Plantback restrictions for herbicides used in the dryland wheat production areas of the Pacific Northwest

By Bradley D. Hanson, Traci A. Rauch, and Donald C. Thill

Consider soil persistence characteristics of herbicides when planning crop and herbicide rotations to maximize economic yield and minimize rotational crop injury.

Selective or non-selective herbicides are applied at least once each year to the majority of all wheat, barley, canola, mustard, pea, lentil, and fallow acres in dryland wheat production areas of the Pacific Northwest. Ideally, soil-active herbicides control weeds during the growing season of the treated crop and dissipate to a non-toxic level before the next crop is seeded. However, they potentially can carry over and injure subsequently planted crops.

Dissipation rate, soil persistence, and hence the potential for carryover injury to subsequently seeded crops are carefully researched before a new herbicide is labeled or before an existing herbicide is labeled for a new crop. Herbicides containing an active ingredient that can persist in the soil usually have a section on the product label detailing specific rotational crop (plantback) restrictions. These restrictions often are relatively simple guidelines expressing how much time must pass between herbicide application and the seeding of a sensitive crop, but they also can include specific rainfall or tillage requirements, requirements for different pH soils, and application rate restrictions.

This bulletin condenses rotational crop restrictions from herbicide labels into one table and discusses important factors affecting herbicide dissipation in the soil environment. For specific rotational crop restrictions for currently labeled herbicides used in dryland winter wheat production areas of the Pacific Northwest, please refer to the table that starts on page 2 and the herbicide product label.

Herbicide Classification: Site of Action

The potential for rotational crop injury depends on complex interactions among herbicide characteristics, soil type, soil moisture and temperature, and the sensitivity of the rotational crops. Because herbicides with the same site of action often have similar persistence characteristics, the rotational crop restrictions discussed in this bulletin are arranged by site of action and chemical family. (See PNW 437, Herbicide-Resistant Weeds and Their Management.)

Herbicide site of action refers to the specific way that susceptible plants are affected by the herbicide. Herbicides with the same site-of-action group disrupt the same biochemical process in plants. A site-of-action group may, however, consist of several structurally diverse chemical families. For example, the group 2 herbicides, which include sulfonylureas, imidazolinones, and others, all inhibit the enzyme acetolactate synthase (ALS). An understanding of site-of-action classification is very important in developing herbicide rotations to minimize injury to rotational crops and to minimize selection for herbicide-resistant weeds. For more information on herbicide-resistant weeds and their management, see PNW 437.

Herbicide Dissipation and Half-life

Dissipation includes all possible fates of an herbicide once it enters the environment. Two basic processes affect the rate of herbicide dissipation after application, transfer and degradation. Transfer processes change the location or availability of the herbicide without changing its chemical structure or properties. Transfer processes include spray drift at application, volatilization, adsorption to soil, leaching through soil, surface erosion, and plant or animal uptake and removal from the site. Degradation processes change the chemical structure and properties of the herbicide, making it less toxic to plants. They include photo-

This publication contains the Plantback Restrictions reference table
## Plantback restrictions for herbicides used in the dryland wheat production areas of the Pacific Northwest

