Weed Control With Imazaquin And Pendimethalin Around Newly Planted Shrub And Tree Seedlings

Wayne A. Geyer, Walter H. Fick, and Eric Rhodenbaugh

Vegetation management is an important component for successful establishment of woody plants for riparian buffers, windbreaks, aesthetics or forest plantings in the Great Plains region. Reducing herbaceous competition improves survival and growth of the desired woody species. Competition control strategies include cultivation, herbicide applications, and mulches. Many herbicides have been evaluated and approved for use in woody crops over the past five decades and new products are continually under development. Problems with using herbicides include lack of effectiveness throughout the growing season and target plant resistance to the chemicals. Two products have recently been introduced that show promise for release of woody species. These are imazaquin (SCEPTER® 70 DG) and pendimethalin (PENDULUM®). Imazaquin is registered for use in controlling weeds when applied before the bud swell stage and over-the-top of actively growing hybrid poplar plantations (1, 3, 4). It can be used in combination with pendimethalin in dormant plantings (2).

The objective of these studies was to compare weed control effectiveness and herbicide tolerance of selected woody plants to imazaquin and pendimethalin when applied alone or in combination as a dormant season over-spray. Survival and stem growth were assessed on several woody plant species following herbicide applications.

Table 3. Survival, height, and damage of treated plants in the 1999 study.

<table>
<thead>
<tr>
<th>Herbicide Treatment</th>
<th>Survival (%)</th>
<th>Height (in.)</th>
<th>Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Imazaquin (0.123 lb a.i./acre)</td>
<td>89a</td>
<td>13.0c</td>
<td>Slight</td>
</tr>
<tr>
<td>Imazaquin (0.245 lb a.i./acre)</td>
<td>81b</td>
<td>13.4bc</td>
<td>Slight</td>
</tr>
<tr>
<td>Pendimethalin (3.96 lb a.i./acre)</td>
<td>90a</td>
<td>15.4a</td>
<td>Slight</td>
</tr>
<tr>
<td>Imazaquin + pendimethalin (0.124 + 4.0 lb a.i./acre)</td>
<td>92a</td>
<td>14.0bc</td>
<td>Slight</td>
</tr>
<tr>
<td>Imazaquin + pendimethalin (0.248 + 4.0 lb a.i./acre)</td>
<td>91a</td>
<td>14.2bc</td>
<td>Slight</td>
</tr>
</tbody>
</table>

1 About 50% silver maple had red leaves, 40% golden currant exhibit stunting, and 30% Oriental arborvitae had brown leaves.
2 Values in the same column followed by different letters are significant at p<0.05.

LITERATURE CITED

Note: Trade names are used to identify products. No endorsement is intended, nor is any criticism implied of similar products not mentioned.
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Values in the same column followed by different letters are significant at p< 0.05.
PROCEDURES

Two studies were conducted near Manhattan, KS. The first was initiated in 1999 on newly planted shrubs and trees; the second in 2002, three years after planting. The study site is on alluvial land and was well-cultivated for several years prior to planting. The soil is silty clay loam having a pH of 7.3. All species were planted on March 1, 1999. Six-inch cuttings of poplar clones were planted; seedlings were planted of other species. Species/clones studied were:

- black walnut (*Juglans nigra*)
- choke cherry (*Prunus virginiana*)
- fragrant sumac (*Rhus aromatica*)
- green ash (*Fraxinus pennsylvanica*)
- golden currant (*Ribes odoratum*)
- hackberry (*Celtis occidentalis*)
- Oriental arborvitae (*Thuja orientalis*)
- ponderosa pine (*Pinus ponderosa*)
- eastern redbud (*Cercis canadensis*)
- Russian mulberry (*Morus alba var. tatarica*)
- silver maple (*Acer saccharinum*)
- Poplar clones:
  - P-18 96.18 Populus deltoides
  - P-26 107.14 Populus deltoides x nigra
  - P-48 91.D5-10 Populus deltoides
  - P-56 EUGENE Populus deltoides x nigra

In the second study only the higher rates were applied on each side of the plants, along with tillage-only and mow-only treatments. Cultivated plots were not included in 1999 since the initial objective of the study was to evaluate efficacy of the herbicides relative to one another.

