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Use of Sulfometuron in Hybrid Poplar Energy Plantations

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ABSTRACT.—Reports that low rates of sulfometuron, 70 grams per hectare (1 ounce product or 0.75 ounces active ingredient per acre), applied when hybrid poplars are completely dormant, can provide season-long weed control and increase hybrid poplar growth. If plantation access is not possible before growth activity begins in the spring, late fall application of this herbicide may be best.

KEY WORDS: Intensive culture, weed control, herbicide, short rotation, biomass, dormant season.

Short-rotation intensive culture (SRIC) of hybrid poplar uses an agronomic system of plantation establishment similar to row crops such as corn and soybeans (Hansen *et al.* 1983). Control of competing weeds is critical in establishing successful plantations. One way of controlling weeds is by applying herbicides, but few, if any, herbicides are known to provide season-long weed control without damaging hybrid poplars (Netzer and Noste 1978). Sulfometuron (Oust¹) is a promising candidate to fill this gap (Netzer 1986). I conducted studies to determine if low rates of sulfometuron applied at the proper time of the year can control competition without damaging hybrid poplars.

METHODS AND RESULTS

Spring and fall applications of sulfometuron were compared in four trials in existing hybrid poplar plantations in Wisconsin and Minnesota. A single application was made to each plantation without shielding the trees, similar

to methods that might be used in commercial tending operations. Sulfometuron was applied in the fall to a planting near Howard Lake, MN, and in the spring to plantings at Milaca, MN, and Mondovi and Harshaw, WI. At each of the four sites, height growth measurements were made in the growing season after herbicide application along with weed control and tree damage observations. Herbicide rates and clones were replicated in some, but not all trials. Spray date was confounded by location. All plantations were established using unrooted hardwood cuttings.

Howard Lake: 1-Year-Old Plantation, Sulfometuron Applied in Fall

A 12.3-meter-wide strip was sprayed with sulfometuron across a 48.5-hectare 1-year-old hybrid poplar plantation near Howard Lake, MN, on October 23, 1987. Each of three herbicide rates—70, 140, and 210 grams per hectare (1, 2, and 3 ounces product or 0.75, 1.50, 2.25 ounces active ingredients per acre)—was applied to a 4-meter-wide section of spray strip. A sprayer with an adjustable boom set 1.2 meters above the ground was used to apply the chemical. The plantation consisted of clonal blocks of 11 hybrid poplar clones (table 1), all of which appeared to be completely dormant at the time of spraying. Weeds were controlled before herbicide application by discing, allowing the chemical to be applied directly to bare ground.

During 1987 and 1988 a record drought occurred throughout the region (National Oceanic and Atmospheric Administration 1987, 1988). Control plots adjacent to the test strips were disced once during the 1988 growing season and mowed once because the

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¹ Mention of trade names does not constitute endorsement of products by the USDA Forest Service.

Table 1.—Hybrid poplar clones tested for tolerance of sulfometuron in Minnesota and Wisconsin

| Clone | Parentage | Site* |
|--------|--|----------------------|
| DN1 | <i>P. deltoides</i> x <i>euramericana</i> | Howard Lake, Harshaw |
| DN34 | <i>P. deltoides</i> x <i>euramericana</i> (Carolina) | Howard Lake, Harshaw |
| DN164 | <i>P. deltoides</i> x <i>euramericana</i> | Harshaw |
| DN182 | <i>P. deltoides</i> x <i>euramericana</i> | Howard Lake |
| NC5260 | <i>P. tristis</i> x <i>P. balsamifera</i> | Howard Lake |
| NE41 | <i>P. maximowiczii</i> x <i>P. trichocarpa</i> | Howard Lake |
| NE47 | <i>P. maximowiczii</i> x <i>P. berolinensis</i> | Howard Lake |
| NE54 | <i>P. candicans</i> x <i>P. berolinensis</i> | Howard Lake, Milaca |
| NE299 | <i>P. betulifolia</i> x <i>P. trichocarpa</i> | Howard Lake |
| NE308 | <i>P. charkowiensis</i> x <i>P. incrassata</i> | Howard Lake |
| NE387 | <i>P. candicans</i> x <i>P. berolinensis</i> | Howard Lake |

*Only 1 of the 45 hybrid poplar clones in the Mondovi, Wisconsin, plantation was exposed to more than two herbicide treatments, so all clones were combined for analysis.

parched soil could not be effectively disced. At the end of the year, weeds covered 90 percent of the area in the control plots, 41 percent in the 70 gram per hectare plot, and 27 percent in both the 140 and 225 grams per hectare plots. The major components of the weed cover consisted of yellow foxtail (*Setaria lutescens* (Weigell)) and thistle (*Cirsium* spp.).