<table>
<thead>
<tr>
<th>Group number, site of action, and chemical family</th>
<th>Trade name</th>
<th>Common name</th>
<th>Rotational crop</th>
<th>Special conditions</th>
<th>Plantback restrictions in OR, WA, ID</th>
</tr>
</thead>
</table>
| **Group 1**  
Acetyl CoA carboxylase (ACCase) inhibitors | Achieve | tralkoxydim | wheat, barley, pea, lentil, chickpea, canola, mustard | 30 days | 106 days |
| | Hoelon | diclofop | wheat, barley, pea, lentil, chickpea, canola, mustard | no restriction | no restriction |
| | Poast | sethoxydim | wheat, barley, chickpea, canola, mustard | no restriction | no restriction |
| | Puma 1EC | fenoxaprop | wheat, barley, pea, lentil, chickpea, canola, mustard | no restriction | no restriction |
| | Select | clethodim | canola, mustard, wheat, barley, pea, lentil, chickpea | no restriction | no restriction |
| | Discover | clodinafop | wheat, barley, pea, lentil, chickpea, canola, mustard | no restriction | 30 days |
| **Group 2**  
Acetolactate synthase (ALS) inhibitors | Assert | imazamethabenz | wheat, barley, pea, lentil, chickpea, canola, mustard | next season | 15 months |
<p>| | Pursuit WDG | imazethapyr | wheat, barley, canola, mustard | no restriction | 4 months |
| | Pursuit Plus EC | imazethapyr + pendimethalin | wheat, barley, pea, lentil, chickpea, canola, mustard | no restriction | 4 months |
| | | | | | 9.5 months |
| | Beyond | imazamox | wheat (Clearfield), pea, lentil, chickpea, canola (Clearfield) | no restriction | 3 months |
| | | | wheat (non-Clearfield) | | 9 months |
| | | | barley | pH 6.2 or higher AND more than 18 in. precip. | 18 months |
| | | | barley | pH 6.2 or lower OR less than 18 in. precip. with plow | 26 months |
| | | | barley | pH 6.2 or lower OR less than 18 in. precip. with no plow | 34 months |
| | | | canola (non-Clearfield), mustard | | |
| | Everest | flucarbazone-sodium | wheat, barley, canola, pea, lentil, mustard, chickpea | not specified | 4 months |
| | | | | | 9 months |
| | | | | | 24 months |
| | Ally XP | metsulfuron | wheat (except durum) | pH 7.9 or lower | 1 month |
| | | | durum wheat, barley | pH 7.9 or lower | 10 months |
| | | | pea, lentil, canola, pea, lentil, canola | pH 6.8 or lower AND more than 18 in. precip. | 15 months |
| | | | canola | pH 6.9 to 7.9 AND more than 18 in. precip. | 34 months |
| | | | mustard | pH 6.9 to 7.9 AND more than 18 in. precip. | 34 months |
| | Amber Custom Pak | triasulfuron | wheat (except durum) | pH 6.9 or less | 4 months and field bioassay |
| | | | durum wheat, barley | pH 7.0 or higher | 8 months |
| | | | pea, lentil, chickpea, canola, mustard | | 6 months |</p>
<table>
<thead>
<tr>
<th>Product</th>
<th>Herbicides</th>
<th>Crops</th>
<th>pH Conditions</th>
<th>Restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canvas</td>
<td>thifensulfuron + tribenuron + metsulfuron</td>
<td>wheat (except durum), durum wheat, barley, pea, lentil, canola</td>
<td>pH 7.9 or lower</td>
<td>1 month</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pea</td>
<td>pH 6.8 or lower AND more than 18 in. precip.</td>
<td>10 months</td>
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<td></td>
<td></td>
<td>lentil</td>
<td>pH 6.9 to 7.9 AND more than 18 in. precip.</td>
<td>15 months</td>
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<tr>
<td></td>
<td></td>
<td>canola</td>
<td>pH 6.9 to 7.9 AND more than 18 in. precip.</td>
<td>22 months</td>
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<td></td>
<td></td>
<td>mustard</td>
<td>more than 28 in. precip.</td>
<td>34 months</td>
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<td></td>
<td>* all crops</td>
<td></td>
<td>* if drought conditions prevail between application and seeding rotational crops, extend all restrictions by 1 crop season</td>
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<tr>
<td>Express XP</td>
<td>tribenuron</td>
<td>wheat, barley, pea, lentil, chickpea, mustard</td>
<td>no restriction</td>
<td>45 days</td>
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<td></td>
<td></td>
<td>canola, winter rapeseed</td>
<td></td>
<td>60 days</td>
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<tr>
<td>Finesse</td>
<td>chlorsulfuron + metsulfuron</td>
<td>rates of 2/10 to 4/10 oz/A wheat (except durum), barley, durum wheat, pea, lentil</td>
<td>pH 6.5 or lower</td>
<td>10 months</td>
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<td></td>
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<td></td>
<td>pH 6.6 to 7.9</td>
<td>16 months</td>
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<td></td>
<td>pH 6.5 or lower AND more than 35 in. precip.</td>
<td>24 months</td>
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<td></td>
<td>pH 6.5 or lower AND more than 50 in. precip.</td>
<td>36 months</td>
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<td>pH 6.6 or higher</td>
<td>field bioassay</td>
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<td>rates above 4/10 oz/A</td>
<td>field bioassay</td>
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<td></td>
<td></td>
<td>pea, lentil, chickpea, mustard canola, mustard</td>
<td>all crops</td>
<td>field bioassay</td>
</tr>
<tr>
<td>Glean</td>
<td>chlorsulfuron</td>
<td>wheat</td>
<td>pH 7.6 or lower</td>
<td>no restriction</td>
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<td></td>
<td></td>
<td>wheat</td>
<td>pH 7.6 to 7.9</td>
<td>4 months</td>
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<tr>
<td></td>
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<td>barley</td>
<td>pH 6.5 or lower</td>
<td>10 months</td>
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<td></td>
<td></td>
<td>barley</td>
<td>pH 6.5 to 7.5</td>
<td>16 months</td>
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<td>barley</td>
<td>pH 7.6 to 7.9</td>
<td>24 months</td>
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<tr>
<td></td>
<td></td>
