30</b>	<b>44</b>	<b>450</b>

\* Limited to cases with illness classified by DOH as definite, probable, or possible due to pesticide exposure.

**TABLE 4**

Occupational and Non-Occupational  
 Agricultural Cases\* by Location

	Occupational	Non-Occupational	Total
<b>Eastern WA</b>	334	60	394
<b>Western WA</b>	42	14	56
<b>Total</b>	<b>376</b>	<b>74</b>	<b>450</b>

\* Limited to those classified definite, probable, or possible due to pesticide exposure.

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## Severity of Cases

Sixty-seven percent of the cases had mild medical outcomes (Table 5). These frequently involved eye irritation, headache, shortness of breath, coughing, and/or nausea. One hundred thirty-three experienced moderate symptoms; 14 were severe.

All 14 cases classified as severe were occupational: six were orchard workers, six were field workers, one was an ornamental tree applicator, and one was an irrigation technician. Seven resulted from drift exposure; five from inadequate personal protection during application, mixing, or loading; one from residue exposure while thinning; and one from walking into a field during an application.

## Type of Activity

The largest number of illnesses (174) was related to pesticide application, mixing, and loading. Exposure to pesticide drift was the second (151) greatest cause of illness and was responsible for the majority (76%) of the non-occupational agricultural cases. The pesticide residues category (18%) represents the third largest source of exposure.

## Symptoms Reported

Table 7 (page 4) shows the symptoms reported by category. The most frequently reported (55%) occupational health complaint was eye irritation; it was reported by 64 percent of the applicator, mixer, and loader cases. Eye irritation was also

Classification by Severity				
	Mild	Moderate	Severe	Total
<b>1995</b>	32	54	4	90
<b>1996</b>	68	28	1	97
<b>1997</b>	73	18	2	93
<b>1998</b>	71	25	6	102
<b>1999</b>	59	8	1	68
<b>Total</b>	<b>303</b>	<b>133</b>	<b>14</b>	<b>450</b>

reported in 45 percent of the occupational drift cases. Eighty percent of the cases involving cleaning or fixing reported eye irritation.

Systemic effects were the second most frequently reported category of illness. Fifty-two percent of the occupational cases and 68

percent of the non-occupational cases reported systemic effects, which can include headache, nausea, and/or dizziness. Systemic effects were also present in 82 percent of the occupational and 73 percent of the non-occupational drift cases.

Of the cases where individuals were exposed to pesticide residues, 51 percent reported skin irritation, 47 percent reported systemic effects, 41 percent reported eye irritation, and 36 percent reported respiratory effects.

## Applicator, Mixer, and Loader Cases

From 1995 to 1999, DOH received 320 reports of suspected agricultural pesticide-related illness involving applicators, mixers, and loaders. Of that number, 174 (54%) were considered definite, probable, or possible cases. Ninety-nine percent (173) occurred on the job: 122 from ground applications, 26 from miscellaneous uses, and 25 through mixing or loading. Sixty percent (103) of these cases occurred in the tree fruit industry, 46 occurred in field crops, and 24 were associated with other agricultural commodity groups.

Occupational and Non-Occupational Agricultural Cases* by Type of Pesticide Exposure			
Activity	Occupational	Non-Occupational	Total
<b>Applicator/Mixer/Loader</b>	173	1	<b>174</b>
<b>Drift</b>	95	56	<b>151</b>
<b>Residues</b>	74	7	<b>81</b>
<b>Cleaning/Fixing</b>	10	0	<b>10</b>
<b>Fumigation Field</b>	4	1	<b>5</b>
<b>Accident</b>	14	3	<b>17</b>
<b>Other</b>	6	6	<b>12</b>
<b>Total</b>	<b>376</b>	<b>74</b>	<b>450</b>

**\*Limited to cases with illness classified by DOH as definite, probable, or possible due to pesticide exposure.**

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**TABLE 7**

Symptoms\* by Activity, Occupational (O) and Non-Occupational (N)  
 Agricultural Cases

	Eye		Systemic		Skin		Respiratory		Other	
	O	N	O	N	O	N	O	N	O	N
<b>Applicator/Mixer/Loader</b>	110	1	74	0	77	1	39	0	34	0
<b>Drift</b>	43	33	78	41	25	9	44	29	8	7
<b>Residue</b>	33	0	34	4	38	3	27	2	10	4
<b>Cleaning/Fixing</b>	8	0	3	0	2	0	1	0	0	0
<b>Other/Unknown</b>	11	4	7	5	2	6	6	0	1	3
<b>Total</b>	<b>205</b>	<b>38</b>	<b>196</b>	<b>50</b>	<b>144</b>	<b>19</b>	<b>117</b>	<b>31</b>	<b>53</b>	<b>14</b>

\* Individuals frequently report more than one symptom.

Seventy-one of the applicator/mixer/loader cases in fruit were considered mild, 30 were considered moderate, and two were considered severe. In field crops, 34 were mild, 10 were moderate, and two were severe (both of the severe cases were mixers/loaders). (See Tables 8 and 9, page 6.)

The following examples of cases illustrate the variety of ways that exposure occurred, resulting in illness to pesticide applicators, mixers, and loaders:

- Pesticide drifted under shirt collar onto neck during application.
- Not wearing Personal Protective Equipment (PPE) when spraying.
- Applicator wearing PPE finished spraying, took off PPE, then had an asthma attack after smelling the pesticide.
- Poor condition of safety goggles.
- Wore PPE but removed goggles and rubbed eyes.
- Splash in eye while spraying.
- Used work shirt to wipe sweat from head causing skin irritation.
- Unlicensed farmworker applicator not wearing PPE developed conjunctivitis.
- Severe skin burn to foot after applying and not wearing rubber boots.
- Applicator wore respirator but no goggles after applying in a grain bin. Developed severe eye irritation.

### Drift Cases

From 1995 to 1999, 151 definite, probable, or possible cases of agricultural pesticide illness were due to exposure to pesticide drift. Of these, 95 were occupational: 49 in fruit production, 40 in field crops, four in nursery and greenhouses, and two in livestock. Of 56 non-occupational drift cases, 32 resulted from applications to fruit, 14 to row crops, seven to berries, and three to forests.

The 95 occupational drift cases were classified as definite (14), probable (25), or possible (56). The severity of symptoms reported was 39 mild (41%), 49 moderate (52%), and 7 severe (7%). This compares to 63% mild, 33% moderate, and 4% severe for all occupational agricultural cases. Descriptions of the seven severe drift cases follow:

- Three farmworkers (tying apple trees) became ill after an aerial application to a neighboring potato field drifted.
- Two of seven apple orchard thinners experienced drift from an application to another section of the orchard. The two workers received medical treatment.
- An irrigation technician became ill from an aerial application that drifted. He was treated for organophosphate poisoning.
- Two field workers inadvertently walked into a field during an application. They were not wearing PPE and became ill; one was classified as severe.

### Residue Cases

From 1995 to 1999, 81 agricultural cases resulted from exposure to pesticide residues; 74 were work-related. These occurred in the production of fruit (56), field crops (5), and vegetables (4); in nursery or greenhouse situations (11); and under other circumstances (5).