In 1999 at 90 days after treatment weed control was visually evaluated as percent bare ground (0=complete coverage with weeds; 100=completely bare ground), total tree height, survival, and leaf damage were also recorded at 90 days after treatment. Woody plant growth was not measured in 2002. In 2002, efficacy (percent bare ground) was evaluated at 90 days after treatment and at 130 days after treatment. Data from 1999 were analyzed using analysis of variance to detect treatment effects, species differences, and species x treatment interactions. Dependent variables were percent bare ground, survival (%), and height (in.). Percent bare ground from 2002 was summarized, but not statistically analyzed. Data analyses were conducted using SAS (SAS Institute, Inc., Cary, NC).
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**PROCEDURES**

Poplar clones were:
- black walnut (Juglans nigra)
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- fragrant sumac (Rhus aromatica)
- hackberry (Celtis occidentalis)
- Oriental arborvitae (Thuja orientalis)
- ponderosa pine (Pinus ponderosa)
- eastern redbud (Cercis canadensis)
- Russian mulberry (Morus alba var. tatarica)
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- Kansas clone
- Iowa clone I.D. Parentage
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- P-56 EUGENE Populus deltoides x nigra

The study was initiated in 1999 using a randomized design with three replications. Species were located randomly in each plot, with six rows per replication for a total of 18 rows. Rows were 12 feet apart and trees were planted at one foot spacing. No weeds were present at the time of planting. No untreated controls were established because survival and growth without weed control would be minimal. In the second study (2002), the same planting as in 1999 was used for evaluating herbicide treatments. Herbs were applied on March 15, 1999 for study 1 and April 5, 2002 for study 2. All applications were done with a CO2-powered backpack sprayer set at 150p.s.i. Chemicals and rates applied were imazaquin at 0.123 + 0.245 lb a.i./acre, pendimethalin at 1.86 and 3.96 lb a.i./acre, and imazaquin + pendimethalin at 0.124 + 0.4 and 0.248 + 0.4 lb a.i./acre.

In the second study only the higher rates were applied on each side of the plants, along with tillage-only and mow-only treatments. Cultivated plots were not included in 1999 since the initial objective of the study was to evaluate efficacy of the herbicides relative to one another.

In 1999 at 90 days after treatment weed control was visually evaluated as percent bare ground across weed species. 100=completely bare ground; 90% total weed height, survival, and leaf damage were also recorded at 90 days after treatment. Woody plant growth was not measured in 2002. In 2002, efficacy (percent bare ground) was evaluated at 90 days after treatment and at 130 days after treatment. Data from 1999 were analyzed using analysis of variance to detect treatment effects, species differences, and species x treatment interactions. Interactional variables were percent bare ground, survival, and height (in.). Percent bare ground from 2002 was summarized, but not statistically analyzed. Data analyses were conducted using SAS (S.A.S. Institute, Inc., Cary, NC).

The 30-year-average rainfall in March measured March 1999 (0.89 in.) may account for the poor foxtail control, but gave good weed control results in 2002 (Table 1).

**RESULTS AND DISCUSSION**

Survival of the other treatments averaged 90% or greater, indicating little difference among the six species. Multiple species were tested and the similarity in survival among species is not presented in detail due to the large number of species tested and the similarity in survival among species. When averaged across treatments, Poplar clone P-18 had the least survival at 64%, and was significantly less than ponderosa pine, hybrid poplar P-48 and P-56 (70%), and other species which had survival of 94%. Survival of ponderosa pine and poplar clones P-48 and P-56 were also significantly less than the remaining species.

Survival of woody plants (1999 study only) was significantly different for both treatments and species with no significant species x treatment interaction (Table 2), thus, survival data for hardwoods were averaged over species, and data for species are averaged over treatment. All treatments had at least 61% survival: the high rate of imazaquin resulted in the least survival (Table 3). Survival of the other treatments averaged 90-95% or greater, indicating little difference among the four herbicide treatments.

Survival by species is not presented in detail due to the large number of species tested and the similarity in survival among species. When averaged across treatments, Poplar clone P-18 had the least survival at 64%, and was significantly less than ponderosa pine, hybrid poplar P-48 and P-56 (70%), and other species which had survival of 94%. Survival of ponderosa pine and poplar clones P-48 and P-56 were also significantly less than the remaining species.

Total tree height differed significantly among treatments and also by species. Poplar clones were the tallest and redid the shortest. Only the height of poplar clone P-56 was reduced significantly by any of the herbicide treatments. When averaged across species, both levels of imazaquin and imazaquin + pendimethalin reduced total height significantly, but height reductions were small (Table 3).

**SUMMARY AND CONCLUSIONS**

Control of both broadleaf and grassy weeds is necessary for successful establishment and growth of tree plantings in the Great Plains region. Imazaquin alone may not control grasses sufficiently and needs to be combined with another herbicide, especially in the absence of adequate early spring precipitation. Pendimethalin alone in combination with imazaquin, as applied in this study, can be used for controlling weeds with little damage noted 90 days after treatment to the woody plants tested. About 88% had slight damage or no damage, and 7% had slight damage, with slight reddening of the green leaves on arborvitae. Only one of the four Populus clones tested, P-26, and golden currant, showed any life of substantial reduction in height, and survival was good for all species. These results show that any of the four pendimethalin treatments applied during the dormant season on the 15 clones/species of woody plants studied were effective in controlling weeds while causing little or no damage to the plants.