<td>pea</td>
<td>pH 6.5 or lower AND more than 35 in. precip.</td>
<td>24 months</td>
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<tr>
<td></td>
<td></td>
<td>lentil</td>
<td>pH 6.5 or lower AND more than 50 in. precip.</td>
<td>36 months</td>
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<td></td>
<td></td>
<td>pea, lentil, chickpea, mustard canola, mustard</td>
<td>pH above 6.5</td>
<td>field bioassay</td>
</tr>
<tr>
<td>Harmony Extra XP</td>
<td>thifensulfuron + tribenuron</td>
<td>wheat, barley, pea, lentil, chickpea, mustard canola, winter rapeseed</td>
<td>no restriction</td>
<td>45 days</td>
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<tr>
<td>Harmony GT XP</td>
<td>thifensulfuron</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
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<tr>
<td>Maverick</td>
<td>sulfosulfuron</td>
<td>wheat, barley, canola, lentil</td>
<td>pH less than 7.5 AND more than 24 in. precip.</td>
<td>no restriction</td>
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<tr>
<td></td>
<td></td>
<td>barley, canola, lentil</td>
<td>pH 7.5 or higher OR less than 24 in. precip.</td>
<td>22 months</td>
</tr>
<tr>
<td></td>
<td></td>
<td>pea, chickpea</td>
<td>pH less than 6.5 AND more than 30 in. precip.</td>
<td>17 months</td>
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<tr>
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<td></td>
<td>pea, chickpea</td>
<td>pH 6.5 or higher AND more than 24 in. precip.</td>
<td>22 months</td>
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<td></td>
<td></td>
<td>mustard</td>
<td>field bioassay</td>
<td>field bioassay</td>
</tr>
<tr>
<td>Muster</td>
<td>ethametsulfuron</td>
<td>spring wheat, durum wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td>10 months</td>
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<td></td>
<td>22 months</td>
<td>22 months</td>
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<td></td>
<td></td>
<td>and field bioassay</td>
<td></td>
</tr>
<tr>
<td>Peak CustomPak</td>
<td>prosulfuron</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard all crops</td>
<td>pH 7.2 or lower</td>
<td>no restriction</td>
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<td></td>
<td></td>
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<td>pH 7.2 or lower AND applied before July 1 previous yr.</td>
<td>10 months</td>
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<td>pH 7.2 or lower AND applied before June 15 previous yr.</td>
<td>10 months</td>
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<td></td>
<td></td>
<td>all other situations</td>
<td>field bioassay</td>
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<tr>
<td>Rave</td>
<td>triasulfuron + dicamba</td>
<td>wheat (except durum), durum wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>pH 6.9 or lower</td>
<td>12 days</td>
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<td></td>
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<td>pH above 6.9</td>
<td>8 months</td>
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<td>4 months and field bioassay</td>
<td>6 months</td>
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<td>18 months</td>
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<tr>
<td>Group number, site of action, and chemical family</td>
<td>Trade name</td>
<td>Common name</td>
<td>Rotational crop</td>
<td>Special conditions</td>
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<td>-------------------------------------------------</td>
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<tr>
<td><strong>Group 3</strong> Microtubule assembly inhibitors</td>
<td>Prowl 3.3 EC</td>
<td>Pendi methalin</td>
<td>winter wheat</td>
<td>Prowl rate less than 4.8 pt/ A</td>
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<td></td>
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<td>winter wheat</td>
<td>Prowl rate 4.8 pt/ A or higher</td>
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<td></td>
<td></td>
<td>barley, pea, lentil, chickpea, canola, mustard</td>
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<tr>
<td>Sonalan HFP</td>
<td>ethalfluralin</td>
<td>winter wheat, winter barley</td>
<td></td>
<td>no restriction; however, injury may occur if seed is planted 4 months after application under dry conditions</td>
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<tr>
<td>Treflan HFP</td>
<td>trifluralin</td>
<td>winter wheat, winter barley</td>
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<td>no restriction</td>
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<td></td>
<td></td>
<td></td>
<td>spring wheat, spring barley, pea, lentil, chickpea, canola, mustard</td>
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<tr>
<td><strong>Group 4</strong> Synthetic auxins</td>
<td>2,4-D LV4</td>
<td>2,4-D</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>1 to 6 pt/ A applied in fallow</td>
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<td></td>
<td>Landmaster BW</td>
<td>2,4-D + glyphosate</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
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<td>barley</td>
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<td></td>
<td>MCP A Amine</td>
<td>MCPA</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>6 pt/ A applied in fallow</td>
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<td></td>
<td>Thistrol</td>
<td>MCPB</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
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<td>benzoic acids</td>
<td>Clarity</td>
<td>dicamba</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>rates below 24 fl oz/ A</td>
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<td>barley</td>
<td>rates above 24 fl oz/ A</td>
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<td>pea, lentil, chickpea, canola, mustard</td>