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Exposure to pesticide residues was the most reported cause of pesticide poisoning on the job (394 reports), but only 19 percent of these illnesses were definitely, probably, or possibly related to the exposure. The majority of these cases affected farmworkers who became ill after picking, thinning, or pruning in orchards. The illnesses may have been due to exposure to pesticide residues on foliage, irritation from foliage or branches, heat, exhaustion, a pre-existing condition, or an infection. Pesticide residue may be present hours to days after an application, and can be in the air, soil, dust, or on vegetation.

The following are examples of illnesses reported from exposure to pesticide residues (these examples include all reported cases, not just definite, probable, or possible ones):

Farmworker developed eye irritation and headache after working in a hop yard. He saw a doctor eight days later. Spray records showed that a fungicide was applied five days before contact.

Farmworker thinning pear trees developed a rash and itching.

Farmworker thinning apple trees developed shortness of breath and wheezing. He saw a doctor two days later. Spray records showed last application was four days before symptoms.

Farmworker covering apples with paper bags developed hives all over body.

Nursery worker mowed lawn 24 hours after herbicide application. The re-entry interval (REI) was 48 hours.

A farmworker drove through an apple orchard within the REI.

An apple thinner became ill. Spray records showed that a pesticide application was made 48 hours earlier. He saw a doctor eight days after symptoms began.

Farmworker on a tractor reported symptoms possibly related to exposure from entering a hop field sprayed two hours earlier with a miticide. He was not wearing PPE, the REI had not expired, and he did not see the warning signs.

The severity of symptoms for the occupational cases with exposure to pesticide residues was predominantly mild (72%), with some moderate cases (27%) and one severe case. The severe case resulted from exposure to pesticide residue while thinning trees. DOH classified the case as possible. The seven non-occupational cases were considered mild (6) and moderate (1).

## Crops Involved

The 450 agricultural definite, probable, or possible cases resulted from pesticide applications to fruit (263), field crops (108), nursery/greenhouses (29), berries (10), vegetables (8), livestock (6), forest (6), fire/flood/disaster (5), tree farms (2), and unknown (13).

**Cases Resulting from Applications to Fruit**  
The greatest number (263) of pesticide illnesses in agriculture occurred in the production of tree fruit; 221 occurred on the job and 42 were not work-related. Pesticide applications (primarily ground applications), mixing, and loading were involved in 104 cases, 80 were attributed to drift, 56 to field residues, and 23 to other causes. Table 8 (page 6) lists the severity of the cases resulting from applications to fruit.

The majority of cases occurred in the production of apples. Other tree fruits included pears, cherries, and apricots. Most cases were classified as mild (141 or 64%) or moderate (75 or 34%). Six were severe. Of the six severe cases, three related to drift, two to ground applications, and one to residues.

## Cases Resulting from Applications to Field Crops

One hundred and eight cases were due to application of pesticide to field crops; 94 were on the job. (Field crops refer to wheat, barley, potatoes, beans, hops, hay, lentils, sugar beets, etc.) Drift was most frequently associated with pesticide illness (54 cases), followed by applicator/mixer/loader (46), residues (5), and accidents (3). Most (94%) cases involved mild (52) or moderate (36) symptoms, with six reporting symptoms of greater severity. All fourteen non-occu-

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<b>TABLE 8</b>							
Fruit Production Cases* by Severity and Activity							
	Severity of Occupational Cases			Severity of Non-Occupational Cases			Total
	Mild	Moderate	Severe	Mild	Moderate	Severe	
<b>Applicator/Mixer/Loader</b>	71	29	2	1	1	0	104
<b>Drift</b>	23	22	3	28	4	0	80
<b>Residue</b>	37	15	1	2	1	0	56
<b>Accident</b>	4	2	0	3	0	0	9
<b>Other</b>	6	6	0	1	1	0	14
<b>Total</b>	<b>141</b>	<b>74</b>	<b>6</b>	<b>35</b>	<b>7</b>	<b>0</b>	<b>263</b>

**\*Limited to cases with illness classified by DOH as definite, probable, or possible due to pesticide exposure.**

Occupational cases related to field crops resulted from drift and most (13) had mild symptoms (Table 9).

### Cases Occurring in Nurseries or Greenhouses

From 1995 to 1999, 25 occupational incidents occurred in nurseries or greenhouses, involving 29 cases; 16 were male and 13 were female. The majority (80%) occurred in western Washington, with five each in Skagit and Snohomish counties.

Eleven cases occurring in greenhouses and nurseries were due to exposure to residues, seven were due to applications, four to drift, three to mixing or loading, two to cleaning or fixing equipment, and two to other causes. The majority of cases reported mild symptoms (79%); 17 percent reported moderate symptoms and one case was severe. The most frequently reported complaint was eye irritation. Similar to other agricultural cases, the routes of exposure were eye (9), inhalation (7),

dermal (1), and ingestion (1). The remaining cases were a combination of exposure routes.

### Conclusions

From 1995 through 1999, the Washington State Department of Health investigated 1,163 cases of pesticide illness in the agricultural environment.

450 cases were classified as definite, probable, or possible. 84% of cases were occupational.

97% of individuals reported mild or moderate symptoms. (The most frequently reported health complaints were eye irritation and systemic effects.) Most incidents resulted from exposure during applications, pesticide drift, or exposure to residues.

### Locations of Incidents

263 cases occurred in the production of tree fruit. 108 cases occurred in the production of field crops. 29 cases occurred in nursery/greenhouse environments.

### Risk Factors Identified

Lack of eye protection.  
 Removing personal protective equipment (PPE) too soon.  
 Inadequate PPE.

### Prevention Messages

Be certain that people are not present during applications.  
 Use pesticides as directed on the label.

<b>TABLE 9</b>							
Field Crop Cases* by Severity and Activity							
	Severity of Occupational Cases			Severity of Non-Occupational Cases			Total
	Mild	Moderate	Severe	Mild	Moderate	Severe	
<b>Drift</b>	13	23	4	13	1	0	54
<b>Applicator/Mixer/Loader</b>	34	10	2	0	0	0	46
<b>Residue</b>	3	2	0	0	0	0	5
<b>Accident</b>	2	1	0	0	0	0	3
<b>Total</b>	<b>52</b>	<b>36</b>	<b>6</b>	<b>13</b>	<b>1</b>	<b>0</b>	<b>108</b>

**\*Limited to cases with illness classified by DOH as definite, probable, or possible due to pesticide exposure.**

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The annual average number of cases investigated over the last five years is 360. Of this number, two hundred individuals annually experience some measure of pesticide-related illness. Though this number is relatively small compared to the number of uneventful pesticide applications made statewide, efforts should continue to provide intervention measures to the public and pesticide user community.

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## After 30 Years in Print, Next Month AENews Goes 100% Electronic

Beginning January 2002, *Agrichemical and Environmental News* will be available in electronic format only, on the Internet at URL <http://aenews.wsu.edu>. If you have been receiving a paper copy of this newsletter, you will now need to log onto the Internet to read it.

This decision represents good news and bad news both for the production staff at Washington State University's Pesticide Information Center and for you, the reader. From the staff's perspective, the bad news is that resources are simply not available to continue printing the paper version of the newsletter. The good news is that the readership of our electronic version has increased dramatically, with electronic "subscriptions" (more on those in a moment) doubling each of the past two years. From your perspective as a reader, the good news is that the electronic edition is free. The bad news is, well, we are all going to miss the paper version.

