A Strategic Overview of Rights-of-Way Weed Management Within the North Central States

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Facilitator
David R. Pike 217 352 6405 airs-inc@insightbb.com

Participants
William Rahm 815 463 1481 quicsfop@aol.com
Donnie Pierce 217 235 2263 wumba62@hotmail.com
David Mazurok 314 890 0041
Sean Jones 708 899 7420
Jim Akers 217 423 0455
Travis Payol 217 423 0455
John Behl 217 234 2881
Dan Martinez 815 744 9090
E. J. Eastin 217 253 4685
Steven Eley 815 549 6362 steveneley@hotmail.com
Joe Deckard 217 972 1095 littljoey@hotmail.com
Chris Scheferkort 217 370 6475
William Hartman 570 459 1112 bhartman@dbiservices.com
Harold Attebury 217 423 0455

Summary
On March 20th, 2003 the above group of individuals, with an average of 5 to 7 years of experience in controlling weeds on rights of way, met with the facilitator at Decatur, Illinois to discuss weed problems and the herbicides and techniques commonly used to control them. Most of the participants contract with the DeAngelo Brothers Inc business to control weeds on state, county, township and industrial rights of way in an area including Illinois, Indiana, Missouri, Wisconsin, and Iowa.

Critical Herbicide Uses: The principal need expressed by participants was for the continued registration of the herbicides 2,4-D, glyphosate, and diuron. These herbicides were deemed critical due to their flexible and economic application in a broad range of rights of way applications. Participants also expressed concern about resistant weeds and indicated that rotating herbicides on an annual basis was their principal means of combating its development. Participants also indicated the following issues were concerns they wished were addressed by research, education, and regulatory action.

Research: Participants felt that they needed to know more about the effect of long term human exposure to the herbicides they use. They would encourage the EPA to investigate, or cause to have investigated, the impact of various right of way products or combination of products, on all aspects of the health of applicators. They felt that as a group, they were exposed to these herbicides for longer periods, and at higher doses, than most pesticide applicators, and wished to know of possible effects on their health.

Education: Participants felt that the public needs to be educated regarding the need for herbicides and pesticide use in general and specifically the need for rights of way applicator tanks to be filled from local resources. As a very mobile business, most rights of way spray trucks must fill from public sites or accessible surface water resources. Backing a truck up to a stream or lake has the appearance of being highly suspect, though in reality, quite innocuous activity. A program educating the public about the role and purpose of rights of way applicators would eliminate a great deal of the negative image they currently have.

Regulatory: Participants indicated a need for nation-wide licensing of applicators with reciprocity among states. As a mobile business many rights of way applicators work in several states. To maintain a license in each state for which applications are to be made requires multiple licensing and multiple testing. Development of a uniform standard for testing and licensing would facilitate compliance with existing statutes and enhance enforcement where necessary.
Background:

Weed and brush control on rights of way contributes significantly to the safety, security, and aesthetic quality of our nation’s roadways, railways, and industrial sites. In the absence of control, weeds obscure traffic at road crossings and provide cover to the large animals along roadways which are a hazard to traffic. Weed control also reduces the large amounts of biomass from dead weeds and grass that are a fire and smoke hazard to rail and road traffic. In addition, ditches and medians provide an opportune environment for invasive weeds, insects, and diseases that are a threat to adjacent crops or other desirable plants. In fact, weed control along roads and rails can be considered a primary deterrence to the movement of invasive species.

Table 1. Miles of primary and secondary roadway and estimated acres of Rights of Way by state for the North Central Region.

