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Chemical Control of Inferior Species in the Management of Loblolly Pine[1]

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THE FORESTER'S JOB, if he is concerned with producing tree crops, is to grow the largest volume of the most valuable species. Thus, in practically every timber region in the United States, foresters encounter the problem of limiting the growth of less valued species which inhibit high production of the preferred species. Often these less desired species are utterly worthless and are referred to simply as "brush." For example, laurel and rhododendron slicks cover vast areas in the Southern Appalachians that could produce valued tree crops. Yaupon in East Texas, hazel brush and alder in the Lake States, and manzanita and bear clover in California are other examples of brush that reduce yields and often entirely exclude the valuable tree species.

Brush is not the only problem. Conifers such as pitch pine and shortleaf pine are favored over such hardwoods as black oak, white oak, and chestnut oak on the sandier soils of New Jersey and Pennsylvania. These oaks are classed as desirable in the Southern Appalachians and other oaks are discriminated against. In some regions certain conifers are favored over other conifers, such as western white pine over western hemlock and grand fir in Idaho. Weeds in the forest are notoriously as aggressive and as hard to control as those in the garden. In some areas weed species have taken over huge acreages of forest land.

In the loblolly pine region of the Carolinas, the problem of aggressive hardwood weed species is particularly acute. During the past two decades there has been a steady building up of dense undergrowths, mainly of inferior oaks and gums with local associations of southern waxmyrtle, gallberry, and hickories. Their growth rate is accelerated when released by the removal of the pine overstory, and competition with the pine reproduction becomes quite severe. On many sites there is a very definite type conversion—from pure pine to pine-hardwood mixtures, and eventually, perhaps to almost pure hardwoods. A recent forest survey of South Carolina shows that the upland hardwood type, which in 1936 occupied 0.7 million acres, totaled 1.4 million acres in 1947—an increase of 100 percent in less than 12 years.

This problem is not being ignored. A rather surprising number of individuals and agencies are working on it, and there are almost as many solutions as there are investigators.

The inferior species *can* be controlled—by prescribed fire, by mechanical methods, by chemicals, and by an assortment of such manual methods as weeding, girdling, and felling. While each technique has certain advantages, none is universally applicable to all forest conditions, to all sites, and to all systems of management.

Of all these techniques, chemical

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control has captured the fancy of many forest managers. So far we have no truly selective silvicide—one that will kill our oaks and gums without injury to the pines. Nor do we have a single chemical that is equally toxic to all species. We have no single technique that is applicable to all conditions. But we *do* have some useful chemicals and techniques.

Investigations in the use of chemicals for the control of inferior species in the flatwoods of North and South Carolina show that there are two major problems: first, to find the best chemical to do the job, and second, to find the best way to get it into the tree. Three chemicals have a real place in the control of woody species: 2,4-D, 2,4,5-T and ammonium sulfamate (commonly called by the trade name "Ammate"). A fourth, sodium arsenite, is probably the most effective silvicide that we have, but unfortunately its high toxicity to man and beast precludes its widespread use. Several other chemicals are available for minor and special uses.

Although there are only three principal chemicals, we have a variety of formulations to choose from. There are the various metallic and amine salts and the esters of 2,4-D and 2,4,5-T, and these may be carried in either water or petroleum oil. Furthermore, it is reported that they can be made more effective by the addition of other chemicals.

We have applied these chemicals to the brush in just about every imaginable way: to succulent foliage and to mature foliage; to skinned bark and to normal bark; to notches, frills, holes, girdles, stumps, and incisions; to tiny sprouts and to trees 46 inches d.b.h.; in low concentrations and in high concentrations (and many in between); in light doses and in heavy doses; spring, summer, fall, and winter; and to a dozen tree and shrub species.

Final results of all these tests are not yet available, but we have a number of observations; we can offer a few conclusions, and make a few predictions.

Foliage Sprays

With foliage sprays, it is first necessary to reduce trees and brush down to the ground by the use of fire or other means, and spray 1- or 2-year-old sprouts. Any small pine trees among the brush have a poor chance of surviving, for either the fire or the chemical spray will kill them. Thus, foliage sprays are restricted to even-aged management.

In our early work with foliage sprays we used the cheapest chemicals available—the aqueous solutions of the metallic salts and amine forms of 2,4-D. Only during a short period of the summer—about the time of the formation of the terminal bud—were they reasonably effective in killing the root stocks of our local species. The sodium salt and the amines were even less effective than the ammonium salt.

We had much better success with emulsions of the esters of 2,4-D and still better control with 2,4,5-T—at any time during the growing season, except during the early spring. All our species are susceptible, but we do have resprouting from some of the oaks.