*Agrichemical and Environmental News'* electronic format will evolve in the months ahead. Initially, we will be eliminating the PDF (portable document format) version and publishing an HTML (hypertext markup language) version only. Current readers of the electronic version will notice very few other changes, except that we will no doubt take greater advantage of the Internet's ability to offer color photographs and other visual enhancements. However, *AENews* has always been, and will continue to be, a content-driven publication. We will continue to emphasize original, accurate information and analyses over graphic style.

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# Pesticide Safety and Beneficial Arthropods

In the February 2001 issue of *Agrichemical and Environmental News*, Jennifer Coyle and I presented the first results from a new entomological and pesticide research program being conducted at Washington State University's Irrigated Agriculture Research and Extension Center (IAREC) in Prosser (2). This program, funded by the Washington Hop Commission, the Washington Association of Wine Grape Growers and the Washington State Commission on Pesticide Registration, aims to identify pesticides (insecticides, miticides, fungicides) that are safe to common beneficial insects in Washington's vineyards and hop yards. Identification of safe pesticides is essential to the development of integrated pest management (IPM) programs, which are currently being researched in both crops.

This article presents our latest findings on the safety of various pesticides to five species of beneficial insects and mites. Both laboratory data and field monitoring data will be presented. I will also discuss results from the study that have immediate, practical significance to hop and grape growers.

## Methodology

We based our decisions as to the relative safety of various pesticides on a sensitive laboratory bioassay technique (described in detail in the February article). The five species on which our study focuses include three predatory mites (*Galendromus occidentalis*, *Neoseiulus fallacis*, *Amblyseius andersoni*) and two predatory lady beetles (*Stethorus picipes*, *Harmonia axyridis*). *G. occidentalis*, *N. fallacis*, *A. andersoni* and *S. picipes* are important predators of spider mites in Washington hops and grapes, while *H. axyridis* is a predator of aphids.

From April through September 2001, effects of the new miticides bifenazate (Acramite) and fenpyroximate (Fujimite) and the insecticides pymetrozine (Fulfill) and imidacloprid (Provado) on populations of predatory mites and the overall complex of beneficial arthropods were evaluated in three commercial hop yards. Populations of spider mites, predatory mites, hop aphids, and total beneficial

arthropods were sampled weekly. For mites and aphids, we collected thirty leaves at random from each yard on each visit, then examined the leaves under a stereomicroscope and recorded the numbers of mites and aphids. For the total beneficial arthropod count, we randomly selected nine bines\* each week (three bines in each of three locations) and shook them vigorously to dislodge arthropods onto a collecting tray, from which they were aspirated and placed in alcohol for identification and counting in the laboratory. Groups and families of beneficial arthropods recorded include mature and immature stages of lady beetles (Coccinellidae), lacewings (Neuroptera), predatory bugs (Nabidae, Miridae, Pentatomidae, Anthocoridae), predatory thrips (Thripidae), parasitic wasps (Hymenoptera), whirligig predatory mites (Anystidae) and spiders. All of these arthropods are known to feed on herbivorous insects and mites and thus may play a role in suppressing pest outbreaks (e.g., mites, aphids, caterpillars) in hop yards. Cooperating growers provided us with records of spray applications at the end of the season.

## Results

Safety ratings of pesticides (at full field rates) to the beneficial arthropods tested to date are shown in Table 1. Most miticides were harmful to the beneficial arthropod species with only hexythiazox (Savey), propargite (Omite), and bifenazate (Acramite) having moderate or low toxicities. Similarly, most insecticides were harmful except for pymetrozine (Fulfill) and, to a lesser extent, pirimicarb (Pirimor). The synthetic fungicides, myclobutanil (Rally), trifloxystrobin (Flint), and quinoxifen (Quintec) were non-toxic but the sulfur compounds varied from harmless to very harmful, depending on the beneficial species tested.

Bifenazate and pymetrozine had minimal impact on the abundance of predatory mites or the overall community of beneficial arthropods in the monitored hop

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\*ED. NOTE: A "bine" is the vine-like structure on which hop cones grow.

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yards (Figures 1-3, pages 10-11). In contrast, fenpyroximate had an adverse impact on populations of beneficials (Figures 2-3). Imidacloprid (at one quarter of the recommended rate) appeared to reduce the overall community of beneficial arthropods (Figure 2). However, predatory mite (mainly *G. occidentalis*) numbers increased substantially following the use of this insecticide (Figure 4, page 11).

### Implications

Eighteen months after its inception, this project has resulted in the creation of a significant and rapidly expanding database on the toxicity of commonly used and new pesticides on some important beneficial arthropods resident, or potentially resident, in Washington hop yards and vineyards. The three predatory mite and two lady beetle species are also important in other agroecosystems in Washington, extending the relevance of this project to other industries. I believe the safety tables are a good guide to the compatibility of specific miticides, insecticides, and fungicides to biological control and IPM. Certainly the field data thus far obtained for bifentazate, fenpyroximate, pymetrozine, and imidacloprid support the conclusions provided by laboratory bioassays.

Fenpyroximate, bifentazate, and pymetrozine were available to hop growers under a Section 18 for the first time in 2001. They are likely to become the basis for mite and aphid management in hop yards for the next few years. These compounds were chosen for

use in hops due to their efficacy against target pests and their relative compatibility with biological control agents, using information gained from the WSU project. Bifentazate is an effective miticide and also appears to be relatively safe to beneficial arthropods. It is labeled for use at 0.75 to 1.5 lbs/A (pounds per

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<b>TABLE 1</b>						
<b>Safety ratings of selected pesticides against selected beneficial arthropods in Washington hop yards. Ratings derived from direct toxicity laboratory bioassays.</b>						
<b>Type of Pesticide</b>	<i>Galendromus occidentalis</i>	<i>Neoseiulus fallacis</i>	<i>Amblyseius andersoni</i>	<i>Stethorus picipes</i>	<i>Harmonia axyridis</i>	
<b>MITICIDE</b>	Abamectin	H	H	H	H	H
	Cyhexatin	H	H	-----	-----	-----
	Propargite	S	S	MH	H	S
	Hexythiazox	S	S	S	S	S
	Fenpyroximate	H	H	H	H	H
	Bifenazate	MH	MH	H	MH	MH
	Milbemectin	H	H	H	H	MH
	Biomite	H	H	H	H	S
	Dicofol	-----	-----	-----	-----	S
	Fenbutatin Oxide	MH	S	S	-----	S
	Acaritouch	MH	S	S	-----	-----
	<b>INSECTICIDE</b>	Imidacloprid	H	H	MH	H
Pirimicarb		H	S	-----	H	S
Chlorpyrifos		H	H	H	MH	H
Bifenthrin		H	H	H	H	H
Thiamethoxam		-----	-----	-----	H	MH
Endosulfan		-----	-----	-----	-----	S
Malathion		-----	-----	-----	-----	H
Dimethoate		-----	-----	-----	-----	H
Carbaryl		H	H	-----	-----	H
Methomyl		H	H	H	-----	H
Pymetrozine		S	S	S	S	S
Diazinon	MH	H	H	-----	H	
<b>FUNGICIDE</b>	Myclobutanil	S	S	-----	S	S
	Trifloxystrobin	S	S	S	-----	-----
	Quinoxifen	S	-----	-----	-----	-----
	Wettable Sulfur	MH	S	MH	-----	MH
	Lime Sulfur	H	H	S	-----	-----

