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# Bromacil and Picloram under Southern Upland Hardwoods[1]

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**Abstract.** Bromacil (5-bromo-3-sec-butyl-6-methyluracil) was much more effective in killing post oak *(Quercus stellata* Wangcnh.) and blackjack oak *(Q. marilandica* Muenchh.) trees than 4-amino-3,5,6-trichloropicolinic acid (picloram) when applied to soil at 5.6 and 11.2 kg/ha in spots, bands, or by broadcasting. When applied at 5.6 kg/ha in bands or broadcast, picloram effected better crown reduction than bromacil on mockernut hickory *(Carya tomentosa* Nutt.). Differences between rates and methods of applying bromacil were small. While bromacil was superior on the prevalent overstory species, post oak and blackjack oak, picloram excelled on the most numerous understory plants.

## INTRODUCTION

SoiL-applicd herbicides may soon be practical for controlling thick stands of low-grade hardwoods and brush on southern pinelands (1,3, 4). Soil herbicides have killed hardwood trees growing and sandy upland soils in the Southeast (2, 5, 7). Costs are high, but they may become comparable to those for mechanical control as prices for heavy machines rise (1, 6). Reported here are the effects of applying pelleted bromacil or picloram to the soil in a low-grade upland hardwood stand in Louisiana.

## MATERIALS AND METHODS

A total of 12 treatments, combinations of two herbicides and two rates and three methods of application, were tested on 20 species of woody plants during late winter when soil herbicides have proved effective in other regions (1, 6).

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The chemicals were bromacil and picloram, both in 10% concentrations in pellets. Rates were 5.6 and 11.2 kg/ha of active ingredient with all methods of application.

Blackjack oak, post oak, and mockernut hickory composed 80% of the stand of approximately 800 stems per acre. Huckleberry *(Gaylussacia baccata* (Wangenh.) K. Koch), American beautyberry *(Callicarpa americana* L.), and sassafras *(Sassafras albidum* (Nutt.) Nees) were 10% of the stand, mostly as small understory plants. Fourteen other species made up the remaining 10% of the stand. These were southern red oak *(Q. falcata* Michx.), white oak *(Q. alba* L.), black cherry *(Prunus serotina* Ehrh.), flowering dogwood *(Cornus ftorida* L.), hawthorn *(Crataegus* L. *(C. spathulata* Michx.)), red maple *(Acer rubrum* L.), sweetgum *(Liquidambar styraciflua* L.), shining sumac *(Rhus copallina* L.), grape *(Vitis* spp.), witch-hazel *(Hamametis virginiana* L.), loblolly pine *(Pinus taeda* L.), longleaf pine *(P. palustris* Mill.), and shortleaf pine *(P. echinata* Mill.). All sizes of each species were grouped together in assaying results. Stems ranged from 1.25 to 20 cm in diameter 1.37 m above ground and averaged about 8 cm.

Rainfall was sufficient following treatment for adequate leaching of the herbicide into the soil. During March, the month of application, 11.65 cm were received, followed by 15.98 and 10.06 cm during April and May, respectively.

The herbicides were applied in March 1969. Patterns of application were: (a) in 14 bands each 30 cm wide and 20 m long spaced 1.2 m apart, edge to edge; (b) in 14 spots 30 cm in diameter and at 1.2 m intervals, edge to edge, on each of 14 lines 20 m long; and (c) broadcast uniformly over the entire plot. Plots were 20 m square, and dosage rates were based on the entire plot area.

Each of the 12 treatments was replicated three times in a randomized complete block design. Plots were located 7.6 m apart to prevent one treatment from affecting another. The soil was predominantly a Ruston sandy loam that has good internal drainage.

Effectiveness was measured two growing seasons after applications. All woody plants along a transect 1.5 m wide through the center of each plot were observed. This line was perpendicular to the rows for strip and spot applications. On each plant the proportion of crown reduction (topkill) was estimated visually to the nearest 5%, then averaged by plot and treatment. Crown reductions of 91 % or higher were considered satisfactory, 85 to 90% marginal, and under 85% unsatisfactory. Statistical differences reported here were calculated at the 5% level by Duncan's Multiple Range test.

## RESULTS

For all 20 species combined, bromacil was more effective than picloram, with crown reduction averaging 90 versus 68% (Table 1). Bromacil achieved higher average crown reduction than picloram for each method of application. Differences in effectiveness of the chemicals were statistically significant in many instances. Exceptions were bands and broadcast applications at the 11.2 kg/ha rate.

*Table 1.* Percentage of crown reduction on 20 species of woody plants 17 months after treatment.

| Herbicides | Rate | Method of application | | |
|---|---|---|---|---|
| | | Bands | Spots | Broadcast |
| | (kg/ha) | (%) | (%) | (%) |
| Bromacil | 5.6 | 90 b[1] | 90 b | 88 b |
| | 11.2 | 85 c | 98 a | 90 b |
| | Average | 87 | 94 | 89 |
| Picloram | 5.6 | 64 e | 34 f | 64 e |
| | 11.2 | 84 c | 71 d | 91 b |
| | Average | 74 | 52 | 77 |

[1]Values other than averages followed by the same letter do not differ significantly at the 0.05 level according to Duncan's Multiple Range test.

The rate of application of bromacil in spots and bands significantly influenced crown reduction, and differences due to pattern of application were significant at the higher application rate. When all methods were averaged, crown mortality figures for the 20 species were 89 and 91% for 5.6 and 11.2 kg/ha, respectively. Average crown reductions over both rates of bromacil were 87, 94, and 89% with banding, spotting, and broadcasting, respectively.

Both rate and method of application affected results with picloram, though the lower rate gave similar results with banding and broadcasting. The 11.2 kg/ha rate, which caused 82% average crown reduction with all methods, was significantly better than the 5.6 kg/ha rate, which caused 54% crown reduction.

