HOW TO DETERMINE WHETHER FOREST FERTILIZATION PAYS

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ABSTRACT

Calculations to determine whether fertilization pays can be made in four different ways. Rate of return on the investment is the traditional method. Calculating the volume increase needed, the timber value needed, or the fertilization costs needed are other methods the landowner may find easier to understand. Each method is demonstrated for fertilizer applied to sawlog-size red oak trees in north-central West Virginia.

INTRODUCTION

Several timber industries are fertilizing forest land as part of an intensive timber management program (Jones and Broerman 1978). Most of this is being done in the South with species managed under a short rotation for fiber production. Can a forest landowner afford to fertilize sawlog-size hardwoods? We present a method for the forest manager to determine whether fertilizing pays. A research study on sawlog-sized red oak trees in north-central West Virginia is used as an example to calculate the economics of fertilizing.

METHOD

An economic evaluation of fertilizing a forest stand can be done in several ways. It all depends on which values are known, or given, and which values you feel most comfortable estimating. Some people want to know what the rate of return on the investment will be. This requires a fairly accurate estimate of the future product value. Estimating future value is complicated by fluctuations in the rate of inflation and in supply and demand for a product.

If you are not comfortable with estimating the rate of return, then possibly other methods of calculation would be better. We propose the following formulas to calculate what is needed for fertilization to be profitable.

(1) Rate of Return

$$(1 + i)^n = \frac{\text{Value increase due to fertilizing}}{\text{Cost of fertilizing}}$$

(2) Volume Increase Needed = $\frac{\text{End value of fertilization costs}}{\text{Timber value}}$

(3) Timber Value Needed = $\frac{\text{End value of fertilization costs}}{\text{Expected volume increase}}$

(4) Fertilization Costs Needed = Discount to present (Timber value x Expected volume increase)

where: end value of fertilization costs = present fertilization costs times $(1 + i)^n$

and discount to present = future value divided by $(1 + i)^n$

i = interest rate
n = number of years for calculation

If you know any two of the three values (fertilization costs, volume growth, or value of timber), then the third can be calculated. The calculated value will indicate what change is needed for the fertilization to pay. If you, as the timber manager, think this calculated value can be attained, then fertilize.

In most cases, the alternative rate of return is fixed. That is, the investor knows what interest rate he can expect if he invests his money in a savings account. Also estimating future inflation rate, demand and supply for the product is very difficult. Therefore, formula 1 is of little aid in deciding whether to fertilize. However, formulas 2, 3, and 4 offer opportunities for the landowner to exercise some control by selecting the most profitable combinations of fertilizer rates and types to produce an expected growth and to demand a certain price for the timber.

A CASE STUDY

Background

In 1970 a fertilizer trial was established in Tucker and Randolph Counties of north-central West Virginia. This area of rugged mountainous terrain receives about 60 inches of annual precipitation and has a frost-free period of about 150 days. Soils are well-drained silt loams, about 3 feet deep to sandstone and shale bedrock, belonging to either the Gilpin or Calvin series (Typic Hapludults and Typic Dystrochrepts). Red oak site index for the study areas range between 65 and 75.

Four areas located in fully-stocked, even-aged hardwood stands 50 to 70 years old were used for this study. The treatment response was measured for only 78 dominant and codominant red oak (*Quercus rubra* L.) trees (not all trees on the plot were measured).

The trees measured were equipped with aluminum band dendrometers at 4.5 feet. Diameter was recorded to the nearest .01 inch.

Five fertilizer treatments were evaluated:

C = no fertilizer

P = 200 lb P_2O_5 per acre

N = 300 lb N per acre

NP = 300 lb N + 200 lb P_2O_5 per acre

NPK = 300 lb N + 200 lb P_2O_5 + 100 lb K_2O per acre

The fertilizers are urea, triple superphosphate, and muriate of potash.

Statistical analyses of basal area growth have been reported (Auchmoody and Smith 1977, Lamson 1978). We use a 7-year volume growth for our example.

The average dbh of the trees at the beginning of the treatments ranged from 14.4 to 14.8 inches (table 1), and growth was greatest for P-fertilized trees.

The average volume change for each of the control trees was 60 board feet. By fertilizing, the average volume increase over the control was 6 to 14 board feet (table 1).