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<td>wheat</td>
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<td></td>
<td>Weedmaster</td>
<td>2,4-D + dicamba</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>rates below 6 pt/ A</td>
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<td></td>
<td>barley</td>
<td>rates above 6 pt/ A</td>
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<td>pea, lentil, chickpea, canola, mustard</td>
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<td>wheat</td>
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<td></td>
<td>Fallow Master</td>
<td>dicamba + glyphosate</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>rates below 6 pt/ A</td>
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<td>barley</td>
<td>rates above 6 pt/ A</td>
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<td>pea, lentil, chickpea, canola, mustard</td>
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<td>wheat</td>
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<td></td>
<td>pyridines</td>
<td>Curtail</td>
<td>wheat, barley, canola, mustard</td>
<td>30 days</td>
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<td></td>
<td></td>
<td></td>
<td>pea, lentil, chickpea</td>
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<td></td>
<td>Curtail M</td>
<td>clopyralid + MCPA</td>
<td>wheat, barley, canola, mustard</td>
<td>no restriction</td>
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<td></td>
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<td>pea, lentil, chickpea</td>
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<td></td>
<td>Stinger</td>
<td>clopyralid</td>
<td>wheat, barley, canola mustard</td>
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<td></td>
<td>pea, lentil</td>
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<td>chickpea</td>
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<tr>
<td>Herbicide</td>
<td>Mode of Action</td>
<td>Crops</td>
<td>Rates</td>
<td>Restrictions</td>
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<tr>
<td>Tordon 22K picloram</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>rates below 0.5 pt/A</td>
<td>45 days with soil temps above 40°F</td>
<td>120 days</td>
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<td></td>
<td>rates between 0.5 and 1 pt/A</td>
<td>90 days with soil temps above 40°F</td>
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<tr>
<td>Starane fluroxypyr</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td>10 months</td>
<td>24 months and field bioassay</td>
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<tr>
<td>quinolinecarboxylic acid Paramount quinclorac</td>
<td>wheat, barley, canola, mustard, pea, lentil</td>
<td>no restriction</td>
<td>36 months or field bioassay</td>
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<tr>
<td>Groups 5, 6, 7 Photosystem II inhibitors</td>
<td></td>
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<tr>
<td>Triazines Sencor DF metribuzin</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>if following pea or lentil</td>
<td>4 months</td>
<td>12 months</td>
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<tr>
<td>Benzothiadiazoles Basagran bentazon</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td>36 months</td>
<td></td>
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<tr>
<td>Uricils Bronate Advanced bromoxynil + MCPA</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>30 days</td>
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<tr>
<td>Buctrol 4EC bromoxynil</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>30 days</td>
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<td>Ureas Karmex diuron</td>
<td>winter wheat, spring wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>if applied BEFORE Nov. 1 AND deep tillage</td>
<td>no restriction after April 1</td>
<td>12 months</td>
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<td>Groups 9 Inhibitors of EPSP synthase</td>
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<tr>
<td>Roundup UltraMax glyphosate</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
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<td>Groups 10 Inhibitors of glutamine synthase</td>
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<tr>
<td>Liberty glufosinate</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>70 days</td>
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<td>Groups 14 Inhibitors of protoporphyrinogen oxidase (PPO)</td>
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<td>Aryl triazines Spartan sulfentrazone</td>
<td>wheat, barley, canola, pea, lentil, chickpea, mustard</td>
<td>4 months</td>
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<tr>
<td>Aim carfentrazone</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td>12 months</td>
<td></td>
</tr>
<tr>
<td>Groups 15 Lipid synthesis inhibitors but not ACCase inhibitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chloracetamides Dual II Magnum metolachlor</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td>4.5 months</td>
<td>not specified</td>
</tr>
<tr>
<td>Outlook dimethenamid</td>
<td>winter wheat, winter barley</td>
<td>4 months</td>
<td>no restriction</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>spring wheat, spring barley, pea, lentil, chickpea, canola, mustard</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groups 22 Photosystem I inhibitors</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bipyridiliums Gramoxone Extra paraquat</td>
<td>wheat, barley, pea, lentil, chickpea, canola, mustard</td>
<td>no restriction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1 Only considering wheat, barley, pea, lentil, chickpea, canola, and mustard crops in the Pacific Northwest dryland production area; other crop restrictions may apply.
chemical, microbial, and chemical degradation in soil or water and metabolism in plants or animals.