Averages for all 20 species combined were influenced by composition of the stands because species differed in their susceptibility. For this reason, analyses were conducted separately for post oak, blackjack oak, and mockernut hickory, the three most prevalent species in the overstory (Table 2).

On post oak, bromacil was more effective than picloram. Crown reduction was 94% or better for all treatments, whereas effectiveness with picloram ranged from 10 to 84% (Table 2). Neither rate nor pattern of application was important with bromacil. With picloram, however, the high rate was significantly more effective than the low rate, and spotting was inferior to both broadcasting and banding. However, results of all picloram treatments were unsatisfactory.

*Table 2.* Percentages of crown reduction on the three major overstory species 17 months after treatment.

| Method of application | Rate | Bromacil | | | Picloram | | |
|---|---|---|---|---|---|---|---|
| | | Post oak | Blackjack oak | Hickory | Post oak | Blackjack oak | Hickory |
| | (kg/ha) | (%) | (%) | (%) | (%) | (%) | (%) |
| Bands | 5.6 | 94 b[1] | 94 b | 75 b | 45 c | 65 b | 100 a |
| | 11.2 | 100 a | 92 b | 100 a | 80 a | 69 b | 100 a |
| | Average | 96 | 93 | 87 | 62 | 68 | 100 |
| Spots | 5.6 | 98 a | 100 a | 81 b | 10 d | 21 c | 75 b |
| | 11.2 | 100 a | 98 a | 100 a | 55 b | 65 b | 99 a |
| | Average | 99 | 99 | 90 | 32 | 43 | 87 |
| Broadcast | 5.6 | 99 a | 88 c | 80 b | 46 c | 86 ab | 91 ab |
| | 11.2 | 100 a | 87 c | 100 a | 84 a | 98 a | 100 a |
| | Average | 99 | 87 | 90 | 65 | 92 | 95 |
| Overall Average | | 98 | 93 | 89 | 53 | 67 | 94 |

[1]Within a column, values other than averages followed by the same letter do not differ significantly at the 0.05 level according to Duncan's Multiple Range test.

Bromacil applied by spotting and banding was also superior to picloram on blackjack oak. Differences between the two herbicides on blackjack oak were unimportant when broadcast at the lower rate. At the higher rate picloram gave better crown reduction than bromacil.

Mockernut hickory was the most difficult species to kill with 5.6 kg/ha of bromacil, but 11.2 kg/ha completely eliminated all live crowns. This species seemed more susceptible to picloram than the two oak species. Only the low rate of picloram as a spot treatment gave crown reductions of less than 91%.

While bromacil was more lethal to the most prevalent large hardwoods, picloram was more effective on the most abundant understory plants (Table 3). These data were not analyzed statistically because of the large number of plots without certain species. Only the high rate of bromacil in spots was effective on sassafras, and neither rate was effective on American beautyberry and huckleberry. In contrast, all treatments with picloram were highly effective except the spot application of 5.6 kg/ha.

*Table 3.* Percentages of crown reduction 17 months after treatment on the three major understory species.

| Method of application | Rate | Bromacil | | | Picloram | | |
|---|---|---|---|---|---|---|---|
| | | Huckleberry | American beautyberry | Sassafras | Huckleberry | American beautyberry | Sassafras |
| | (kg/ha) | (%) | (%) | (%) | (%) | (%) | (%) |
| Bands | 5.6 | 0 | | 45 | 100 | 100 | 100 |
| | 11.2 | 20 | 0 | | 100 | | 100 |
| Spots | 5.6 | 25 | 25 | 46 | 80 | 53 | |
| | 11.2 | 15 | 77 | 100 | 100 | 95 | |
| Broadcast | 5.6 | 0 | 33 | | 100 | 100 | 100 |
| | 11.2 | 38 | | 0 | 100 | | 100 |
| Average | | 16 | 34 | 48 | 97 | 87 | 100 |

Crown reduction values were 50 and 60% or less on southern red oak and red maple, respectively, after treatment with 5.6 kg/ha of picloram applied by all methods. The 11.2 kg/ha rate was effective (85% or more crown reduction) on southern red oak with all methods. Both rates of bromacil were effective with all methods on southern red oak. There were no red maples on plots treated with bromacil or with the high rate of picloram. Both rates

of bromacil and picloram gave 85% crown reduction or better on the remaining minor species with all patterns of application.

Of the pines present on plots at the time of treatment, 94% of those with stems 1.27 cm in diameter and larger were killed by the treatments. However, more than 90% of loblolly pine seedlings planted one growing season after herbicide application survived. Apparently, by that time the herbicide was no longer highly active in the soil.

## Discussion

On all species combined, bromacil was more effective than picloram. In fact, 5.6 kg/ha of bromacil were more effective than 11.2 kg/ha of picloram except when broadcast. The three methods of application were about equally effective with both rates of bromacil. These crown reductions exceeded those normally obtained by foliar spraying and are comparable to results of tree injection.

Overall results may be biased somewhat by variations in abundance of individual species that differ in susceptibility. Bromacil was superior to picloram on two of the three overstory species making up 80% of the stand, but the low rate of picloram in bands and broadcast excelled on hickory. Bromacil is probably preferable, because hickory is rarely a major component of upland hardwood stands in the South.

On the three most abundant understory species picloram was more effective than bromacil.

Treatment cost, including distribution, would likely exceed that for chopping, shearing, or disking. However, soil herbicides may be practical on tracts not suitable for machine operation because of size, location, or soil conditions. Moreover, costs might be reduced by applying less than 5.6 kg/ha. The small differences in results from 5.6 and 11.2 kg/ha applications suggest that rates lower than 5.6 may be effective.

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