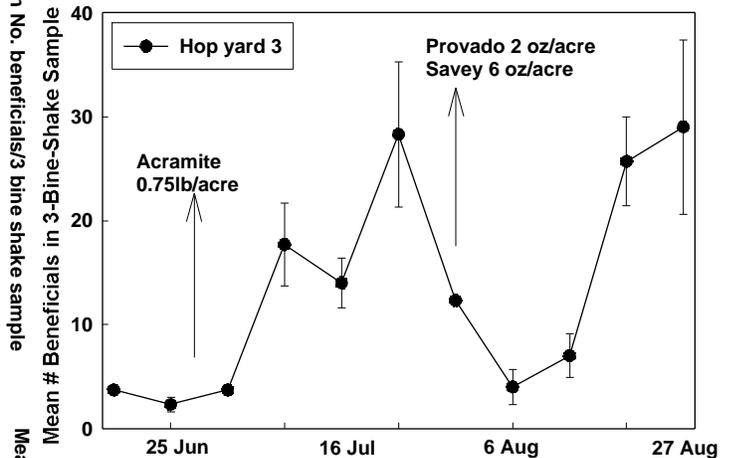
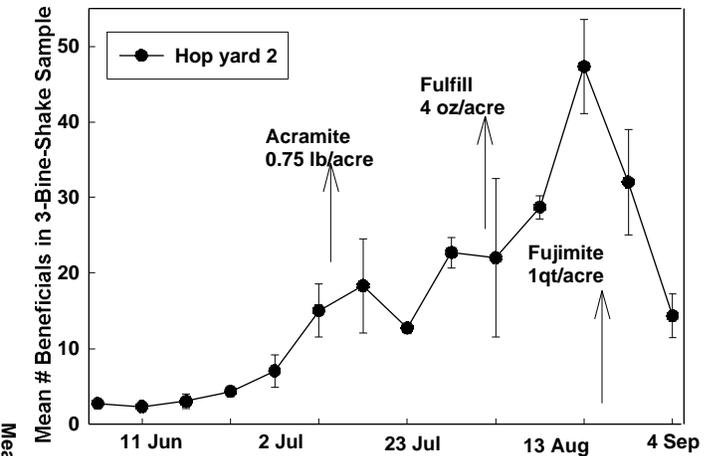
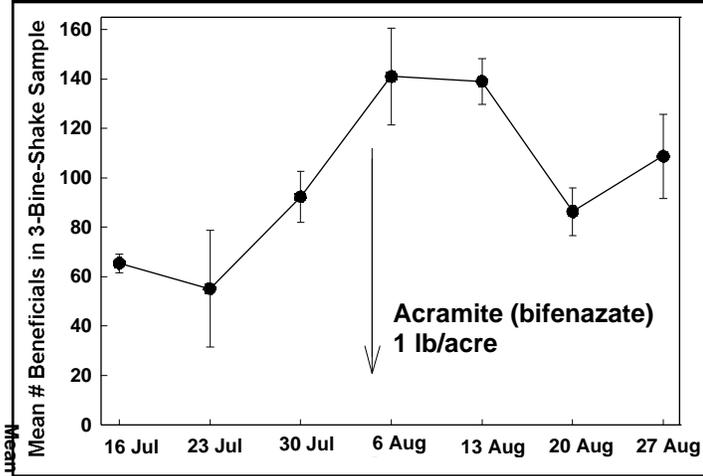
**S = SAFE: less than 33% mortality expected when field rate used.**

**MH = MODERATELY HARMFUL: 33-66% mortality expected when field rate used.**

**H = HARMFUL: 66-100% mortality expected when field rate used.**

FIGURE 1

Effect of bifenazate (Acrامة) on the beneficial arthropod community in Hop Yard 1 during 2001.



control during August. Bifenazate will soon be registered for use in wine grapes where it will provide the same opportunities for improvements in IPM.

In laboratory tests and field studies, fenpyroximate (Fujimite), the second new miticide, appears to be far more harmful to beneficial arthropods than bifenazate. All rates of fenpyroximate gave 100% or near 100% mortality to all the beneficial species tested in the laboratory. This severe effect on beneficials appeared to be confirmed by the sampling data from Hop Yard 2. The use of fenpyroximate in

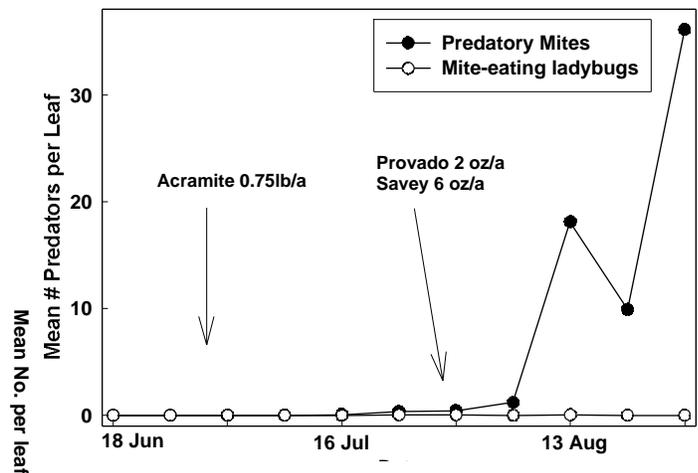
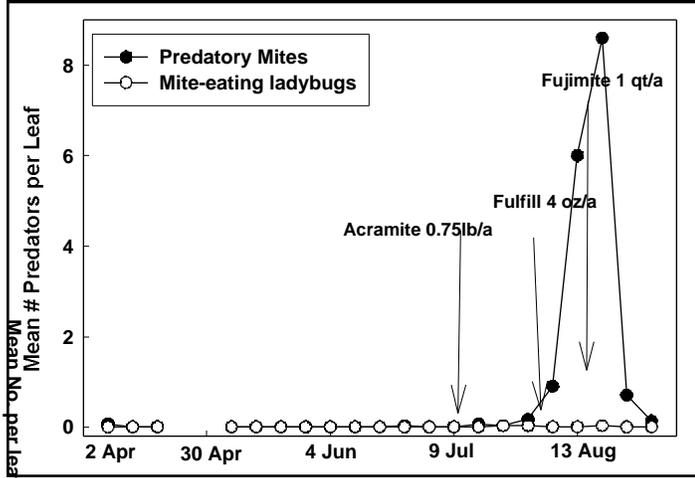
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acre). In laboratory tests, the highest labeled rate of this compound (1.5 lbs/A) did not kill 100% of the predatory mite and lady beetles species tested; around 50% mortality was usual. At the lower rates of 0.75 and 1.0 lb/A, mortalities were usually below 33% for most species. This contrasts with the industry standard miticide, abamectin, which, when used at full rate in laboratory tests, consistently resulted in 100% mortality. Furthermore, field evidence in 2001 indicated bifenazate at the lower rates had very little effect on *G. occidentalis* or the beneficial arthropod community in general. Bifenazate, therefore, appears to be a very useful IPM tool for mite (and aphid) management in hops. For the first time, hop growers have an effective miticide that kills motile stages, but does not destroy the beneficial arthropod complex. Consequently, biological control using endemic natural enemies can be considered an additional control tactic when this miticide is used. The appropriate timing for use of bifenazate in a hop IPM program is likely to be mid-season (July) if natural enemies appear to be struggling to control mites. A well-timed application should reduce mite numbers, while allowing the natural beneficial arthropods to take over

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**FIGURE 3**

**Effect of selected pesticides on predatory mite populations in Hop Yard 2 during 2001.**



hop IPM is best reserved for rescue treatments when biological control is not working and bifenthrin cannot be used (bifenthrin use is currently restricted to one application per season).

