SITE EFFECT ON HERBICIDAL EFFICIENCY

Fred A. Peevy
Plant Ecologist, Southern Forest Experiment Station
USDA Forest Service, Alexandria, Louisiana

ABSTRACT. Soil type did not significantly influence the effectiveness of 2,4-D amine injected into post oak and hickory, but sweetgum was easier to kill on a bottom-land than on an upland soil. Site did not consistently affect the efficiency of bromacil and picloram applied to the soil in bands around individual post and red oak trees. Major differences in kill were caused by species, herbicide, and dosage. Bromacil was more effective than picloram.

Although most published recommendations for herbicide use do not mention a need to vary dosage by site, many land managers believe that hardwoods are more difficult to kill in bottoms than in uplands. Related information in the literature indicates that effectiveness of herbicides is influenced to some extent by site. Better kill of oak (*Quercus* spp.) brush was obtained with foliar-applied 2,4,5-T in Texas on deep valley soils than on shallow rocky soils on slopes or ridges (*1*). In southern Arkansas, 2,4,5-T sprayed on foliage of woody plants gave poorest results on areas with highest site index (*5*). The proportion of resistant species was highest on areas with the lowest kill, however. In east Texas, hardwood kill with 2,4,5-T foliar spray on upland sandy loam soils increased as clay content of the subsoil increased (*6*). In contrast, soil-applied fenuron was more effective on oak brush in Texas on deep sands and permeable sandy loams than on sandy loams or loams with compact subsoils (*2*). Soil-applied picloram in the South and Southeast worked better on woody plants growing in sandy loam and heavier soils than in deep sandy upland soils (*4*). In tests with bromacil on Johnson grass (*Sorghum halepense* (L.) Pers.) and other perennial grasses, higher rates of application were required in heavy soils than in sandy soils (*3*).

The two studies reported here were initiated to determine how much site might influence kills obtained with herbicides injected into trees or applied to the soil in Louisiana. The soils selected varied widely in physical properties; presumably, they also differed in chemical characteristics.

Study Procedures

In one study, trees of three selected species on one upland and one bottom-land site were injected with undiluted amine salt of 2,4-dichlorophenoxyacetic acid (2,4-D) at a concentration of 4 pounds acid equivalent per gallon. The soil on the upland site is predominantly Ruston sandy loam, which has good internal drainage. The area's gently rolling topography provides good surface drainage. The bottom-land site is a Bibb silty clay loam with a lower subsoil of compact, impervious clay which restricts internal drainage. The area is flat and subject to flooding. Species used in the study were post oak (*Quercus stellata* Wangenh.), sweetgum (*Liquidambar styraciflua* L.), and mockernut hickory (*Carya tomentosa* Nutt.). They ranged from 4 to 9 inches in diameter at breast height. Trees on both sites were injected with 1 ml. of herbicide in incisions spaced 3, 5, and 7 inches apart, edge to edge. Injections were made near groundline with a commercial injector whose bit was 1-3/4 inches wide. All treatments were applied in May 1965.

The second study compared the effectiveness of soil herbicides applied in the spring of 1967 on three sites. Post oaks were treated on a Ruston sandy loam and a Caddo silt loam, and red oaks (*Q. falcata* Michx.) were treated on these soils plus a Bibb silty clay loam. The Ruston soil has good internal drainage, and the Caddo is slowly permeable although better than the Bibb soil, which was described above. Trees were treated with 5-bromo-3-sec-butyl-6-methyluracil (bromacil) and 4-amino-3,5,6-trichloropicolinic acid (picloram) at ½-, 1-, 1½-, and 2-g. dosages of effective material for each inch of trunk diameter, except the low rate was not used on the Bibb soil. Treatments were applied to trees ranging from 4 to 12 inches in diameter. Bromacil was applied as 80-percent wettable powder and picloram as 10-percent pellets. The herbicides were spread evenly in 3-foot-wide bands about 12 inches out from tree trunks.

In all studies, a plot consisted of 10 nearby trees of a species. Treatments were replicated three times and assigned to plots in a fully randomized design.

Effectiveness is expressed in terms of top-kill two growing seasons after application. Crown reduction was estimated visually to the nearest 5 percent for each tree, then averaged by plot and treatment. Top-kills of 91 percent or higher were considered satisfactory, 85 to 90 marginal, and under 85 percent unsatisfactory. All differences reported here are statistically significant at the 0.05 level.

Results

Site effects in the injection study were inconsistent (table 1). When all species and treatments were combined into a single analysis of variance, the influence of site was not statistically significant. For all spacings of injections combined, site influenced kill of sweetgum, but not the other two species. Contrary to popular belief, sweetgum was easier to kill on the bottom-land than the upland soil. For all spacings of incisions, the difference averaged about 25 percentage points.

The herbicide was more effective when injected at 3- and 5-inch than at 7-inch intervals with all species on upland soil and with sweetgum on bottom-land soil. Satisfactory kills of post oak and hickory were obtained in the bottom land with injections at 7-inch intervals, but a 5-inch spacing was necessary with sweetgum. In the uplands, a 5-inch spacing of incisions was required for satisfactory kill of post oak and hickory, while kills of sweetgum were unsatisfactory with incisions 3 inches apart.

Table 1.--*Average top-kill of trees 16 months after injection*

Species and spacing of incisions	Bottom land	Upland
	- - - - -*Percent*- - - - -	
Post oak		
3 inches	91	99
5 inches	98	95
7 inches	93	75
Sweetgum		
3 inches	96	71
5 inches	89	62
7 inches	64	43
Hickory		
3 inches	100	100
5 inches	92	100
7 inches	96	81

The soil herbicides were much less effective than anticipated. None of the picloram treatments were satisfactory (table 2). Only two site effects were statistically significant. Bromacil was more effective on Ruston than on Caddo soil, and picloram worked better on Caddo than on Ruston soil.

Table 2.--*Top-kill of oaks growing on three soils 17 months after application of soil herbicides*

Chemical and dose per inch of d.b.h.	Ruston		Caddo		Bibb
	Red oak	Post oak	Red oak	Post oak	Red oak
	- - - - - - - - - -		-*Percent*-	- - - - - - - -	
Bromacil					
½ gram	4	32	0	23	...
1 gram	8	80	29	67	51
1½ grams	50	92	53	87	83
2 grams	67	100	75	80	75
Picloram					
½ gram	0	1	14	6	...
1 gram	11	0	7	0	5
1½ grams	0	3	56	18	3
2 grams	3	0	1	11	6

None of the soil treatments controlled red oak satisfactorily. The 1½- and 2-g. dosages of bromacil gave satisfactory kill of post oak on Ruston sandy loam. These dosages were marginally effective on post oak on Caddo silt loam.

Discussion

Although the soils selected varied widely in physical properties, consistent effects of site on herbicidal efficiency were not found. In the injection study, kills were influenced more by species and spacing of incisions than by site. The differences observed, though not clear cut, indicate that a given species is not more difficult to kill in bottoms than in uplands. Instead, it appears that some species are harder to kill on upland soils than on moister sites.

Why, then, have many land managers assumed that the opposite was true? Probably because such hard-to-kill species as hawthorne (*Crataegus* spp.), hollies (*Ilex* spp.), and swamp-privet (*Forestiera acuminata* (Michx.) Poir.) are more common in bottoms than on upland sites.

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Reprinted from **PROCEEDINGS, TWENTY-THIRD ANNUAL MEETING SOUTHERN WEED SCIENCE SOCIETY, pages 237-240. 1970.**