**Table 1. Weed control (percent bare ground) of the six chemical treatments.**

<table>
<thead>
<tr>
<th>Herbicide Treatment</th>
<th>Pigweed spp</th>
<th>Foxtail spp</th>
<th>Lambsquarters</th>
<th>Pigweed spp</th>
<th>Foxtail spp</th>
<th>Escape spp</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999 Results</td>
<td>90 days</td>
<td>130 days</td>
<td>1999 Results</td>
<td>90 days</td>
<td>2002 Results</td>
<td>90 days</td>
</tr>
<tr>
<td>Imazaquin 0.123 lb a.i./acre</td>
<td>50c</td>
<td>0c</td>
<td>38c</td>
<td>Not applied</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Imazaquin 0.245 lb a.i./acre</td>
<td>96a</td>
<td>0c</td>
<td>88b</td>
<td>95</td>
<td>100</td>
<td>65</td>
</tr>
<tr>
<td>Pendimethalin 1.98 lb b.i./acre</td>
<td>72b</td>
<td>82b</td>
<td>100a</td>
<td>Not applied</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Pendimethalin 3.96 lb b.i./acre</td>
<td>90b</td>
<td>98a</td>
<td>90c</td>
<td>90</td>
<td>95</td>
<td>90</td>
</tr>
<tr>
<td>Imazaquin + pendimethalin</td>
<td>92a</td>
<td>95a</td>
<td>100a</td>
<td>Not applied</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>0.124 + 4.0 lb b.i./acre</td>
<td>95a</td>
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<td>100</td>
<td>50</td>
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</table>

Note: In the values row followed by different letters are significant at P < 0.05.
RESULTS AND DISCUSSION

After 90 days greater than 80% control was achieved for both broadleafs and grasses when using the high rate of pendimethalin or both rates of imazaquin + pendimethalin in both years. Imazaquin alone did not control foxtail in 1999, but gave good weed control results in 2002 (Table 1). Pendimethalin resulted in at least 75% bare ground at low and high rates (Table 1). The lack of adequate rainfall in March 1999 (8.89 in.) may account for the poor foxtail control in study 1. The 30-year-average rainfall in March measured at nearby Tuttle Creek Lake, KS, is 2.20 in. Precipitation was 3.03 in. for April 2002, slightly above the 30-year average of 2.77 in. Kansas Weather Data Library, a service of K-State Research and Extension. Adequate soil moisture within 7 days after application of imazaquin is necessary for optimal weed control (1). The high rate of pendimethalin, alone or in combination with imazaquin, resulted in better early results in spite of the relatively dry early spring in 1999 (Figure 2).

Survival of woody plants (1999 study only) was significantly different for both treatments and species with no significant species by treatment interaction (Table 2). Survival data for herbicides are averaged over species, and data for species are averaged over treatments. All treatments had at least 81% survival; the high rate of imazaquin resulted in the least survival (Table 1). Survival of the other treatments averaged 90% or greater, indicating little difference among the six herbicide treatments.

Survival by species is not presented in detail due to the large number of species tested and the similarity in survival among species. When averaged across treatments, Poplar clone P-26 had the least survival at 62%, and was significantly less than ponderosa pine, hybrid poplars P-48 and P-56 (70%), and all others, which had survival of 94%. Survival of ponderosa pine and poplar clones P-48 and P-56 were also significantly less than the remaining species.

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Control of both broadleaf and grassy weeds is necessary for successful establishment and growth of tree plantings in the Great Plains region. Imazaquin alone may not control grasses sufficiently and needs to be combined with another herbicide, especially in the absence of adequate early spring precipitation. Pendimethalin alone and in combination with imazaquin, as applied in this study, can be used for controlling weeds with little damage noted 90 days after treatment to the woody plants tested. About 88% had slight damage or no damage, and 7% had slight damage, with slight reddening of silver maple and some brown leaves on arborvitae. Only one of the four Populus clones tested, P-26, and golden currant, showed any substantive reduction in height, and survival was good for all species. These results show that any of the four pendimethalin treatments applied during the dormant season on the 15 clones/species of woody plants studied were effective in controlling weeds while causing little or no damage to the plants.

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</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>130 days</td>
<td></td>
<td></td>
<td></td>
</tr>
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<td>100</td>
<td>65</td>
<td>100</td>
<td>Crabgrass (54%)</td>
</tr>
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<td>82b</td>
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<td>90</td>
<td>Barnyardgrass (80%)</td>
</tr>
<tr>
<td>Imazaquin + pendimethalin 0.124 + 4.0 lb a.i./acre</td>
<td>92a</td>
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<td>Not applied</td>
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<td>100a</td>
<td>95</td>
<td>100</td>
<td>50</td>
<td>98</td>
<td>Pigweed (50%)</td>
</tr>
</tbody>
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1 Values in the same row followed by different letters are significant at P < 0.05.