Height growth for the 1988 season, the year after herbicide application, was significantly greater for all 11 hybrid poplar clones at all sulfometuron rates compared to the control (fig. 1). Growth was greatest at the 70 gram per hectare (1 ounce per acre) rate and decreased as the herbicide rate increased. The increase in growth rate was greater for four faster growing clones than for six slower growing clones (fig. 1).

Milaca: 3-Year-Old Plantation, Sulfometuron Applied in Spring

A 3-year-old plantation near Milaca, MN, of a single hybrid poplar clone, NE54, was sprayed April 24, 1992. Two single rows of trees were sprayed on both sides with sulfometuron at 140 grams per hectare (2 ounces per acre) applied with a sprayer pulled by an all-terrain vehicle (ATV) at a boom height of 0.5 meters above the ground. The chemical was applied with flat fan nozzles in 65.5 liters per hectare

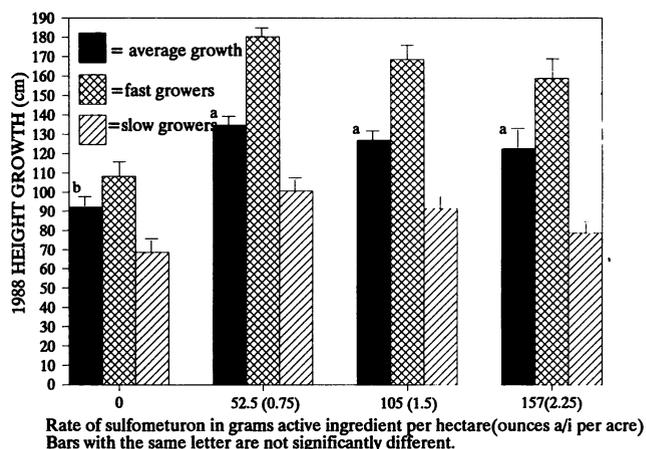


Figure 1.—Average height growth of 11 hybrid poplar clones after fall application of sulfometuron compared to that of slower and faster growing clones of the group.

(7 gallons water per acre). No effort was made to shield the trees from herbicide spray. Tree growth in rows where herbicide was applied was compared with that in two rows that were kept weed free by periodic discing. Buffer rows were left between each treatment. Although it was late April, we could see no growth activity on the hybrid poplars.

There was no significant difference between the sulfometuron rows and the disced rows in height growth or diameter breast height (d.b.h.)

during the 1992 growing season (fig. 2). The height growth was 81 centimeters in the sprayed plots and 73 centimeters in the disced plots. However, the tree diameters in the disc rows averaged 13.2 centimeters compared to 11.7 centimeters in the sprayed rows. Discing was needed twice during the 1992 growing season. Rainfall was normal for the year. Observations of weed control in October 1992 showed excellent season-long control in both the sulfometuron treated areas and the disced areas. Less than 5 percent of the ground was covered with weeds in both treatments after one complete growing season.

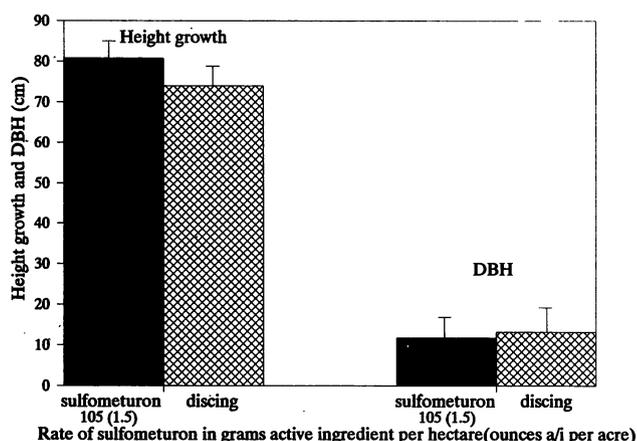


Figure 2.—One-year height growth and diameter breast height (DBH) of 3-year-old hybrid poplar clone NE54 after spring application of sulfometuron or discing.

Mondovi: 1-Year-Old Planting, Sulfometuron Applied in Spring

A 1-year-old hybrid poplar clonal trial near Mondovi, WI, containing 16-tree unreplicated plots of 45 clones, was treated with sulfometuron at 70 and 140 grams per hectare (1, 2 ounces per acre) April 24, 1991. Two rows each were treated with 70 and 140 grams per hectare and two rows were unsprayed controls. This six-row test was replicated three times across the planting. Herbicide was applied directly over the tree rows with a boom sprayer pulled by an ATV with the spray boom set at a constant height of 0.9 meter. The trees showed some signs of growth initiation at the time of treatment; buds were swollen, but leaf tips had not yet extended from the buds. All clones were clumped together for analysis

because the original design of the plantation allowed for only one clone to receive more than two treatments.