Our best foliage spray to date, is a 0.25-percent emulsion of 2,4,5-T ester (acid equivalent by weight); that is, 2500 parts per million. At present prices 2,4,5-T costs about $3 a pound, so that a 0.25-percent emulsion costs roughly 6 cents a gallon. Depending upon the amount of brush to be ical cost may range from $3 to $6 an acre. To this must be added the treated, from 60 to 100 gallons an acre are needed. Thus, the chem- cost of the prescribed burn and the cost of spraying. The entire operation could well cost from $7 to $10 an acre.

It is hard to tell whether this type of treatment is worth-while on a large scale. It requires fairly heavy equipment and a large supply of water. It requires a preparatory fire, or, if the trees are several inches in diameter, some sort of brushing or mechanical destruction. Our present opinion is that foliage sprays will have only limited use in the silviculture of our region. Perhaps their best use will be in the maintenance of rights-of-way.

Cut Surfaces

Another way to apply chemicals is to introduce them into the stems through some sort of cut, such as notches, frills, or stumps. Since this is a selective method—individual trees are treated—it can be done without injury to surrounding pine reproduction.

Most forest managers are familiar with the excellent work of Peevy and others in the use of "Ammate" crystals in notches or cups. This is quite effective and useful in eliminating large trees. Peevy estimates the chemical cost at about 3 cents per 10-inch tree.

Small trees—below 3 or 4 inches d.b.h.—may be cut down and "Ammate" crystals placed on the top of the stump. Instead of using "Ammate" we might spray the top and sides of the stump with 3 percent 2,4,5-T in a kerosene or diesel oil carrier. We have had practically no resprouting of any local species from sprayed stumps. Even lower concentrations, down to 1 percent will give fair control for some species. The chemical cost, using "Ammate," is about ½ to 1 cent per small stump. Spraying with 2,4,5-T costs about ¼ to ½ cent per stump of 3- or 4-inch trees.

"Ammate" in water solution or 2,4,5-T as an emulsion gives excellent control for most species when poured into single-hack girdles or frills. This method is cheaper than notching, for a little chemical does a lot of work. It is even cheaper than stump spraying because water can be used as a carrier instead of the more costly kerosene. Using a 1-percent 2,4,5-T emulsion, the chemical cost of frill applications is from ½ to 1 cent per 10-inch tree. We have had excellent results, for some species, with even lower concentrations of 2,4,5-T—as low as 0.5 percent, acid equivalent, in frills—with correspondingly lower costs. To find a low-cost, all-purpose, all-species tree killer, we are presently testing mixtures of 2,4,5-T with "Ammate" in low concentrations.

Holes, blazes, incisions, and other cut surfaces have been tried, but we have not pursued any of these far enough for this report. It seems reasonable that any method would work that introduces a sufficient quantity of the toxic material into the conducting tissues of the tree.

The question is often raised as to the necessity of poisoning large trees; perhaps simple girdling is all that is needed. If there is no urgency for the immediate kill of the crowns of the offending trees, and if sprouting is not objectionable, why poison? Some of the cut surface methods, however, particularly those that use a minimum of chemicals, are actually cheaper than girdling. If they do a better job of killing the tree and also reduce or prevent resprouting, why not poison?

Basal Sprays

Still another way to get a chemical into the tree—a way that promises to be even cheaper than the others—is to spray it on the bark. This method offers real savings in labor costs. However, it is necessary to strike a neat balance with the chemical, for high concentrations or excessive dosages could well run into prohibitive costs.

Basal sprays (variously called bark, stem, trunk, or dormant sprays) consist simply of spraying a band of bark at the base of the tree. Our studies of this method are not yet complete, but an effective treatment seems to be 2 or 3 percent 2,4,5-T in oil, on a 2-foot wide band circling the tree. Research is under way to test the use of water carriers with added oil penetrants; this could further reduce the cost of treatment.

Trees that are basal-sprayed during the dormant season (when it is easy to do) usually leaf out in the spring. Some species, such as ironwood, myrtle, and gallberry die soon thereafter; others, such as sweetgum and hickory, die slowly. Spraying may be done at any time of the year.

Even though large trees—20 to 30 inches in diameter—can be killed, it is our guess that basal sprays can best be used in the control of small stems, perhaps up to 4 inches d.b.h. In our problem areas, we have thousands of these per acre—too large for prescribed fire, too many for efficient notching or frilling, and where pine reproduction is intermingled, too risky for any other non-selective treatment. Under these conditions, the pine can be released by spraying the basal portion of the inferior competitors. Our studies in chemical weeding show that this costs no more than standard machete weeding, and will be more permanent.

What is the place of chemical control? We are aware that the situation changes as cheaper and more effective chemicals and techniques are developed. At present it does not offer a complete solution to the problem of inferior species in the Carolinas. But, neither does any other method. So, we recognize the merits of chemical control and include it in our methods along with prescribed fire, mechanical devices, and the manual tools.