<table>
<thead>
<tr>
<th>State</th>
<th>Miles of primary and secondary roads</th>
<th>Acres of Rights of way (assuming 16 feet r-o-w either side)</th>
</tr>
</thead>
<tbody>
<tr>
<td>IL</td>
<td>102,000</td>
<td>394,138</td>
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<tr>
<td>IN</td>
<td>74,000</td>
<td>285,943</td>
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<tr>
<td>IA</td>
<td>108,000</td>
<td>417,322</td>
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<tr>
<td>MN</td>
<td>118,000</td>
<td>455,963</td>
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<tr>
<td>MO</td>
<td>109,000</td>
<td>421,186</td>
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<tr>
<td>MI</td>
<td>92,000</td>
<td>355,497</td>
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<tr>
<td>OH</td>
<td>83,000</td>
<td>320,720</td>
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<tr>
<td>ND</td>
<td>85,000</td>
<td>328,448</td>
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<tr>
<td>NE</td>
<td>88,000</td>
<td>340,040</td>
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<tr>
<td>KS</td>
<td>124,000</td>
<td>479,148</td>
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<tr>
<td>SD</td>
<td>81,000</td>
<td>312,992</td>
</tr>
<tr>
<td>WI</td>
<td>96,000</td>
<td>370,953</td>
</tr>
<tr>
<td>NC Region totals</td>
<td>1160000</td>
<td>4,482,351</td>
</tr>
</tbody>
</table>

There are currently over 3 million miles of primary and secondary rural roads within the United States. Of this total about 500,000 miles of roads are found in the 12 states of the North Central Region outside of urban areas. To this can be added approximately 50,000 miles of rail lines within the region. Assuming an average of 16 feet of right-of-way on either side of roads and rails we can estimate the total amount of right of way to be approximately 2.1 million acres for this region.

Weeds of Concern:

The weeds listed below are those of primary concern to rights of way applicators. However, this list is not meant to be all-inclusive. There are many other weeds which can be found in road, rail, or industrial rights of way, but are less often confronted and less of a problem for control. Many grass plants, which may be considered weeds in field crops, are generally ignored in roadsides or rail rights of way. The only grass which is found on the list is Johnsongrass, as it is a noxious weed.

Annual broadleaf weeds
Horseweed (maarestail) (*Conyza canadensis*) (previously *Erigeron canadensis*)
Kochia (*Kochia scoparia*)
Teasel (*Dipsacus sativus*)
Giant Ragweed (*Ambrosia trifida*)
Common Ragweed (*Ambrosia artemisiifolia*)
Pigweeds/waterhemp (*Amaranthus retroflexus, A. hybridus, A. powellii, A. tuberculatus, A. rudis*)
Lambsquarters (*Chenopodium album*)
Chicory (*Cichorium intybus*)
**Perennial broadleaf weeds**
Canada thistle (*Cirsium arvense*)
Musk thistle (*Carduus nutans*)
Bull thistle (*Cirsium vulgare*)
Sumac (*Rhus sp*)
Poison ivy (*Rhus radicans*)
Wild carrot (*Daucus carota*)
Wild parsnips (*Pastinaca sativa*)
Water hemlock (*Cicuta douglasii*)
**Perennial and annual grasses**
Johnsongrass (*Sorghum halepense*)

**Woody Species**
Multiflora rose (*Rosa multiflora*)
Osage orange (*Maclura pomifera*)
Brambles (*Rubus spp*)
Black locust (*Robinia pseudoacacia*)
Honeysuckle (*Lonicera japonica*)

There are a number of new invading weeds which are already a problem in many parts of the Midwest. The exact extent to which these weeds may become a problem is unknown but they have been recognized as significant problems in some local areas. These include garlic mustard (*Alliaria petiolata*), purple loosestrife (*Lythrum salicaria*), and kudzu (*Pueraria lobata*).
Non-chemical control
• Mowing is commonly used on state and county maintained roadsides, and many industrial areas.
• Cutting or mechanical removal is done where practical or necessary for control of larger woody species.
• Planting of cover crop/desirable species is regularly used after the installation of new roadways. However, once an established area becomes infested with weeds or has eroded extensively the expense and practicality of reseeding may be prohibitive.
• Burning is a control method of last resort. It is not widely used due to threat of fire to adjacent areas and the hazard for existing traffic created by smoke.

Chemical Control
Broadleaf weeds
• Broadleaf weeds often are controlled best with foliar applications.
• Deep-rooted perennials can usually be controlled best when they are at the early bud or bloom stage. Perennials often need multiple treatments spaced several days apart for best control.
• Some herbicides can move through the air and damage nearby desirable trees, shrubs, and broadleaf plants. This can be a serious problem where rights of way are adjacent to homes, orchards, or sensitive field crops.
• Some of the herbicides are mobile in the soil and can damage desirable broadleaves if applied to the soil near their roots. The can also be serious where there are desirable trees or crops nearby.