Pymetrozine is an aphicide combining good efficacy with great safety to beneficial arthropods. In laboratory tests, the full rate had low toxicity to all the beneficial species tested. This selectivity to beneficials was further demonstrated by observations in Hop Yard 2 where neither *G. occidentalis* or the general beneficial arthropod community were adversely affected. Pymetrozine is intended to be an alternative to imidacloprid for aphid control on hops. Imidacloprid is generally harmful to beneficial arthropods even at reduced rates (see below). In addition, evidence is accumulating to suggest it is a stimulant to spider mite oviposition (3). The low impact of pymetrozine on beneficial arthropods makes it an important component of IPM in hops.

As reported in the February 2001 issue of *Agrichemical and Environmental News*, imidacloprid at the full field rate is harmful to predatory mites and lady beetles (2). For experimental purposes, we observed the effects of imidacloprid applied at one-quarter rate in Hop Yard 3. This rate appeared to have a detrimen-

tal impact on the overall beneficial arthropod community, but not on the predatory mite *G. occidentalis*. This latter predator showed a spectacular increase in population size after exposure to imidacloprid. Besides being implicated in stimulating oviposition in spider mites (3), imidacloprid is known to increase egg laying in at least one species of predatory mite (1). Thus, it is possible that a reduced rate of imidacloprid, instead of killing *G. occidentalis*, increases oviposition and population development. Obviously, further research is required. Using rates below the labeled rate is not recommended, and could in fact lead to resistance development. In hops and grapes, use of the systemic formulation of imidacloprid is encouraged, because of its likely reduced impact on beneficials compared to the foliar-applied formulation (Provado).

The toxicity of lime and/or wettable sulfur to predatory mites is of particular significance to grape growers, many of whom routinely use these materials for powdery mildew control. Adverse impacts of sulfur on predatory mite populations have also been seen in field studies in vineyards, particularly when sulfur is the only material used for disease control, and multiple applications are made. Early-season sulfur and broad-spectrum insecticide (e.g., carbaryl, chlorpyri-

## Pesticides and Beneficials, cont.

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fos, methomyl) applications, all of which are toxic to the beneficial arthropods we have examined so far, are probably one of the major reasons why secondary pests like spider mites are a problem in Washington vineyards. Hopefully, this project in due course will identify vineyard pesticides that are more compatible with IPM/biological control, improving the prospects for reduced chemical inputs in the way that bifenthrin and pymetrozine have done for hops.

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### ACKNOWLEDGMENTS

I wish to thank Jennifer Coyle, Tanya Price, Larry Wright, Joe Perez, and Maria Mireles for their invaluable technical assistance in this project.

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2. James, D.G. and J. Coyle. 2001. Which pesticides are safe to beneficial insects and mites? *Agrichemical and Environmental News* 178: 12-14.
3. James, D.G. and T.S. Price. 2001. Pesticides as "fertility drugs" for mites. *Agrichemical and Environmental News* 183: 27-28.

### WSDA Testing Sites

Location	Day	Time
Olympia	Every Tuesday	8:30 am and 1:00 pm
Yakima	Every Tuesday	8:30 am and 1:00 pm
Mt. Vernon	2nd Thurs. each month	8:00 am to 12:30 pm
Wenatchee	4th Tues. each month	12:30 pm to 4:30 pm
Moses Lake	3rd Tues. every other month	12:30 pm to 4:30 pm
Spokane	1st Weds. each month	12:30 pm to 4:30 pm

**Reservations are required. To make a reservation for any of the above locations, call WSDA at 1-877-301-4555.**

## Pesticide Applicator Pre-License Training and Testing

See general information on pesticide applicator training at the top of page 13. The schedule at left shows dates and locations for taking the licensing exam; the schedules below show dates and locations for the pre-license training.

### EASTERN WASHINGTON

## PRE-LICENSE TRAINING

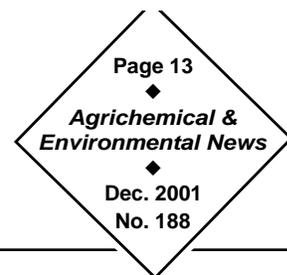
Date	City	Facility
Jan. 8, 9, 10	Pullman	University Inn (Moscow, ID)
Jan. 15, 16, 17	Pasco	Doubletree
Special <b>Aquatics</b> session in Pasco, Doubletree, Jan. 16 afternoon		
Jan. 22, 23, 24	Yakima	Convention Center
Feb. 12, 13, 14	Spokane	Valley Doubletree
Feb. 19, 20, 21	Moses Lake	Convention Center

### WESTERN WASHINGTON

## PRE-LICENSE TRAINING

Date	City	Facility
Jan. 15, 16, 17	Tacoma	Pacific Lutheran University
Feb. 12, 13, 14	Kirkland	Lake WA Technical College
Special <b>Pest Control Operator (PCO)</b> and <b>Wood Destroying Organism Inspector &amp; Applicator</b> Courses Feb. 26, 27, 28 at WSU Puyallup		
Mar. 12, 13, 14	Puyallup	WSU Allmendinger Ctr
Mar. 26, 27, 28	Bellingham	Whatcom Community Coll
Apr. 16, 17, 18	Puyallup	WSU Allmendinger Ctr

# Pesticide Applicator Training Courses



Washington State University offers pre-license and recertification training for pesticide applicators. Pre-license training provides information useful in taking the licensing exam (see schedules on page 12). Recertification (continuing education) is one of two methods to maintain licensing. (The other is retesting every five years.) Private applicators must accumulate twenty recertification credits over a five-year period, with no more than eight credits taken in a single year. All other licensees must obtain forty credits over a five-year period, taking no more than fifteen per year. Credit statements are mailed to licensees in September each year. To obtain information on your current credits, you can contact the Washington State Department of Agriculture toll-free at (877) 301-4555. Course registration (including study materials) for either type of training is \$35 per day if postmarked 14 days prior to the first day of the program you will be attending. Otherwise, registration is \$50 per day. These fees do not include Washington State Department of Agriculture (WSDA) licence fees.