In late June light to moderate damage to the tree leaves was observed at both rates of sulfometuron. Weed control was nearly 100 percent for the entire growing season in all herbicide-treated plots. Weeds completely covered the control plot, growing to heights of 1 to 1.2 meters and overtopping many of the smaller trees. Deer seemed attracted to the open areas created by the herbicide applications; subsequent browsing ranged from 50 percent of the trees in the 140 grams per hectare plots to less than 10 percent in the control plots (fig. 3). Bud damage and resultant multi-branching occurred from the deer browsing as expected, but additional bud damage and multi-branching appeared to be the result of herbicide damage.

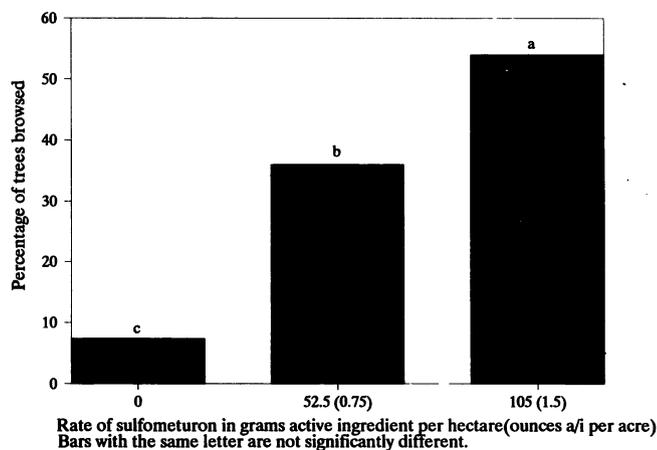


Figure 3.—Percentage of 1-year-old hybrid poplar browsed by deer after application of three rates of sulfometuron.

Single-stemmed trees showed a slight increase in growth at the 70 gram rate and a significant decrease in growth at the 140 gram rate (fig. 4). Only one clone, NE154, was located in both herbicide treatments and the control. This clone showed a decrease in growth at both sulfometuron rates compared to the unsprayed control. In late October 100 percent of the ground was weed covered in the controls, 51.6 percent was weed covered in the 70 gram per hectare areas, and only 5 percent of the ground was weed covered in the 140 gram per hectare rate plots. Normal to above normal rainfall

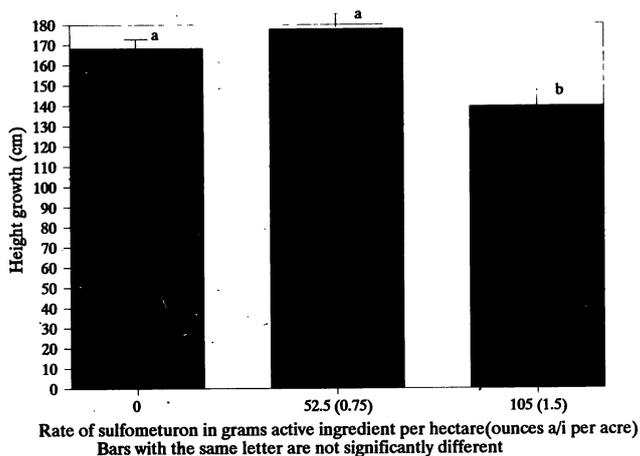


Figure 4.—Height growth of 1-year-old hybrid poplar after late spring broadcast application of sulfometuron.

patterns occurred at Mondovi in 1991, providing adequate moisture for trees in the weedy control plots.

Harshaw: 1-Year-Old Planting, Sulfometuron Applied in Spring

A 1-year-old hybrid poplar plantation near Harshaw, WI, consisting of three hybrid poplar clones, DN1, DN34, DN164, in pure clonal blocks, was oversprayed on April 23, 1991. Sulfometuron was applied directly over the trees at rates of 70 and 140 grams per hectare (1, 2 ounces per acre) with a handheld boom sprayer containing flat fan nozzles. The tree buds were more active than at Mondovi with some green leaf tips extending from the buds. In each of the 3 clones, 10 randomly located single-tree plots were treated per the 2 herbicide rates and 10 plots were left as untreated controls. An area adjacent to the sprayed plots was regularly disced throughout the growing season and was compared to the other test plots even though it was not randomized within the rest of the test plots. In 1991 trees in the disced area grew significantly more in height than the sulfometuron-treated plots and the controls (fig. 5). Height growth at the 140 grams per hectare rate was significantly less than at the control and the 70 grams per hectare rate. Weed control was significantly greater in both sulfometuron treatments and the disc area compared to the control. The control had weed cover averaging 86 percent compared to 5 percent for the 70 gram