Herbicide dissipation in soil often is expressed in terms of half-life, that is, the amount of time required for one-half of the original amount of herbicide to dissipate (figure 1). For example, a herbicide with a half-life of 12 days would be expected to have dissipated to one-half the original amount 12 days after application, to one-fourth of the original amount 24 days after application, and so on. Half-life differs greatly among herbicides and can vary for the same herbicide in different soil types, temperatures, moisture levels, and pH levels.

Herbicides with a half-life of 120 days or more typically are classified as highly persistent; however, half-life does not address the sensitivity of subsequently planted crops. Some rotational crops may be sensitive to extremely small amounts of even low to moderately persistent herbicides. For example, the herbicide Pursuit typically has a half-life of 60 to 90 days; however, canola is very sensitive to Pursuit and should not be planted for at least 40 months after a Pursuit application (13 to 20 half-lives).

**Herbicide Availability**

Herbicides in soil usually exist in equilibrium among three phases: adsorbed to the surface of soil particles, in soil water, and, to a lesser extent, in soil air spaces. Different chemical properties of the herbicide and of the soil environment may shift this equilibrium toward one phase over the others. Herbicide adsorption to soil particles greatly affects most transfer and degradation processes. Generally, herbicides in soil water are biologically active; that is, available for plant uptake, transport in the environment, and microbial and chemical degradation. Herbicides bound (adsorbed) to soil particles are less available for transfer and degradation processes and may persist longer. Because adsorption to soil and degradation by chemical or microbial processes have the greatest impact on rotational crop safety, this bulletin focuses on these processes.

**Soil factors affecting herbicide adsorption**

Soil particle size distribution (relative percentages of sand, silt, and clay) plays an important role in herbicide adsorption. Soils with a higher percentage of clay particles have more surface area per volume of soil and often adsorb more herbicide molecules than more sandy soils. Also, some clay types have relatively more chemically reactive sites and therefore adsorb more herbicide. Sandy soils have relatively few reactive sites and are more prone to herbicide leaching out of the root zone.

The amount of organic matter (OM) in a soil also affects herbicide adsorption. Higher OM soils typically have more reactive sites for herbicide adsorption and can adsorb more herbicide molecules.