EASTERN WASHINGTON		
RECERTIFICATION		
Date	City	Facility
Jan. 9, 10	Pullman	University Inn (Moscow)
Jan. 16, 17	Pasco	Doubletree
Jan. 23, 24	Yakima	Convention Center
Jan. 30, 31	Wenatchee	Red Lion Hotel
Feb. 13, 14	Spokane	Valley Doubletree
Feb. 20, 21	Moses Lake	Convention Center
Special <b>Commercial Applicator Workshops</b> will be held Jan. 28 at WSU Tri-Cities Auditorium and Jan. 29 at Moses Lake Convention Center		

WESTERN WASHINGTON		
RECERTIFICATION		
Date	City	Facility
Jan. 10, 11	Vancouver	WSU Vancouver
Jan. 16, 17	Tacoma	Pac Lutheran Univ
Jan. 24, 25	Lynnwood	Edmonds Comm Coll
Feb. 4, 5	Lacey	St. Martins Coll
Feb. 7, 8	Des Moines	Highline Comm Coll
Feb. 13, 14	Kirkland	Lake WA Tech Coll
Feb. 20, 21	Port Orchard	Givens Comm Center
Mar. 6, 7	Seattle	UW Ctr for Urban Hort
Mar. 26, 27	Bellingham	Whatcom Comm Coll

SPECIAL WORKSHOPS			
Date	Topic/Emphasis	City	Facility
Jan. 10	Christmas Tree Problems	Vancouver	WSU Vancouver
Jan. 16	Wood Treatment	Tacoma	Pac Lutheran Univ
Jan. 28	Commercial Applicator	Richland	WSU Tri-Cities Auditorium
Jan. 29		Moses Lake	Convention Center
Jan. 29, 30, 31	Integrated Plant Health	Puyallup	WSU Allmendinger Ctr
Mar. 5	Commercial Applicator	Puyallup	WSU Allmendinger Ctr

For detailed information on training opportunities, visit the Pesticide Education Program's training page at

**<http://pep.wsu.edu/education/educ.html>**

or call (509) 335-2830.

# Strobilurin Fungicides

## Tools for Fruit Disease Management

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Fungicides are critical components of many tree fruit and vine disease management programs. Without them, powdery mildew and other plant diseases would be difficult, if not impossible, to control during years of high disease pressure.

### A Brief History of Fungicides in Fruit Production

Until the advent of the benzimidazoles (e.g., Benlate) in the 1960s, sulfur and other protectants were the primary fungicides for fruit disease management. In some areas, benzimidazoles were used extensively for mildew control until their use gradually declined due to resistance concerns.

Demethylation-inhibiting fungicides (DMIs, also known as sterol-inhibiting fungicides or SIs) first entered the marketplace in the late 1970s. For almost two decades, these have been our primary line of defense against powdery mildews and apple scab.

### Resistance Development

It has been documented that fungal pathogens can gradually lose their sensitivity to DMI fungicides under repeated and prolonged usage. The most widely known example in fruit crops was the development of Bayleton resistance by *Uncinula necator*, the grape powdery mildew pathogen. Bayleton first entered the California grape market in the early 1980s and was initially considered a panacea against powdery mildew. Within several years, total control failures had been documented. Today, the compound is seldom used to control grape mildew by our neighbors to the south.

Resistance to the DMI compounds has been documented in a number of other crops as well. Control failures have been reported when certain DMI fungicides have been used extensively against *Podosphaera clandestina*, the cherry powdery mildew pathogen. We have not documented any control failures in apple, but patterns of intensive DMI use on apples and other crops result in a high risk for resistance.

It is now known that two of the keys to resistance management are minimizing the number of fungicide applications and alternating fungicides with different modes of action. Until recently, growers had very few effective alternatives besides sulfur compounds to alternate with the DMI fungicides when trying to control powdery mildews. The emergence of the new strobilurins fungicide class has brightened the grower's future.

### Enter: Strobilurins

One of the more exciting advances in disease control during the last decade has been the discovery, development, and marketing of strobilurin fungicides. Chemically, the strobilurins are a unique class of fungicidal compounds derived from or related to oudemansin or strobilurin A, compounds produced by the woodland mushrooms *Oudemansiella mucida* or *Stobilurus tenacellus*, respectively (2). These compounds inhibit other fungi that could compete for nutrients in the rotting plant material.

Several companies have developed synthetic strobilurin products. The first to enter major markets in Washington State was Abound (azoxystrobin). Abound is currently registered for use against, among other things, grape and cherry powdery mildew and shothole of stone fruits including cherry. Abound is extremely phytotoxic to certain apple varieties (e.g., Gala) and should be used with caution if the cherry orchard or grape vineyard to be treated is in close proximity to apple orchards or if using the same sprayer to treat multiple crops.

Sovran (kresoxin-methyl) and Flint (trifloxystrobin) are registered for use on apples, other pome fruits, and grapes for powdery mildew and other diseases. Sovran and Flint offer the additional benefit of excellent activity against apple scab and should improve our control of fruit scab when mixed or alternated with DMI fungicides.

Strobilurins will fit into our spray programs as protectant fungicides, meaning they need to be on the plant surface before the pathogen gets there and

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before the disease intensifies. Strobilurins are good or relatively good stand-alone mildewcides, but in our studies seem to perform equally as well or better when used in alternation with DMI fungicides.

Strobilurins have some curative activity, but their primary use should be as protectants. They should not be used as eradicants because this will increase the risk of resistance.

### Modes of Action, Site Specificity

The way in which the fungicide affects the fungus is known as the compound's mode of action. Some fungicides have wide modes of action, meaning that they affect sensitive fungi at numerous biochemical points or in numerous ways. Others, such as anilopyrimidines (APs), DMIs, strobilurins, and benzimidazoles, have narrow modes of action, which means they affect the fungus at fewer biochemical points. The narrowest mode-of-action fungicides are known as site-specific compounds, meaning that they interfere with one essential biochemical step (or site) in the pathogen's metabolism. Site specificity can be monogenic (affecting one gene), as in the case of the benzimidazoles, or polygenic (affecting multiple genes or gene types), as in the case of DMI, strobilurin, and AP fungicides.

The narrow mode-of-action, site-specific fungicides that are at highest risk for resistance development include DMI fungicides such as Bayleton, Rally, Rubigan, Procure, Funginex, Elite, Orbit, and Indar. These site-specific, locally systemic compounds affect susceptible fungi by interfering with the synthesis of ergosterol, a necessary component of fungal membranes. Because the biosynthesis of ergosterol is site-specific and under the biochemical control of a few genes, the risk of resistance develop-

<b>TABLE 1</b>			
<b>Fungicides for tree fruit<sup>†</sup> and vine<sup>†</sup> disease management in Eastern Washington. An essential component of resistance management is the alternation of fungicides of different classes.</b>			
Class	Examples	Target <sup>†§</sup> Organisms	Resistance Risk
anilopyrimidine	Vanguard	AS, BR, BRG	high
benzimidazoles*	Benlate*	PM*, AS*, BRG	high
DMI	Rally, Rubigan, Elite, Orbit, Bayleton, Funginex, Procure	PM, AS, BR	high
oils	Stylet Oil, Orchex Oils, Others	PM	low
soap	Mpede	PM	low
strobilurin	Abound, Flint, Sovran	AS, PM	high
sulfur	Lime Sulfur, Sulforix, Wettable Sulfur, Flowable Sulfur	PM	low

**\* Not recommended for use in Washington orchards**

**<sup>†</sup> Disease spectrum and crop registration varies according to commodity. Always read the fungicide label.**

**<sup>§</sup> AS (apple scab), PM (powdery mildews), BR (brown rot of stone fruits), BRG (bunch rot of grape).**

ment to DMI fungicides is relatively high. Strobilurins such as Abound, Flint, and Sovran are site-specific, locally systemic compounds with modes of action that disrupt energy production in the fungus. For this reason, they are potent inhibitors of spore germination. I consider the resistance risk of strobilurins to be moderate to high because of their site-specificity. Benzimidazole fungicides are absorbed by the fungus and prevent the formation of mitotic spindles, which

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interferes with the normal process of cell division. Sulfur compounds are active in the vapor phase (which is why they work only under a narrow temperature range), preventing spore germination. Oil fungicides may have protective, eradicator, and antispore activity. An in-depth study on the modes-of-action of petroleum and plant oils was published by Northover (1).