Assumptions

We assume that the average 65-year-old red oak stand in north-central West Virginia would contain 50 dominant or codominant trees per acre like those fertilized in this study. Thus, the 7-year volume growth of the red oak trees ranged from 3,000 to 3,700 board feet per acre.

We assumed an alternative rate of interest of 6 percent--the interest earned by a savings account.

The cost of fertilizing was assumed to be $54/acre for 200 lb. P_2O_5/acre as triple superphosphate, which was based on the fertilizer cost of $150/ton. The application cost was .05/lb. These are current operational costs.

The value of the timber was set at $80/M bf--the current stumpage price for red oak in north-central West Virginia.

We used the formulas presented, and calculated:

Rate of Return (formula 1)

$$(1 + i)^n = \frac{\text{Value increase due to fertilization}}{\text{Cost of fertilizing}}$$

$$(1 + i)^7 = \frac{.7 \text{ M bf/acre} \times \$80/\text{M bf}}{\$54/\text{acre}} = \frac{\$56}{\$54} = 1.037$$

Compound interest tables showed that i = 0.52 percent.

Table 1. Average dbh and 7-year volume growth of red oak trees after fertilization treatments

Treatment	Dbh		7-year volume growth[a]	
	Initial	End	Growth	Increase
	----Inches----		---Board feet---	
C	14.8	16.4	60	--
P	14.9	16.9	74	14
N	14.4	16.2	67	7
NP	14.8	16.6	71	11
NPK	14.4	16.1	66	6

[a] International 1/4-inch rule.

Volume Increase Needed (formula 2)

$$V = \frac{\text{End value of fertilization costs}}{\text{Timber value}}$$

$$V = \frac{\$54/\text{acre} \times (1.06)^7}{\$80/\text{M bf}} = \frac{\$81.1944/\text{acre}}{\$80/\text{M bf}} = 1.015 \text{ M bf/acre}$$

Timber Value Needed (formula 3)

$$T = \frac{\text{End value of fertilization costs}}{\text{Expected volume increase}}$$

$$T = \frac{\$54/\text{acre} \times (1.06)^7}{.700 \text{ M bf/acre}} = \frac{\$81.1944/\text{acre}}{.7 \text{ M bf/acre}} = \$115.992/\text{M bf}$$

Fertilization Costs Needed (formula 4)

C = Discount to present (Timber value x Expected volume increase)

$$C = \frac{\$80/\text{M bf} \times .700 \text{ M bf/acre}}{(1.06)^7} = \frac{\$56/\text{acre}}{1.5036} = \$37.24/\text{acre}$$

CONCLUSION

Remember, this is a case study, and general conclusions about forest fertilization cannot be drawn from these data. Although our data show that fertilizing these red oak trees in West Virginia did not produce enough volume growth to make 6 percent interest, it did return a small profit of $2. The additional 1,015 board feet per acre in volume growth needed to make 6 percent is about a 34 percent increase in volume growth over the 7 years. This may be possible to achieve with other types of fertilizers. The value needed of $116/M bf is not unreasonable to expect by the year 1985, given the current rate of inflation and the increasing demand for high-quality sawtimber.

Our purpose is to show a simple method that a forest manager can use to estimate whether fertilizing pays. Of the equations presented, the third one, Timber Value Needed, is the best to use.

Fertilization costs and expected yields from fertilizing can be obtained from current data and information. By comparing the calculated timber value needed to the current stumpage value, you can see what changes would be necessary to make fertilization pay.

LITERATURE CITED

Auchmoody, L. R., and H. Clay Smith. 1977. RESPONSE OF YELLOW-POPLAR AND RED OAK TO FERTILIZATION IN WEST VIRGINIA. Soil Sci. Soc. Am. J. 41(4): 803-807.

Jones, S. B., and F. S. Broerman. 1978. THE ROLE OF FERTILIZATION IN INTENSIVE FOREST MANAGEMENT. South. J. Appl. For. 2(2):34-37, illus.

Lamson, N. I. 1978. FERTILIZATION INCREASES GROWTH OF SAWLOG-SIZE YELLOW-POPLAR AND RED OAK IN WEST VIRGINIA. U. S. Dep. Agric. For. Serv. Res. Pap. NE-403. 6 pp.