Woody plants
• Most of the herbicides used to control woody plants are applied to the foliage.
• Foliar treatments usually are applied in the spring as soon as the leaves of brush or trees have fully expanded.
• Many herbicides also may be applied as basal-bark treatments if the woody plants have stems smaller than 5 inches in diameter.
• Cut-surface (frilled) treatments can be used if the plants are larger. Basal-bark treatments usually are applied in fuel oil. Application may be made throughout the year, even during the dormant season. Cut-surface treatments also may be made throughout the year, but herbicides should be applied to the cut surface within 2 to 3 hours of cutting.
• The use of cut stump treatments is typical for control of many woody species in rights of way.

Weedy grass control
• Except for Johnsongrass and in areas where total vegetation control is desired few grasses are targeted for control. Weedy grasses can be controlled selectively with Assure II (quizalofop), Glyphosate (many), Select (clethodim), or Vantage (sethoxydim).
• Although glyphosate is nonselective and kills broadleaves as well as grasses, the use of low rates will often injure broadleaf weeds without seriously damaging grasses.

Resistant Weeds
The possibility of resistant weeds moving from rights of way into farm fields or causing persistent problems for those treating non-crop areas has not gone unnoticed. Right of way applicators rotate herbicide products with different modes of action on an annual basis to forestall resistance. Tank mixes of two herbicides with different modes of action is common but not always done. A number of factors, including high rates of herbicide for total vegetation control (TVC), few modes of action from which to choose, and weeds which have a high propensity for resistance, make weed resistance a serious concern.

Chemical Weed Control
Chemical weed control is widely used on rights of way to prevent weed growth or to remove existing vegetation. The advantages of herbicide use are primarily in the ease with which control may be effected on a wide range of weed species with minimal amounts of labor. When properly used herbicides can selectively favor short stature grasses or legumes which are aesthetically pleasing and provide a competitive disadvantage to weeds.

Herbicides for Residual weed control
ALS (amino acid synthesis inhibitors)
• Group has high potential for weed resistance
Imazapyr (Arsenal 2AS)
  May be foliar- or soil-applied
  Typical uses: primarily used on railroads
  Has the potential for off target movement
  Level of control = Fair to good

ALS+PSI
Imazapyr + diuron (Topsite 2.5G)
  Typical uses: not widely used
  Level of control: Fair to good

Sulfometuron (Oust 75DF)
  Primarily soil-applied
  Typical uses: roadsides and rail roads and industrial sights
  Level of control: Fair to good

Photosynthetic inhibitors (PSI)
  Group has high potential for weed resistance

Bromacil (Hyvar X 80W and Hyvar XL 2L)
  For spray application
  Hyvar XL is combustible
  Cannot be used around wells or surface water
  Typical uses: minimally used for rights of way
  Level of control: fair on annuals, none on perennials

Diuron (Karmex 80DF, Krovar 80DF (1:1 bromacil + diuron)
  Soil-applied
  Should not be used around wells or surface water
  Typical uses: sub stations, guard roads, bare ground, railroads
  Level of control: excellent when used properly
  Must keep tank agitated to prevent settling

Hexazinone (Velpar 2L or 75SP)
  Foliar or soil applied.
  Should not be used around wells or if surface water is present
  Typical uses: minimal use for rights of way except for guard rails
  Level of control: Fair to good

Prometon (Pramitol 25E, 5PS)
  25E may be foliar- or soil applied
  5PS formulated for soil application only
  Typical uses: not widely used because of past reputation of off-target movement and injury
  Level of control: Fair

Tebuthiuron (Spike 80DF or 20P)
  80DF soil-applied for broadleaf weed and brush
  20P may be used for brush control in pastures
  Typical uses: bare ground, rail roads, and industrial sites
  Level of control: fair to good