Soil pH interacts with the charge characteristics of various herbicides. Some herbicides bind to soil more at low pH, while others do at high pH.

**Herbicide factors affecting adsorption**

Very water-soluble herbicides such as Clarity are more likely to remain in soil water where they can be degraded, taken up by plants, or leached out of the system. Herbicides with low water solubility such as Prowl tend to be adsorbed to soil particles and often persist longer.

Charge characteristics of the herbicide also affect adsorption, with more positively charged herbicide molecules generally being more strongly adsorbed to negatively charged soil particles and negatively charged herbicide molecules remaining in the soil air or water phases. Gramoxone Extra so tightly binds to soil that it is unavailable for plant uptake or degradation. Charge characteristics of many herbicides such as the triazines, sulfonylureas, imidazolinones, and synthetic auxins are pH dependant.

**Factors affecting chemical degradation**

Chemical degradation generally involves splitting chemical bonds in the herbicide molecule. These reactions commonly take place in soil water or at the interface between water and soil particles. Soil moisture and temperature affect the rate and amount of chemical degradation. Warm, moist soils generally support much faster rates of degradation than cool, dry soils. Soil pH also can affect the chemical degradation rate of herbicides, depending upon the specific herbicide structure. For example, the sulfonylurea herbicides degrade much more slowly in alkaline soils than in more neutral or slightly acidic soils, while the imidazolinones degrade more slowly in acidic soils than in neutral or slightly alkaline soils.

**Factors affecting microbial degradation**

Bacteria and fungi in the soil use various enzymes to degrade complex molecules such as herbicides for use as nitrogen and carbon sources. Overall, microbial degradation is the most important mechanism for herbicide dissipation in soil. Microbial activity is the primary mechanism of degradation for each chemical family except for the sulfonylureas (low pH = chemical hydrolysis and microbial, high pH = microbial), the triazines (low pH = chemical hydrolysis, high pH = microbial), and the bipyridili-
ums (irreversibly bound to soil, very slow degradation).

Generally, environmental factors that encourage growth and reproduction of microbial populations such as warm soil temperature, adequate soil moisture, and high organic matter lead to higher rates of herbicide degradation. Conversely, cold or frozen soils, droughty soils, and low OM in soils often result in longer herbicide persistence. Extremely high or low soil pH also can reduce microbial activity and decrease degradation. As a general rule, soil moisture, temperature, and pH that are ideal for plant growth are also ideal for soil microbes and, hence, microbial degradation of herbicides.

**Conclusion**

The potential for rotational crop injury depends upon complex interactions among herbicide characteristics, soil type, seasonal differences in soil moisture and temperature, and the sensitivity of the rotational crops. The complexities of these interactions preclude all but a few generalizations. However, some herbicide families tend to have greater persistence due to their specific chemical properties. Also, some rotational crops commonly grown in the Pacific Northwest are more sensitive to herbicides than others.

Because herbicide dissipation rates can vary from year to year and even among areas within a field, injurious persistence of a particular herbicide can be difficult to predict. When considering the application of herbicides, it is very important to understand the effects that a persistent herbicide may have on all crops in the rotation.

Information on herbicide labels can be used to make better decisions about the crop sequence in a rotation, about which herbicides to use or avoid in a system, and about the rate and timing of herbicide applications. The rotational crop restrictions on herbicide labels take into account basic chemical properties of the herbicide, the half-life of the herbicide, typical environmental characteristics of the state or region, and the sensitivities of rotational crops. Thus, the label for each herbicide used in the crop rotation should be studied along with this bulletin to reduce economic losses due to herbicide carryover.

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Trade Names—To simplify information, trade names have been used. No endorsement of named products is intended nor is criticism implied of similar products not mentioned.

Pesticide Residues—Any recommendations for use are based on currently available labels for each pesticide listed. If followed carefully, residues should not exceed the established tolerances. To avoid excessive residues, follow label directions carefully with respect to rate, number of applications, and minimum interval between application and reentry or harvest.

Groundwater—To protect groundwater, when there is a choice of pesticides, the applicator should use the product least likely to leach.