HERBICIDES IN FLORIDA'S FLATWOODS-EFFICACY AND OPPORTUNITY

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ABSTRACT

Herbicide usage in the intensively-managed forests of north Florida have moved from a testing phase to full-scale operational use over the past 4 years. Much information still needs to be developed on the combinations of herbicides and rates needed to control weeds during site preparation and release operations. Use of herbicides in Florida's forests will require professional skill to achieve potential productivity increases in a cost-effective manner. This paper discusses the rationale behind use of herbicides in forestry and introduces the topics of efficacy and productivity benefits.

INTRODUCTION

This paper introduces the topic of herbicide use in operational forestry in Florida. In the past 4 years herbicide use has grown from a "testing" phase to full operational use (Miller 1984). Although much has been learned in this period, many questions still remain. Also, foresters just starting operational use of herbicides have many basic questions which can be answered by the shared experience of those skilled in silvicultural herbicide use.

Florida's forests contain a complex assemblage of grass, broadleaved, and woody weeds (Swindel et al., 1982; Moore et al., 1982). Many weed species are easily controlled by a variety of herbicides, but others like palmetto (Serenoa repens (Bartram) Small and gallberry (Ilex spp.) are very tolerant. Thus, one of the most frequently asked questions is, "Which herbicide do I use?" The Auburn University Silvicultural Herbicide Cooperative has been doing a great deal of research on this topic. A subsequent paper (also appearing in this volume) will present a synopsis of the silvicultural herbicides currently registered and some being developed. The Herbicide Cooperative's data base has been gathered from efficacy trials spread throughout the South and in parts of Florida. Two other papers will discuss results of testing done specifically in Florida.

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[1] The use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement or approval by the U.S. Department of Agriculture of any product or service to the exclusion of others which may be suitable.

Other questions commonly asked regarding operational use of herbicides relate to application equipment, the economics of herbicide usage, and the short-term and long-term benefits of improved tree growth. Separate papers will address these subjects. The objectives of this paper are to (1) discuss some of the reasons behind herbicide use, (2) to introduce the subject of the efficacy of herbicides on the major weed species in Florida's forests, and (3) to look at some of the potential achievements for controlling weeds.

BACKGROUND- WHY HERBICIDES?

Reestablishment of the South's "second forest" in the 1950s first met with only marginal success due to weed competition and, in some cases, poor soil physical condition after logging. Fast-growing grasses, broadleaved herbaceous species, and hardwood sprouts put young seedlings at a severe disadvantage. As a result, many regenerated stands were left understocked and slow growing. Burning had been used, but often did not produce satisfactory results by itself. Chopping, disking, bedding, KG blading, windrowing, and shearing and piling were introduced to improve soil aeration, moisture conditions, and nutrient supply, as well as reduce weed competition (Broerman et al., 1983; Crutchfield and Martin 1982). Although these mechanical site preparation treatments proved successful in improving reforestation, questions were raised about their effects on long-term site productivity.

In the late 1970s a great deal of attention was focused on nutrient removals from forests as a result of intensified biomass removal from whole-tree harvesting and generally shorter rotations (Morris and Pritchett 1982). However, research in several regions, including north Florida (Pritchett and Morris 1982), indicated that nutrient redistributions as a result of over-intensified site preparation was producing a greater impact on site nutrient supply (Neary et al., 1984a). Thus, a large effort was made to refine mechanical site preparation or to find acceptable alternatives.

Rising energy costs in the late 1970s and the early 1980s forced economic evaluations to catch up with mechanical site preparation. Research in progress since the 1960s has indicated that chemical weed control can be done effectively (Gjerstad 1981) as well as economically (Guldin 1983, Kerr 1982, Stewart and Row 1981). Recent economic evaluations indicate that any comparison between chemical and mechanical weed control heavily favors chemical (Clark, this volume).