Herbicides for short-term (nonresidual) control

PS I inhibitor
Paraquat (Gramoxone MaxRUP 3S)
  Low potential for weed resistance
  Contact herbicide
  Use a crop-oil concentrate or nonionic surfactant
  Typical uses: very little used, not persistent
  Level of control: fair on immature annuals only

EPSP inhibitors (amino acid synthesis inhibition)
  Low to moderate potential for weed resistance

Glufosinate (Finale)
  Low potential for weed resistance
  Controls annual grass and broadleaf weeds
Primarily a contact herbicide that can be used in noncrop areas
Maximum spray coverage is imperative for adequate control
Typical uses: minimally used for rights of way
Level of control: fair on some annuals, weak on perennials

**Glyphosate (Roundup Pro, Touchdown, Accord, etc.)**
- Translocated (systemic) herbicides
- Slow to act
- Low to moderate potential for weed resistance
- Typical uses: widely used for weed control and seed head suppression
- Level of control: good to excellent for short term weed control on most weeds

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- Slow to act
- Low to moderate potential for weed resistance
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- Level of control: good to excellent for short term weed control on most weeds

**Plant-growth regulators (PGR)**
- Group has very low probability of weed resistance
- Primarily foliar applied
- Typical uses: used with glyphosate. Used to selectively control broadleaf weeds in grasses

**2,4 D (Many trade names)**
- Many formulations: acid, amine, salt, or ester
- Often mixed to broaden control spectrum and reduce cost
- Typical uses: tank farms, some roadsides
- Level of control: fair to good
- Use not permitted at certain times of the year

**Dicamba (Banvel 4S, Clarity 4L, Sterling 4S, or Vanquish 4S (dicamba);**
- Dicamba + diflufenzinopyr (Distinct 70WG) (+auxin transport inhibitor)
- Dicamba + 2,4-D (Brash or Weedmaster (1:3)
  - Typical uses: Vanquish used for roadsides
  - Level of control: fair to good

**Triclopyr (Garlon 4E, Garlon 3A, or Remedy and Crossbow (2:1 triclopyr + 2,4-D))**
- Typical uses: roadside, rail roads, stump treatments with basal oil
- Level of control: fair to good

**Picloram (Tordon K 2S and Tordon 101 (picloram + 2,4-D) Pathway (picloram+2,4-D))**
- Formulated as amines for foliar application
- Typical uses: roadsides, widely used
- Level of control: fair to good
- Applications are subject to drift and movement through soil

**Other modes of action**

**Acetolactate-synthase inhibition (ALS)**
- Group has high potential for weed resistance, especially in some weeds

**Imazapyr**
- (Arsenal 2AS) Used for foliar or soil application
- (Stalker 2S or RTU) Basal-bark or cut-surface application to control brush
- Typical uses: brush control
- Level of control: good

**Metsulfuron (Escort 60DF)**
- Foliar or soil application
- Typical uses: widely used, roadsides, brush, railroad, used as tank mix
- Level of control: good

**Chlorsulfuron (Telar 75DG)**
- Foliar or soil application
Typical uses: moderate use, roadsides, especially for wild carrot and chicory
Level of control: good though spectrum narrow
Bromoxynil (many trade names: Buctril, Moxy, Bromox, Broclean, etc.) **PS II inhibitor**
- Moderate potential for weed resistance
- Contact activity against broadleaf weeds, may suppress perennials
- Toxic to fish-- observe proper precautions around water
- Cannot be applied with backpack or handheld equipment
- May require surfactant in cool, dry conditions
- Typical uses: minimally used for rights of way
- Level of control: poor to fair
Fosamine (Krenite S 4S) (**enzyme inhibitor, not assigned MOA**)
- Unknown potential for weed resistance
- For total control or side trimming of brush, depending upon amount sprayed
- When applied within 2 months of autumn color susceptible plants fail to refoliate the following spring
- Typical uses: minimal use, used on roadsides and public access
- Level of control: fair to poor (limited spectrum)

**Applicator Exposure**

The predominant method of herbicide application to rights of way is via truck mounted sprayers. During applications, about 70 percent of applicators are separated from the sprays or spray drift by the enclosed truck cab and air conditioning. However, about 30 percent of sprays require the applicator to manually apply herbicides via hoses attached to the truck mounted sprayer unit. During the predominant part of the spray season, April through October, right of way applicators may load and fill applicators, spray, or clean sprayer equipment a total of 40 to 45 hours per week.

