

USDA Forest Service Research Note SE-233

FUEL ACCUMULATIONS IN PIEDMONT
LOBLOLLY PINE PLANTATIONS



Abstract.--Weight of minor vegetation under unthinned loblolly pine (*Pinus taeda* L.) plantations was closely related to stand age and basal area stocking. Weight of this vegetation peaked 3 years after clearcutting and planting, then diminished as the pine canopy became denser. Forest floor weight increased steadily through age 23, when it began to level off. Equilibrium forest floor weight on average Piedmont sites apparently is about 17,000 pounds per acre and is reached at about age 35.

To estimate fire intensity, smoke generation, and smoke dispersal in prescribed burns, forest managers must know how much fuel is present in the understory vegetation and on the forest floor. This Note describes the rates of fuel accumulation for unthinned loblolly pine (*Pinus taeda* L.) plantations.

Wiegert and Monk reported increasing litter production for longleaf pine (*P. palustris* Mill.) with advancing stand age.¹ Williston used age and basal area to estimate oven-dry weight of forest floor material beneath 8- to 16-year-old loblolly pine plantations.² In this Note we provide equations for predicting the weight of understory vegetation and forest floor materials when either the age or basal area of an unthinned loblolly pine plantation is known.

STUDY AREA

We studied the forest floor in 23 clearcut and planted loblolly pine stands of 23 ages on the Hitchiti Experimental Forest near Macon, Georgia. One-acre plantations were established on eroded, abandoned, farmland that had reverted to loblolly pine. After clearcutting, slash was piled and burned. No additional site preparation was used, 1-0 stock was hand planted at a 6- by 8-foot spacing. The predominant soil type is Lloyd clay loam on which the tallest planted trees have reached a height of 63 feet at age 23. Site index is estimated to be 66 at reference age 25,³ or 82 at reference age 50.⁴ Height of trees and basal area stocking of planted stands were strongly correlated with stand age. In the 23-year-old plantings, basal area is 160 square feet per acre and is beginning to level off.

¹Wiegert, Richard G., and Carl D. Monk. 1972. Litter production and energy accumulation in three plantations of longleaf pine (*Pinus palustris* Mill.). *Ecology* 53:949-953.

²Williston, Hamlin L. 1965. Forest floor in loblolly pine plantations as related to stand characteristics. USDA For. Serv. Res. Note SO-26, 3 p. South. For. Exp. Stn., New Orleans, La.

³Clutter, Jerome L., and J. David Lenhart. 1968. Site index curves for old field loblolly pine plantations in the Georgia Piedmont. Ga. For. Res. Council. Rep. 22, Ser. 1, 4 p.

⁴MacKinney, A. L. 1936. Recent site index curves for second-growth loblolly pines. USDA For. Serv. Tech. Note 22, 4 p. Appalachian For. Exp. Stn., Asheville, N. C.

STUDY METHOD

Green vegetation and forest floor material were collected separately on 10 one-quarter-acre quadrats in each plantation. Green fuels included grasses, herbs, and vines. Forest floor material included principally litter and fermentation layers, although humus was sometimes present in older stands. Composite fuel samples from the 10 sampling points were weighed. About 10 percent subsamples were drawn separately from both the green and floor fuels for oven-drying and conversion of data on the composite samples to dry weights per acre.

Scatter diagrams were made by plotting the two categories of fuel against stand age and basal area. A curvilinear trend was apparent, and regression analyses were made to determine the models that best explained the relationships of fuel weight to stand characteristics.

RESULTS AND DISCUSSION

Green vegetation.--The weight of green ground fuel was correlated with plantation age. The first growing season after clearcutting and planting, grasses, legumes, and other herbs invaded and generated close to 4,000 pounds of oven-dry weight per acre. By the end of the third year, 5,000 pounds of herbaceous fuel had developed. This material, after a frost and when cured, constitutes a flash fuel. Weight of green fuels declined rapidly during the next few years as pine seedlings overtopped the herbs, shed needles, and gradually suppressed the ground-level vegetation. At ages 14 to 20, less than 400 pounds per acre of ground vegetation were present. As pine stands get older, the height of the canopy increases and some light begins to trickle through; however, a slight increase in ground cover, especially honeysuckle (Lonicera japonica Thunb.), may occur (fig. 1).

Forest floor (LF&H layers).--Weight of the forest floor was correlated with stand age or basal area stocking. Basal area stocking was also correlated with age. This relationship is significant at the 1-percent level, with R^2 of 93.7. These relationships are illustrated in figure 1. At age 23, dry weight of the LF&H layers was nearly 16,000 pounds per acre. The rate of fuel accumulation was beginning to level off, but equilibrium weight of the forest floor had not yet been reached. However, weight loss of the forest floor from decomposition by micro-organisms was evident at age 23. In young Piedmont loblolly stands planted at 6- by 8-foot spacing, fuel loading can be predicted from age alone. However, basal area stocking, in lieu of age, will give practically the same estimate of fuel weight in stands over 7 years old. Separate curves of fuel weight over age and corresponding basal area are so close together that one cannot be distinguished from the other (fig. 1). The curve for total fuel is the sum of weights of green vegetation and forest floor material for each age class. In stands up to 4 years of age, ground vegetation constitutes most of the fuel, but as stands grow older the forest floor contributes about 97 percent to the total oven-dry fuel weight.