This combination of factors has led to considerable changes in site preparation strategies and policies. While mechanical site preparation has not been totally abandoned, more forest managers have turned to creative combinations of mechanical and chemical methods. They have also become more site specific in their prescriptions. However, many questions still exist as to rates, combinations, and timing of herbicide use.

HERBICIDE EFFICACY

Use of herbicides in forestry really did not develop in a systematic manner until after World War II when phenoxyacetic acid herbicides became readily available (Fitzgerald 1980).

Most of the major forestry herbicides (Table 1) have had southwide testing by chemical manufacturers, forestry cooperatives, and other research organizations. Herbicides have been integrated into silvicultural systems in the past 4 years as more information on efficacy has become available (Fitzgerald 1982). Implementation of chemical weed control technology has been limited by lack of understanding of the factors which affect herbicide application success.

Table 1. Herbicides commonly used for site preparation and release in the United States (after Hamel 1983).

Common name	Rate	Carrier	Formulation[1]	Combination[2]
	lb/ac	gal		
1. Amitrol	1-2	1-100	LC, WP	12
2. Asulam	3.3	10-20	LC	
3. Atrazine	2-4	20-40	LC, WP, G	
4. Dalapon	3-11.2	40-100	SP	
5. Dicamba	var	# 1/	L	6
6. 2,4-D	var	0-100#	LC, EC	10, 11
7. 2,4-DP	3.7	10	LC	6
8. Fosamine ammonium	4-12	10-15	LC	
9. Glyphosate	3-4	5-15	LC	
10. Hexazinone	0.7-10	5-100*	LC, SP, G	
11. MSMA	var	#	LC	
12. Picloram	2-8.5	#* 4/	G	
13. Simazine	4-6	20-100	WP, LC, G	3
14. Triclopyr	1-8	20-40	LC	6

[1] Formulations: LC = liquid concentrate; WP = wetable powder; G = granule, P = pellet; EC = emulsifiable concentrate; SP = soluble powder.

[2] Combination with other herbicide(s) listed in column 1.

[3] # includes injection so rate and carrier volume are variable.

[4] * indicates granular formulation with no liquid carrier.

Table 2. Mean percent cover for six plant species groups on weed control and untreated plots in coastal plain flatwoods based on 216 line transects 90 days after treatment with 0.5 lb/ac a.i. Oust®.

Species	Common name	Percent cover		
		untreated	weed control	
Andropogon capillipes	Chalky bluestem	2	6	**
Andropogon spp.	Bluestems	1	1	
Aristida stricta	Wiregrass	2	1	**
Dichanthelium spp.	Panicum grasses	33	7	**
Ilex glabra	gallberry	15	12	
Serenoa repens	Saw palmetto	7	4	
Above species total		60	25	

** Significant at the p = 0.01 level, SAS ANOVA procedure.

Stimulation of a weed species by use of a particular herbicide might not be important if the stimulated weed is not a serious competitor. However, if the opposite is true, then use of the herbicide might not have gained any advantage for the released pines.

In another flatwoods pine release trial, three single herbicides and one combination, were applied at two rates in May 1984 to 2-year-old slash pine competing with typical flatwoods species (Table 3). This same group of six species discussed previously made up 60 to 90% of the plant cover on the site. After 90 days, only Escort® had much palmetto control. Both rates of Arsenal® and Escort®, as well as the high rate of Garlon® (triclopyr) achieved more than 33% control of gallberry. Both Arsenal® rates as well as both rates of the Velpar®-Oust® combination (hexazinone and sulfometuron methyl) produced >86% control of the panicum grasses. Wiregrass was resistant to everything but Arsenal®. Only Arsenal® produced some control of the chalky bluestem grasses. The rest of the herbicides resulted in a stimulatory effect on chalky bluestem.