**Application Timing**

<table>
<thead>
<tr>
<th></th>
<th>Ja</th>
<th>Fe</th>
<th>M</th>
<th>Ap</th>
<th>M</th>
<th>Jn</th>
<th>Jy</th>
<th>Au</th>
<th>Se</th>
<th>Oc</th>
<th>Nv</th>
<th>Dc</th>
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</thead>
<tbody>
<tr>
<td>Foliar Spray</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil applied</td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Basal/cut bark</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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**Table 2. Spray applications for residual (long-term) weed control**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Rate of formulation per acre</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Formulations</td>
</tr>
<tr>
<td>Arsenal 2AS</td>
<td>2 to 4 pt</td>
</tr>
<tr>
<td>Hyvar X 80W</td>
<td>3 to 6 lb</td>
</tr>
<tr>
<td>Hyvar X-L 2L</td>
<td>1.5 to 3 gal</td>
</tr>
<tr>
<td>Karmex, Direx 80DF</td>
<td>5 to 15 lb</td>
</tr>
<tr>
<td>Krovar 80DF</td>
<td>4 to 6 lb</td>
</tr>
<tr>
<td>Oust 75WDG*</td>
<td>3 to 5 oz</td>
</tr>
<tr>
<td>Pramitol 25E 2S</td>
<td>4 to 6 gal</td>
</tr>
<tr>
<td>Spike 80DF</td>
<td>5 to 7.5 lb</td>
</tr>
<tr>
<td>Velpar 75SP</td>
<td>2.5 to 6.5 lb</td>
</tr>
<tr>
<td>VelparL 2L</td>
<td>1 to 2.5 gal</td>
</tr>
<tr>
<td>Herbicide</td>
<td>Annuals and &quot;easy to control&quot; perennials</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>2,4-D</td>
<td>1 to 2 qt</td>
</tr>
<tr>
<td>Brushmaster (2,4-D + 2,4-DP + dicamba)</td>
<td>2 to 4 qt</td>
</tr>
<tr>
<td>Bromoxynil (many)</td>
<td>1 to 2 pt</td>
</tr>
<tr>
<td>Crossbow (triclopyr + 2,4-D)</td>
<td>1 to 2 qt</td>
</tr>
<tr>
<td>Dicamba (many)</td>
<td>0.5 to 1 qt</td>
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<tr>
<td>Distinct (dicamba + difluenzopyr)</td>
<td>4 to 6 oz</td>
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<tr>
<td>Escort (metoluron)</td>
<td>0.33 to 0.5 oz</td>
</tr>
<tr>
<td>Finale IS (glufosinate)</td>
<td>2 to 4 qt</td>
</tr>
<tr>
<td>Garlon 3A (triclopyr)</td>
<td>2 to 3 qt</td>
</tr>
<tr>
<td>Garlon 4/Remedy (triclopyr)</td>
<td>1 to 2 qt</td>
</tr>
<tr>
<td>Glyphosate (many)</td>
<td>0.5 to 3 qt</td>
</tr>
<tr>
<td>Gramoxone Max (paraquat)</td>
<td>1.5 to 3 pt</td>
</tr>
<tr>
<td>Oust (sulfometuron)</td>
<td>3 to 5 oz</td>
</tr>
<tr>
<td>Stinger, Transline (clopyralid)</td>
<td>0.33 to 0.5 pt</td>
</tr>
<tr>
<td>(2,4-D + 2,4-D + dicamba)</td>
<td>1 to 2 qt</td>
</tr>
<tr>
<td>Telar DF (chloresulfuron)</td>
<td>0.25 to 1 oz</td>
</tr>
<tr>
<td>Tordon 101 Mixture (picloram + 2,4-D)</td>
<td>2 to 3 qt</td>
</tr>
<tr>
<td>Tordon K (picloram)</td>
<td>0.5 to 2 qt</td>
</tr>
<tr>
<td>Weedmaster, Brash (2,4-D + dicamba)</td>
<td>0.5 to 4 pt</td>
</tr>
</tbody>
</table>
### Table 4. Herbicides for woody plant control

