FERTILIZERS CHANGE SUSCEPTIBILITY OF HARDWOODS TO 2,4,5-T

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ABSTRACT. Fertilizing with 200 pounds per acre of nitrogen, phosphorus, or both decreased susceptibility of sweetgum to foliar treatment with a 2,4,5-T ester. Susceptibility of post oak was unaffected by nitrogen fertilization, but addition of phosphorus increased it. Phosphorus application also increased the susceptibility of red maple to foliar sprays of 2,4,5-T. Susceptibility of loblolly pine was not affected by fertilization.

Agronomists learned early that the response of both weeds and crops to applied herbicides was altered when the treated area was fertilized. With interest in fertilizing of southern pine forests increasing, it becomes essential to determine the effects of such treatment on the response of woody plants to herbicides commonly used in forest management. This paper reports responses of three hardwood and one pine species fertilized and treated with 2,4,5-T.

Procedures

Seedlings of sweetgum (*Liquidambar styraciflua* L.), post oak (*Quercus stellata* Wangenh.), red maple (*Acer rubrum* L.), and loblolly pine (*Pinus taeda* L.) were grown for 1 year in 6-inch plastic pots that contained a sandy loam soil of the Ruston series. Sixteen plants of each species were then selected for uniform size. One group of four seedlings of each species was assigned to each of four treatments: (a) an unfertilized check, (b) 200 pounds per acre of N applied as ammonium nitrate, (c) 200 pounds per acre of P applied as phosphoric acid, and (d) 200 pounds per acre of N and P. Fertilizers were applied in four increments of 50 pounds per acre of the elemental nutrient at 2-week intervals.

Four weeks after the final application the foliage of each seedling was treated with ½ ml. of a water solution of the isooctyl ester of 2,4,5-T. The concentration was 4 pounds ae per 5 gallons. To each dose 0.3 μc of C^{14} in 2,4,5-T was added. The herbicide was applied to the foliage with a hypodermic syringe to assure uniform distribution and control of the chemical.

Ninety-six hours after herbicide application, all plants were harvested. Each was cut into top and root portions at the junction of the lowest branch or leaf. The tops were washed with water, then rinsed in ethyl alcohol to remove all dirt and unabsorbed herbicide. The lower sections were washed with water to remove all dirt. All samples were ovendried at 60° C. and weighed. The

two sections of each treated plant were analyzed separately for labeled 2,4,5-T content by standard extraction, cleanup, and liquid-scintillation counting procedures.

Combined counts for the two samples from a single plant were taken as a measure of total absorption, that from the roots as downward translocation. All results were analyzed statistically, and only differences significant at the 5-percent level are reported.

Results and Discussion

Fertilizing with nitrogen and phosphorus alone or in combination increased the growth of all three hardwood species (table 1). The treatments did not significantly influence growth of loblolly pine seedlings.

Table 1.--*Average dry weight of tops of woody plants 3 months after fertilizer application*

Fertilizer treatment	Sweetgum	Post oak	Red maple	Loblolly pine
		Grams		
None	7.7a[1/]	6.7a	6.1a	5.2a
200N	18.7b	18.4bc	18.9c	4.9a
200P	11.1b	13.8b	13.4b	11.0a
200N, 200P	23.0b	19.7c	24.0c	11.2a

1/ For a given species, values followed by the same letter do not differ significantly at the 5-percent level by Duncan's new multiple range test.

All fertilizer treatments on sweetgum and nitrogen fertilization on post oak decreased absorption of 2,4,5-T ester (table 2). These decreases may be of practical significance. Peevy and Brady (*2*) observed that 2,4,5-T ester was not as effective on mixed brush on a bottom-land site as on the same species on upland sites. They had expected the herbicide to be more effective in the bottom lands due to more favorable moisture relationships. Decreased effectiveness may have been due to the greater fertility of the bottom-land soils. Fisher *et al.* (*1*) reported higher kills of mesquite with 2,4,5-T on sandy soils than on adjacent clay soils, even when moisture conditions were favorable on both sites and stage of growth was identical. They concluded that the differences were due to higher fertility of the clays, the nature of the root systems, and the greater physiological resistance of plants growing on more favorable sites.