These results are very preliminary and are being confirmed by additional release trials on other sites. Arsenal®, which had the longest weed control effect, produced 55 to 65% terminal damage. However, this problem may have been corrected by a recent formulation change. Escort® may be effective on resistant weeds like gallberry at rates much lower than tested here upon addition of foliar penetrants like Cidekick®. Combinations like Velpar® and Oust® produced the least pine terminal damage and mortality, but they need to be tested at higher rates. Other trials with herbicides like Roundup® (glyphosate), not tested here, indicate that resistant flatwoods weed species like gallberry and chalky bluestem can be controlled at rates which should not produce significant pine mortality.

Table 3. Preliminary results of the efficacy of five herbicides applied to a typical flatwoods site to release slash pine, 1984, 90 days after application.

Herbicide	rate	Weed species or group[1]				
		Palmetto	Gallberry	Panicum	Wiregrass	Chalky bluestem
	lb/ac	——— % control ———				
1. Arsenal	1.00	2	37	92	64	0
	2.00	6	41	99	56	30
2. Escort	0.33	44	41	25	9	0 *[2]
	0.66	52	68	35	16	0 *
3. Garlon 4a	0.75	15	28	20	2	0 *
	1.50	36	58	22	9	0 *
4. Velpar L	0.26/0.25	0	21	86	6	0
+ Oust	0.39/0.25	0	21	96	13	0 *
5. Control		0	0	0	0	0

[1] See Table 2 for scientific names.

[2] Stimulatory effect, species increased in percent cover.

Data being produced by herbaceous and woody weed control studies in Florida indicate that herbicides currently available and ones under testing can be effective. Because of the early stage of our understanding of weed control in Florida's forests, it is advisable that chemical company representatives, University of Florida staff, or the Auburn Silvicultural Herbicide Cooperative be contacted for the most recent information.

POTENTIAL ACHIEVEMENTS

There is fairly substantial indication from the forestry literature that weed control enhances productivity of southern pines. A number of studies established in the South in the past decade have indicated that weed control at the establishment of a stand can increase biomass production by four- to twelve-fold (Bengston and Smart 1981; Nelson et al., 1981). Weed control on some sites can increase productivity by 300% over a 10-year period (Hebb 1981). There is also good information that weed control some 7 to 15 years after planting can increase stand volume 15 to 30% (Clason, 1984, Plenarr et al., 1983). Implications for productivity increases over the whole rotation are discussed by Glover (this volume). These increases, combined with generally lower chemical site preparation costs, indicate that substantial productivity increases can still be obtained from coastal plain pine forests.

Because of the rapidly shrinking forest landbase in the Southeast and the need to maintain or increase future regional wood product supplies, forest productivity must be increased. The Intensive Management Practices Assessment Center (IMPAC) at the University of Florida has initiated a series of studies to determine the factors limiting the growth of slash and loblolly pine