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Formulation</th>
<th>Application</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arsenal 2AS (imazapyr)</td>
<td>Foliar or cut-surface</td>
<td>Foliar</td>
<td>2 to 3 qt/A</td>
</tr>
<tr>
<td>Brushmaster (2,4-D + 2,4-DP +</td>
<td>Foliar</td>
<td>Foliar</td>
<td>1 to 2 gal/100 gal water</td>
</tr>
<tr>
<td>Crossbow (triclopyr + 2,4-D)</td>
<td>Foliar</td>
<td>Basal-bark</td>
<td>1 to 4 gal/100 gal fuel oil</td>
</tr>
<tr>
<td>Dicamba (many)</td>
<td>Foliar</td>
<td>2 to 4 qt/A</td>
<td></td>
</tr>
<tr>
<td>Distinct (dicamba + diflufenzopyr)</td>
<td>Foliar</td>
<td>4 to 6 oz/A</td>
<td></td>
</tr>
<tr>
<td>Garlon 3A (triclopyr)</td>
<td>Foliar or cut-surface</td>
<td>2 to 3 gal/A</td>
<td></td>
</tr>
<tr>
<td>Garlon 4 /Remedy (triclopyr)</td>
<td>Foliar or basal-bark</td>
<td>4 to 8 qt/A</td>
<td></td>
</tr>
<tr>
<td>Glyphosate (many trade names)</td>
<td>Foliar or cut-surface</td>
<td>2 to 5 qt/A</td>
<td></td>
</tr>
<tr>
<td>Krenite S (4 lb/gal)</td>
<td>Basal-bark</td>
<td>1 to 5 gal/100 gal water</td>
<td></td>
</tr>
<tr>
<td>Pathway (picloram + 2,4-D)</td>
<td>Cut-surface</td>
<td>Foil</td>
<td>1.5 to 6 gal/A</td>
</tr>
<tr>
<td>SBK (2,4-D + 2,4-DP + dicamba)</td>
<td>Foliar or cut-surface</td>
<td>0.5 to 1 gal/100 gal water</td>
<td></td>
</tr>
<tr>
<td>Stalker (2 lb/gal imazapyr)</td>
<td>Basal-bark or cut-surface</td>
<td>8 to 12 oz/gal; wet cambium thoroughly</td>
<td></td>
</tr>
<tr>
<td>Stalker RTU (3% imazapyr)</td>
<td>Basal-bark or cut-surface</td>
<td>Wet cambium thoroughly</td>
<td></td>
</tr>
<tr>
<td>Tordon 101 Mixture (picloram +</td>
<td>Foliar or cut-surface</td>
<td>1 to 4 gal/A</td>
<td></td>
</tr>
<tr>
<td>Tordon K (picloram)</td>
<td>Foliar or soil</td>
<td>1 to 2 qt/A</td>
<td></td>
</tr>
<tr>
<td>Patron 170 (2,4-D + diclorprop)</td>
<td>Basal-bark or cut-surface</td>
<td>4 to 6 qt/100 gal spray</td>
<td></td>
</tr>
<tr>
<td>2,4-D ester</td>
<td>Foliar or basal-bark</td>
<td>2 to 4 qt/A</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5. Herbicide for weed grass control

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Rate of formulation per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assure II (quizalofop)</td>
<td>Annuals: 5 to 10 fl oz, Perennials: 8 to 12 fl oz</td>
</tr>
<tr>
<td>Glyphosate (many)</td>
<td>Annuals: 0.38 to 2 qt, Perennials: 1 to 5 qt</td>
</tr>
<tr>
<td>Select (clethodim)</td>
<td>Annuals: 6 to 10 fl oz, Perennials: 8 to 16 fl oz</td>
</tr>
<tr>
<td>Vantage (sethoxydim)</td>
<td>Annuals: 2.25 to 2.5 pt, Perennials: 3.0 to 3.75 pt</td>
</tr>
</tbody>
</table>

Glyphosate rates based on 3 lb a.e./gal formulation.