In summary, AP, DMI, strobilurin, and benzimidazole fungicides have site-specific, narrow modes of action, while oils, sulfur, and soaps have wide modes of action. The resistance risk of the former group is high and of the latter group is low. Neither strobilurin nor AP fungicides show cross-resistance to members of other fungicide classes, but the reader should keep in mind that research on this phenomenon in the strobilurins is still in an early phase.

### Resistance Development

During prolonged exposure to DMI fungicides, the pathogenic fungus gradually loses its sensitivity to the registered rates of the compound. Prior to exposure to DMI fungicides, a wild-type powdery mildew population will include individuals sensitive to low, average, and high doses of the fungicide, (e.g., 2 oz. per acre and higher), individuals susceptible to average and high doses (e.g., 4 oz. per acre and higher), and individuals sensitive to high doses (e.g., 6 oz per acre and higher). The low- and medium- dose sensitive fungi are selected out of the population over time. Eventually the population consists of individuals that can be eliminated only by high doses of the fungicide. In the orchard or vineyard, this eventually manifests as a loss of control. Growers find themselves having to spray more often and at higher rates in order to maintain an adequate level of control. Under high disease pressure, when the pathogen is reproducing rapidly and multiple DMI sprays are applied, the shift towards a population consisting of "high-dose" individuals can occur within one growing season. This is why it is imperative to alternate fungicide classes during the growing season. Numerous factors affect fungicide resistance development.

Nature of the chemical. Site-specific, narrow mode-of-action (AP, DMI, strobilurin, and benzimidazole) fungicides have a higher inherent resistance risk than compounds with wide modes of action (oils, soaps, sulfurs, and EBDCs or Ethylene bis-dithiocarbamates).

Intensity and timing of usage. Using a site-specific fungicide in an eradicator (after-the-fact) manner poses a higher resistance risk than using it in a protective manner. Using resistance-prone compounds after a disease has become well established exposes a larger pathogen population to the chemical. Using one or closely related compounds continuously and exclusively increases the risk of resistance.

Nature of the pathogen. Any pathogen that reproduces rapidly, spreads through the air, and reproduces sexually is more likely to develop resistance. The powdery mildew, apple scab, and brown rot pathogens all meet these criteria.

Proportion of naturally occurring resistance strains in the population. A larger proportion of naturally occurring resistant strains in the wild-type population will increase the risk of resistance development.

The American Phytopathological Society's recommendations for avoiding fungicide resistance are provided in the sidebar opposite.

### Managing Strobilurin Resistance

Resistance has been studied in azoxystrobin (Abound), one of the compounds considered at moderate risk for inciting resistance. The resistance risk can be minimized by applying optimal doses and by avoiding sublethal or suboptimal doses (in other words, by following the directions on the product label).

Strobilurin resistance development is a multi-step process favored by low doses of the fungicide. Strobilurins should be used preventatively and should not be used to attempt to bring mildew under control

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once it has intensified. They should always be applied at the rates specified on the label. The strobilurin proportion should not exceed 30 to 50 percent of total spray applications per season. Strobilurins should be alternate or "blocked" with fungicides of other classes. "Blocks" are a structured type of alternation. For example, a block could be two consecutive strobilurin sprays followed by two consecutive DMI sprays then by two more strobilurin sprays. For mildew control the strobilurins can be alternated or blocked with oils, sulfur compounds, or DMI fungicides. If strobilurins are used in blocks, use them in blocks of one to three sprays. Always be sure that the strobilurin blocks are separated by at least two sprays of a fungicide with a different mode-of-action.

Fungicide resistance management is a multi-faceted process. One of the key components of it is the alternation of different fungicide chemistries. The new AP, strobilurin, and oil fungicides provide us with more tools for disease control and are also excellent resistance-management tools. The wise use of strobilurin fungicides will keep them working for us for years to come.

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1. Northover, J., and Schneider, K.E. 1996. Physical modes of action of petroleum and plant oils on powdery and downy mildews of grapevines. *Plant Disease* 80: 544-550.
2. Ypema, H.L., and Gold, R.E. 1999. Kresoxin-methyl. Modification of a naturally occurring compound to produce a new fungicides. *Plant Disease* 83(1): 4-18.

## Resistance Reduction

**The Fungicide Resistance Action Committee of the American Phytopathological Society has created recommendations to help reduce the risk of fungicide resistance.**

**1**

Use cultural methods to reduce disease pressure. When there is high disease pressure, the fungus is reproducing rapidly and there is a larger population of pathogen spores. This increases the likelihood of having resistant spores in the population. With the powdery mildews, pruning for air circulation and light penetration is one cultural practice that can slow the rate of pathogen reproduction and make orchard conditions less favorable for infection.

**2**

Use of fungicide alternations and mixtures. Alternate or tank-mix fungicides with different modes of action, (e.g., sulfur with DMI, strobilurin with DMI, etc.) Alternations are preferred over tank mixes.

**3**

Limit the use of the resistance-prone compounds. Limit the number of AP, DMI, and strobilurin fungicide sprays to no more than three of each per year.

**4**

Do not use narrow mode-of-action fungicides to attempt to control mildew when it is already out of control. Use AP, DMI, and strobilurin fungicides in a protective rather than eradicated manner. In most cases, it is acceptable to use all three classes in post-infective programs. With the exception of cherries, an out-of-control powdery mildew epidemic is best managed using one of the oil fungicides. (ED. NOTE: In cherries, prevention is the only acceptable management technique.)

# Upcoming Conferences

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## Call for Presentations and Posters 4th Ag and Water Quality Conference

The steering committee for the Agriculture and Water Quality in the Pacific Northwest conference seeks presentations, posters, and exhibits for the 2002 conference, to be held November 19 and 20, 2002, at the Yakima Convention Center. Deadline for presentation descriptions is January 25, 2002. The conference mission is

**“To provide a forum for agricultural interests, government, and environmentalists to come together in one place to discuss issues relevant to agriculture and water quality. The intent is to present different perspectives in a non-confrontational forum and help each other see and understand other points of view so we can work together for new solutions that benefit all.”**

A write-up of the 2000 conference was featured in *Agrichemical and Environmental News*, attesting to the fact that this conference indeed engenders some lively discussions and represents disparate points of view. Held every other year since 1996, the Ag and Water Quality conference attracts 300 to 400 people from the farming community, agricultural service organizations, universities, regulatory agencies, and environmental organizations. Details are available on the Internet at URL <http://www.agwaterquality.org/>.