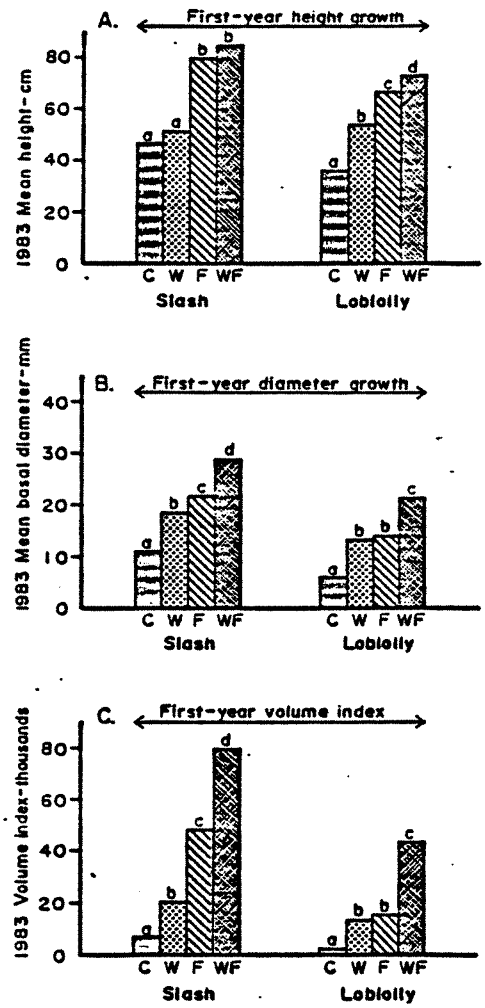

Figure 1. (A) First-year height growth; (B) Basal diameter growth; and (C) Volume index for slash and loblolly pine, by treatment, on flatwoods spodosols, 1983. Means not followed by the same letter are significantly different at the p = 0.05 level. (Legend: C- untreated control; W- weed control; F- fertilized; and WF- combination of weed control and fertilized. (From Neary et al., 1985.)

(Comerford et al., in press). One study was set up to investigate the interactions of weed control and fertilization on the growth of slash and loblolly pine on a typical flatwoods spodosol (Neary et al. 1985).

This study consisted of three replications of a randomized split block design with four treatments (untreated, weed control, fertilized, and weed control plus fertilizer). The fertilizer regime was based on a maximum growth sequence (Woods 1976) and included all essential elements timed to coincide with tree growth flushes. Weed control consisted of mechanical plus Oust® applied in April (0.5 lb/ac a.i.) and in June (0.25 lb/ac a.i.) of 1983 and directed application of a 2% solution of Roundup® in early May for the next 2 years.

During the first growing season slash and loblolly pine height, diameter, and volume growth were significantly increased by weed control alone and in combination with fertilizer (Figure 1). Weed control, with and without fertilizer, extended the growing season by 60 to 100 days and resulted in four to five growth flushes vs. two to three for untreated trees. Weed control eliminated light, moisture, and nutrient competition and allowed the trees to approach their biological potential. Also, any allelopathic actions from competition was effectively eliminated. Thus, the true productivity enhancement of fertilization was realized with removal of competing weeds.

Two growing seasons later these trends have only magnified. Data are currently being analyzed to determine the exact responses. However, it is visually obvious that competition from woody, grass, and broadleaved weeds in the flatwoods has severely limited the growth of both slash and loblolly pine. During the first year, untreated trees were growing at only 2% of their potential.

CONCLUSIONS

Herbicides are now becoming an operational silvicultural tool in the intensively-managed forest of Florida's coastal plain. There are a number of effective herbicides currently registered or in the process of being registered. Because of the complex nature of weeds in Florida's forests, these herbicides will have to be selectively prescribed. Field trials are currently in progress to further refine our information on efficacy. Herbicides have the potential to increase productivity in a cost-effective manner. Foresters will need to stay up-to-date on this rapidly-changing field to efficiently transfer this technology into operational use.

LITERATURE CITED

Bengston, G.W., and G.C. Smart, Jr. 1981. Slash pine growth and response to fertilizer after application of pesticides to the planting site. For. Sci. 27:487-502.

Broerman, F.S., T.I. Sarigumba, and M.J. Immel. 1983. Chapter 8: Site preparation and slash pine productivity. Pp 131-149 In: E.L. Stone (ed), The Managed Slash Pine Ecosystem Proceedings, 9-11 June 1981.

Clason, T.R. 1984. Hardwood eradication improves productivity of thinned loblolly pine stands. South. J. Appl. For. 8:194-197.

Comerford, N.B., L.F. Conde, W.R. Marion, D.G. Neary, H. Riekerk, D.L. Rockwood, B.F. Swindel, and R.C. Wilkinson. In press. IMPAC assesses biological potential of southern pines. USDA Southeastern For. Exp. Stn. Res. Note, 8 p.

Crutchfield, D.M. and J.P. Martin. 1982. Site preparation-Coastal Plain. Pp 49-57 In: R.C. Kellison and S. Gingrich (ed), Proceedings Symposium on Loblolly Pine Ecosystem, Raleigh, NC, 9-10 December 1982. North Carolina State Univ. 335 pp.