Phosphorus fertilization increased absorption of 2,4,5-T by post oak and red maple. Selman and Upchurch (*3*) reported similarly that increases in available phosphorus lessened the amount of several herbicides required to reduce growth of annuals by 50 percent.

None of the fertilizer treatments affected the absorption of 2,4,5-T by loblolly pine.

Table 2.--*Absorption of C^{14} labeled 2,4,5-T ester 96 hours after foliar application*

Fertilizer treatment	Sweetgum	Post oak	Red maple	Loblolly pine
	- - - - - - - - - - *Counts per minute* - - - - - - -			
None	3,213b[1/]	2,542b	1,965ab	1,896a
200N	1,865a	1,732a	2,775bc	2,396a
200P	1,197a	3,360c	2,912c	1,927a
200N, 200P	1,846a	2,517b	1,526a	2,060a

1/ For a given species, values followed by the same letter do not differ significantly at the 5-percent level by Duncan's new multiple range test.

Conflicting results demonstrate that absorption of 2,4,5-T applied to foliage is affected differently by fertilization in different woody species. In one species, post oak, the response to nitrogen fertilization was the reverse of that to phosphorus.

Another measure of treatment success is the amount of herbicide translocated from the leaves to the roots. To kill a plant 2,4,5-T must reach all parts in lethal amounts. In new leaves it causes early browning and defoliation, but the plants frequently recover rapidly since the herbicide is lost from the plant in the fallen leaves.

More 2,4,5-T ester was found in the roots of post oak fertilized with nitrogen and nitrogen plus phosphorus than in the unfertilized checks, but less was found in the roots of sweetgum following phosphorus and phosphorus plus nitrogen fertilization (table 3).

An indicator of the efficiency of downward translocation is the percent of absorbed 2,4,5-T that was recovered from the roots. Nitrogen fertilization increased efficiency of translocation in sweetgum and post oak but decreased it in red maple (table 3). Phosphorus application raised the efficiency of 2,4,5-T translocation in sweetgum but not post oak and red maple. The combination fertilizer treatment did not affect translocation in sweetgum or red maple, but increased it in post oak. It must be noted that two of the three increases in efficiency were the result of lower total absorption rather than higher translocation.

When either herbicide absorption or effective translocation is altered without other compensating changes in the treated plants, it can be assumed that the susceptibility of the plants has changed. By these criteria, phosphorus and phosphorus plus nitrogen fertilization increased the susceptibility of post oak to 2,4,5-T, and phosphorus fertilization increased that of red maple. Resistance of loblolly pine did not appear to be influenced by fertilizer application. Apparent resistance of sweetgum was increased.

Table 3.--*Translocation of C^{14} labeled 2,4,5-T ester to roots 96 hours after foliar application*

Species	Fertilizer treatment			
	None	200N	200P	200N, 200P
	ACTIVITY IN ROOTS			
	Counts per minute			
Sweetgum	393a[1/]	424a	281b	287b
Post oak	223b	339a	315ab	420a
Red maple	273a	190a	228a	278a
Loblolly pine	133a	117a	180a	176a
	PROPORTION OF TOTAL ACTIVITY IN ROOTS			
	Percent			
Sweetgum	12b	23a	23a	16ab
Post oak	9b	20a	9b	17a
Red maple	14a	7b	8ab	18a
Loblolly pine	7a	5a	9a	9a

1/ For individual species, values followed by the same letter do not differ significantly at the 5-percent level by Duncan's new multiple range test.

Firm conclusions about susceptibility must await field tests, but the changes reported here appear to be large enough to affect treatment success. Hence, brush-control measures may well have to be modified in pine plantations that are fertilized.

Literature Cited

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