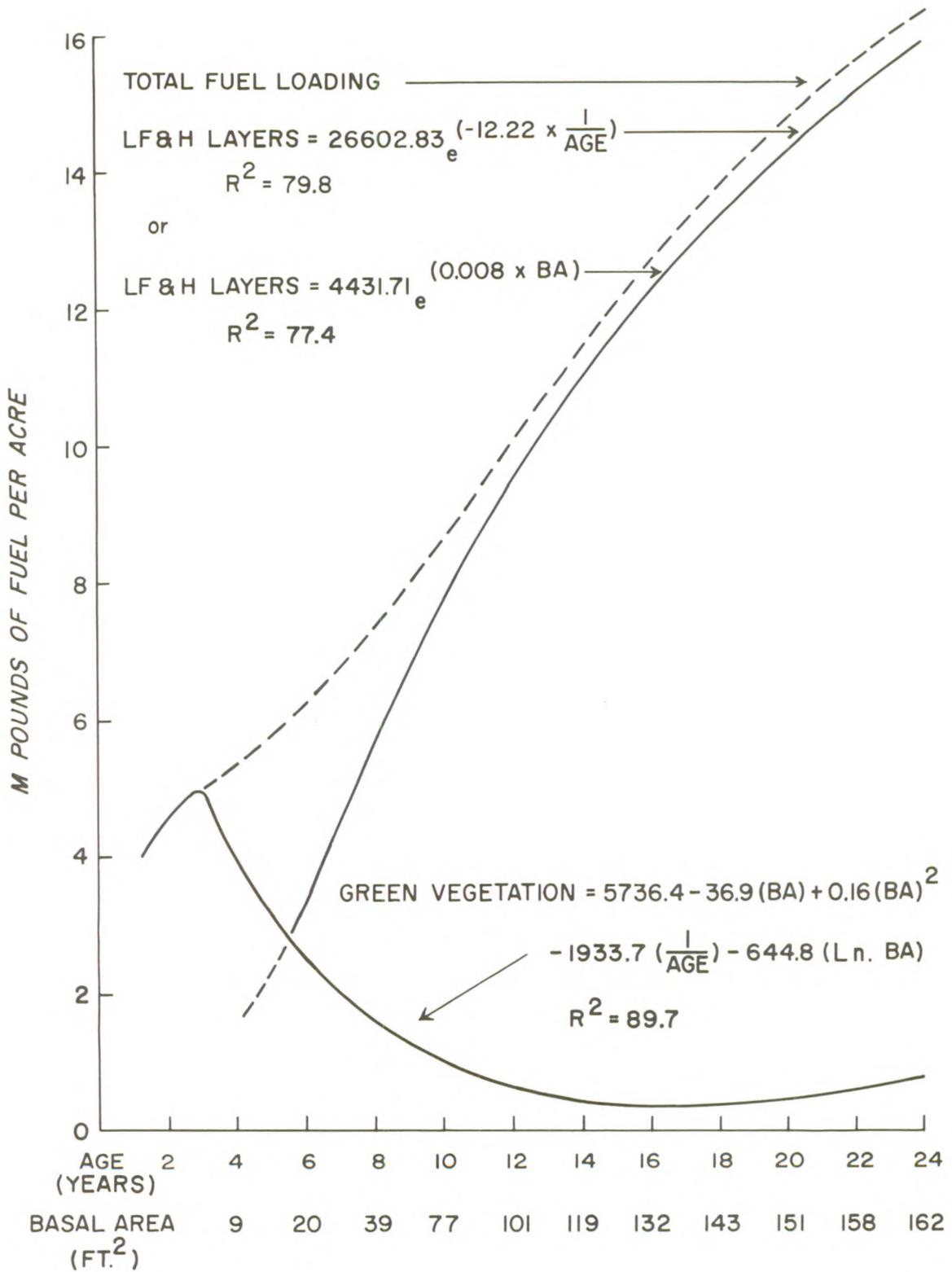


Figure 1.--Fuel accumulations in average Piedmont loblolly pine plantations ranging from 1 to 23 years old.

Equilibrium of forest floor.--To estimate when equilibrium in forest floor weight is reached in loblolly pine stands, plots were established in well-stocked natural stands of age 70 and 110. Stockings were 170 and 180 square feet of basal area per acre, respectively, and site index 82 (reference age 50). Fire had been excluded from these stands for 40 years or longer. The stands had forest floor weights of 17,190 and 17,300 pounds per acre, of which 5 percent was material one-quarter inch and larger in diameter. The humus layer in these mature stands made up 47 percent of the forest floor. In the 20-year-old stand the humus layer was not determined because there was only a small amount present. By extending and harmonizing the curves developed from the equations, it appears that the equilibrium weight of fine fuels (less than one-quarter inch in diameter) on the forest floor is about 16,500 pounds per acre and is reached on average sites at about age 34.

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