Gjerstad, D.H. 1981. Chemical weed control in southern forests. Pp 116-120 In: H.A. Holt and B.C. Fischer (ed), Weed Control in Forest Management, Proceedings, J.S. Wright Forestry Conference, Purdue Univ., Lafayette, IN. 305 pp.

Guldin, R.W. 1983. Site preparation costs in the southern region-an update. USDA Forest Service, Southern Forest Experiment Station Res. Note SO-292, 3 pp.

Hamel, D.R. 1983. Forest management chemicals. USDA Forest Service Agricultural Handbook No. 585. 645 pp.

Hebb, E.A. 1981. Choctawhatchee sand pine growth on a chemically prepared site--10 year results. South. J. Appl. For. 5:208-211.

Kerr, E. 1982. Herbicides offer promise for lower site preparation costs. For. Farmer 41(10):6-7, 15-16.

Miller, J.H. 1984. Where herbicides fit into forest management schemes. Pp 1-13 In: Proceedings 4th Annual Forestry Forum, Herbicides: Prescription and Application, Clemson Univ.

Moore, W.H., B.F. Swindel, and W.S. Terry. 1982. Vegetative response to clearcutting and chopping in a north Florida flatwoods forests. J. Range Manage. 35:214-218.

Morris, L.A., and W.L. Pritchett. 1982. Nutrient storage and availability in two managed pine flatwoods forests. Pp. 17-26 In: S.S. Coleman, A.C. Mace, and B.F. Swindel (ed), Impacts of Intensive Forest Management Practices, Univ. Florida.

Neary, D.G., L.A. Morris, and B.F. Swindel. 1984a. Site preparation and nutrient management in southern pine forests. Pp 121-144 In: E.L. Stone (ed), Forest Soils and Treatment Impacts, Proceedings Sixth North American Forest Soils Conference, June 1983, University of Tennessee, Knoxville.

Neary, D.G., L.F. Conde, and J.L. Smith. 1984b. Effects of sulfometuron methyl on six important competing species in coastal plain flatwoods. Proc. South. Weed Sci. Soc. 37:193-199.

Neary, D.G., T.E. Cooksey, N.B. Comerford, and P.B. Bush. 1985. Slash and loblolly pine response to weed control and fertilization at establishment. Pp. 246-253 In: Proceedings, Southern Weed Science Society; Challenges in food production. 38th annual meeting, 1985 January 14-16; Houston, TX.

Nelson, L.R., R.C. Pederson, L.L. Autry, S. Dudley, and J.D. Walstad. 1981. Impacts of herbaceous weeds in young loblolly pine plantations. South. J. Appl. For. 5: 153-158.

Pienaar, L.V., J.W. Rheney, and B.D. Shiver. 1983. Response to control of competing vegetation in site prepared slash pine plantations. South. J. Appl. For. 7:38-45.

Pritchett, W.L. and L.A. Morris. 1982. Implications of intensive forest management for long-term productivity of Pinus elliottii flatwoods. Pp 27-34 In: S.S. Coleman, A.C. Mace, and B.F. Swindel (ed), Impacts of Intensive Forest Management Practices, Univ. Florida.

Stewart, R.E. and C. Row. 1981. Assessing the economic benefits of weed control in forest management. Pp 26-53 In: H.A. Holt and B.C. Fischer (ed), Weed Control in Forest Management, Proceedings, J.S. Wright Forestry Conference, Purdue Univ., Lafayette, IN. 305 pp.

Swindel, B.F., L.F. Conde, and J.E. Smith. 1982. Effects of forest regeneration practices on plant diversity and succession in Florida ecosystems. Pp. 5-16 In: S.S. Coleman, A.C. Mace, and B.F. Swindel (ed), Impacts of Intensive Forest Management Practices, Univ. Florida.

Woods, R.V. 1976. Early silviculture for upgrading productivity on marginal Pinus radiata sites. Southeastern Region, South Australia Woods and Forest Dept., So. Australia Bull. 24.