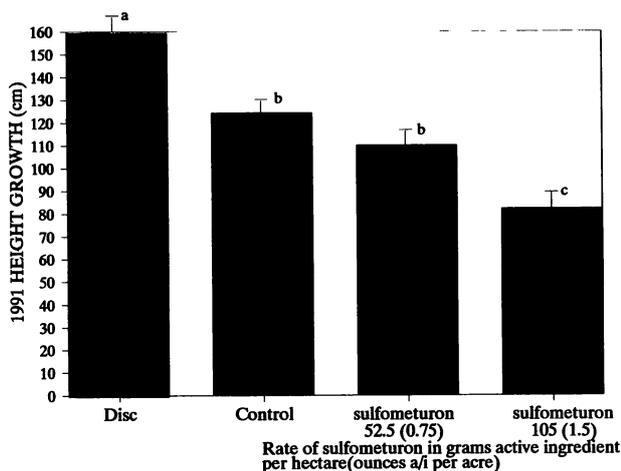


Figure 5.—Average height growth of 1-year-old hybrid poplar clones DN1, DN34, DN164, after spring overspray with sulfometuron.

sulfometuron treatment, 2 percent for the 140 gram sulfometuron treatment, and 2 percent for the disced area.

DISCUSSION

Height growth of 11 hybrid poplar clones at Howard Lake increased significantly during the second growing season (fig. 1). But application rates of more than 70 grams per hectare reduced tree height growth in three of the trials (figs. 1, 4, 5). It appears that damage occurs to trees that have begun any growth activity even if buds have not flushed, as seen at Harshaw. When treated in late fall, the same aged trees showed only a slight decrease in growth as herbicide rate increased at Howard Lake. However, tree growth increased significantly in all sulfometuron-treated plots when compared to control plots at Howard Lake. This may reflect the extreme effect of the 1987-1988 drought on young hybrid poplars. Mechanical weed control was ineffective because cultivators could not penetrate the dry soil. An herbicide would, in this case, be the most effective way to control weeds. The Howard Lake study was the only one of the four where sulfometuron was applied in the fall. It is possible that fall application after complete tree dormancy has set in, but before ground freeze up, may reduce, if not completely eliminate, tree growth damage the following year while still controlling weeds throughout that growing season. Field conditions are often drier in the fall than in the

early spring, making application of sulfometuron easier over dormant trees. In addition, fall application allows a longer time for the herbicide to degrade and become less toxic to the poplars.

The hybrid poplar clones that have proven to be the best growers over a number of years showed the greatest increase in growth with fall herbicide application at Howard Lake (fig. 1). Tree size may have been important in that the faster growing clones were larger than the slower growers at the time of herbicide application, thus exposing the smaller slower growers to more herbicide. Further evidence that tree size may be a factor in preventing herbicide damage was found at Milaca where 3-year-old trees treated in spring showed no growth reduction when compared to trees in plots where standard discing was done to control weeds (fig. 2). The thicker bark and taller trees likely limited exposure to sulfometuron even though the trees were not shielded from the herbicide spray and it was near the time when growth activity is expected. Smaller trees exposed to complete coverage by the herbicide spray are damaged if they are not completely dormant, even at low sulfometuron rates. Greater than normal branchiness was noted in a 1-year-old hybrid poplar treated with sulfometuron at Mondovi, indicating possible herbicide damage. This type of damage has been noted in other plantings in Wisconsin by Michler (personal communication). Heavy deer browsing of the Mondovi trees masked any herbicide damage. Deer browse was heaviest in the treated areas (fig. 3) possibly due to the easy access of these plots compared to the weedy controls. In commercial plantations larger acreages of hybrid poplar plantations treated uniformly would likely eliminate this deer problem (Netzer 1984).

Most weeds are controlled for the entire growing season by sulfometuron applied at the rates tested, even at the lowest rate of 70 grams per hectare (1 ounce per acre) in these trials. A few grasses can occasionally escape but are easily controlled by herbicides like sethoxydim (Poast) during the growing season. Thistle seems to regularly escape control with sulfometuron and can cause severe problems when competing with hybrid poplars. It can, however, be controlled by directed spray application of glyphosate.

CONCLUSIONS

Low rates of sulfometuron, 70 grams per hectare (1 ounce product or 0.75 ounces active ingredient per acre), applied when hybrid poplars are completely dormant, can provide season-long control of weeds and increase hybrid poplar growth. Growth increases in drought years or dry areas may be greater when weeds are controlled by herbicides rather than by mechanical cultivation. Trees 1 year old and younger or smaller trees may be damaged during broadcast applications if even slight growth activity is just beginning for the season. A few weeds may escape sulfometuron at low rates. Thistles seem most resistant to this herbicide and present the greatest challenge to its use. Patches of thistle may be controlled with directed sprays of contact herbicides like glyphosate. Late fall application of sulfometuron may be better than spring application if field access before early growth activity is a problem.

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