The conference committee is seeking presentations that provide the audience with a thoughtful, reasoned, and informative point of view, focusing on applied solutions: what works or doesn't work, and why. Cooperative efforts between organizations are encouraged. General topics may include water quality and quantity management and monitoring; nutrient, sediment, and pesticide management; issues and interactions regarding the Clean Water Act, Endangered Species Act, and pesticide registration laws; and emerging ag/water issues.

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## 5th NW Direct Seed Conference

The 5th Northwest Direct Seed Cropping Systems Conference is being held January 16 to 18, 2002, in Spokane. Registration includes entrance to the Spokane Ag Expo (January 15 to 17), the largest agricultural show in the Inland Northwest, featuring over 300 exhibits, as well as the Pacific Northwest Farm Forum and seminar series in adjoining facilities.

The conference is organized as a service to Northwest growers by the Pacific Northwest STEEP (Solutions to Environmental and Economic Problems) program and the Pacific Northwest Direct Seed Association. STEEP is a cooperative research and educational program on conservation tillage systems through the University of Idaho, Oregon State University, Washington State University, and USDA-Agricultural Research Service. The PNW Direct Seed Association is a grower-driven organization working to facilitate the development and adoption of direct seed cropping systems through research coordination, funding, and information exchange. Formed in 2000, the Direct Seed Association already has a membership of over 300.

The conference will feature twenty-four speakers (including ten growers, from Idaho, Oregon, Washington, Alberta, and Saskatchewan), a poster exhibition, and panel sessions on topics including soil acidity management, soilborne pathogen management, field record systems, mapping strategies, and rotation and moisture management. The conference Web site, at Internet URL <http://pnwsteep.wsu.edu/directseed> explains the complete program and includes a registration form. If you still have questions after viewing the Web site, contact the NW Direct Seed Conference Office at (509) 547- 5538 or [wpeay@mcmgt.com](mailto:wpeay@mcmgt.com).

# Bug of the Month

## Damsel Bug

Dr. William E. Snyder and Amanda K. Fallahi, Entomologists, WSU

Damsel bugs, *Nabis* spp. (Heteroptera: Nabidae), are one of the larger and more effective predators in Washington agricultural fields.

### General Description

When we say “large,” of course we mean that damsel bugs are large by bug standards: adult damsel bugs can reach about three-eighths of an inch in length. They are slender, grayish brown insects with large protruding eyes on the sides of their thin heads. Adult damsel bugs have wings, while those in the nymph stage look like smaller, lighter-colored, wingless versions of the adults,

### Habits and Life Cycle

Damsel bugs are common in a wide variety of crops throughout Washington State. They are active throughout the growing season, from about mid-May until early October. Damsel bugs go through at least two generations per year. In the spring we see mostly adults, while later in the year the nymphs can be very common.

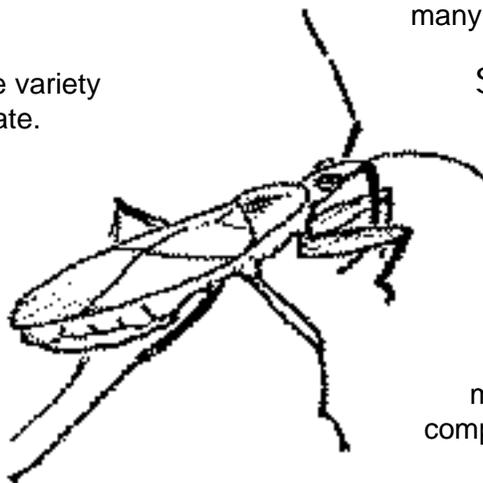
### Damsels Cause Distress

If you look closely at a damsel bug, you'll see that they resemble a small praying mantis, with folded front legs that make them look like they are praying. Entomologists call these “raptorial” legs, and they are used to capture prey. The damsel bug and the praying mantis are only distantly related, but have a similar appearance because they hunt in a similar way. Both are ambush predators. This means they sit and wait for prey to come within reach and then lunge at them with their raptorial front legs.

Damsel bugs are generalists that feed on many different prey species. Like big-eyed bugs (*AENews* featured “Bug of the Month” in the October 2001 issue, No. 186), damsel bugs feed by piercing their prey with their sharp mandibles (mouthparts) and then drinking their victim's bodily fluids. Because they

need to pierce their prey to eat them, damsel bugs prefer soft-bodied insects like caterpillars, beetle larvae, and aphids.

The relatively large size of damsel bugs makes them particularly important predators. We have been studying which predators feed on two common potato pests, the green peach aphid and the Colorado potato beetle. Many of the predators feed on aphids, because aphids are small and cannot do much to defend themselves. But, of the predators we examined, only damsel bugs fed heavily on Colorado potato beetle larvae, which are too large for many smaller predators to subdue.



### Save the Damsels!

The significance of the damsel bug in the Colorado potato beetle predator population illustrates the importance of conserving predator diversity in agricultural fields. Different predator species attack different pest species and stages, therefore the presence of more predator species leads to more complete control.

An integrated pest management (IPM) approach emphasizes preservation of beneficial predators and use of softer pesticides. Like other beneficial insects, damsel bugs are very susceptible to broad-spectrum pesticides. Working in potato fields in Washington, we have found that damsel bugs are ten times more abundant in fields treated with selective pesticides than they are in fields treated with organophosphates. Damsel bugs, working together with other predators, can slow the rate of pest resurgence following application of softer pesticides, making fewer treatments necessary than would be required if broad-spectrum pesticides were used.

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## ACPA Members To Join ACRC

In a press release dated October 15, 2001, the American Crop Protection Association (ACPA) announced a recent decision to make participation in the Agricultural Container Recycling Council (ACRC) a condition of membership. By including agricultural container recycling in their stewardship activities, the industry has demonstrated its commitment to responsible care. All ACPA member companies that sell crop protection products in HDPE containers will now support one of the most successful single-industry recycling programs in the country.

Thanks to the ACRC, about seven million pounds of HDPE crop protection chemical, adjuvant, and micronutrient containers, find new life as recycled products every year. The leadership of the ACPA, and its staff, deserve high praise for a courageous stand on behalf of the environment and the future of a responsible crop protection industry; the staff of *Agrichemical and Environmental News* and the Pesticide Information Center at Washington State University salutes them.

## Upcoming Conferences

The **Research and Extension Regional Water Quality Conference** is being held February 20 and 21, 2002, in Vancouver, Washington. The conference presents current advances in science and discusses their application for technology transfer and outreach. For more information, contact Washington Water Research Center at (509) 335-5531 or [swwrc@wsu.edu](mailto:swwrc@wsu.edu) or go to Internet URL <http://www.wsu.edu/swwrc/conference/index.html>.

**An International Integrated Pest Management (IPM) Conference** is being held in Toronto, Canada, March 24 through 26, 2002. Objectives include showcasing strategies and emerging technologies in IPM and discussing future directions for IPM internationally. To find out more about "Exploring New Frontiers in Integrated Pest Management," log onto Internet URL: <http://www.gov.on.ca/OMAFRA/ipmconference/english/index.html>.

See page 18 for information on other upcoming conferences.