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# AN ESTHETIC ALTERNATIVE TO CLEARCUTTING?

## Deferment cutting in eastern hardwoods

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Although deferment cutting is not a practice common in the United States, it has been used in Europe to harvest some forest stands. After a deferment cutting, the residual stand resembles a seed tree cut; however, residual trees are not cut when the regenerated stand becomes established. Instead, residual trees remain until the regenerated stand is at the end of a rotation. Hence the name "deferment" cutting.

In Germany, deferment cutting is used in managing pine, larch, and oak-beech stands (Kostler 1956, Troup 1966), mainly to improve the esthetics of clearcuts. Smith (1962) described a similar concept where seed trees are left indefinitely for seed production, value, or growth purposes. Residual trees may also be retained for a long period to protect the soil, provide desired species mixtures, carry valuable timber through a period of low market prices, provide multiple products, produce veneer-size quality logs, and improve esthetics.

A type of residual tree or deferment practice for Allegheny hardwoods has been done with saplings, poles, and small sawtimber trees (Marquis et al. 1984, Bennett and Armstrong 1981). Residual trees minimize deer problems; retain tolerant species in the overstory canopy; reduce the risk of forested areas being transformed to nearly permanent savannas of grass, fern, sedge, and weeds; provide a return during the first one-third to one-half of the rotation; and produce wood and seed. This paper describes deferment cutting in 75- to 80-year-old, second-growth Appalachian hardwood stands and presents 5-year results on tree and stand responses.

A number of concerns arise when leaving 75- to 80-year-old trees for another rotation:

- Will the deferred trees withstand risks such as wind, insects and diseases, lightning, fire, ice, and snow?
- Will there be a loss of log quality due to epicormic branching?
- How many residual trees per acre can be left in a stand and not interfere with the regeneration and development of quality intolerant species?
- Will 75- to 80-year-old trees respond to release, and if so, will they produce several high-quality saw and veneer logs?
- Is deferment cutting economically feasible, and how will it affect monetary returns from timber production?

## Study Methods

In cooperation with the Monongahela National Forest, six 10- to 15-acre deferment areas were established on three ranger districts in West Virginia. All areas were on northern red oak, site index 70 or higher, except one located on an oak site index of 55. All trees 1.0 inch diameter at breast height (d.b.h.) and larger were cut except for approximately 12 to 15 deferment trees per acre. These trees, representing a basal area of about 20 square feet per acre, were selected primarily for potential timber value, using tree quality and spacing as criteria. Deferment trees were selected from high-quality dominant and codominant crown class trees with no visible evidence of decay. Though an absence of epicormic branches was preferred, about 23 percent of the deferment trees had at least one epicormic branch on the first or second 16-foot log. Long-lived tree spe-

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cies were preferred. In general, trees were selected at a bole spacing of 50 by 60 feet, and northern red oaks were favored where available.

Reproduction preharvest inventories took an average of 45 permanent points (first point established at random, remaining points fixed) in each study area. At each point, all seedlings between 1.0 foot tall and 0.99 inch d.b.h. were tallied using 1/1,000-acre circular plots, and all sapling species 1.0 to 4.9 inches d.b.h. were tallied using 1/100-acre circular plots.

Crown class, d.b.h., total height, crown width, butt log grade, log height (total log height to nearest 8-foot half log), and number of epicormic branches were determined for each deferment tree. Epicormic branch data were confined to the lower 33 feet of the tree bole. Live epicormic branches at least 1 foot in length were counted by 8-foot bole sections, allowing 1 foot for stump height.

Each deferment tree was examined before and after logging to assess damage, such as sapwood wounds and destroyed trees. The length and width of each wound was measured to the nearest inch.

Stem development (per-acre growth) was determined for the deferment trees in the study area. Dominant and codominant trees from four second-growth, uncut stands on similar sites were used for individual tree growth comparisons. These uncut stands had similar basal areas when compared to the initial deferment stands before cutting. Both areas were measured when the areas were logged and again after five growing seasons. Stumpage prices for individual species were estimated from 1986 timber sale data used by the USDA Forest Service, Monongahela National Forest. Data were analyzed using an analysis of variance with significance tested at the 1 percent level.

## Results

To date, 5-year data on only two of the six deferment cut areas is available. Results presented in this paper are based on these two sites (oak site index 70 or higher) that total 27.9 acres; and species include northern red oak (*Quercus rubra* L.), white oak (*Q. alba* L.), chestnut oak (*Q. prinus* L.), black cherry (*Prunus serotina* Ehrh.), basswood (*Tilia americana* L.), and yellow-poplar (*Liriodendron tulipifera* L.).

**Table 1. Per-acre stand data before and after logging of deferment-cut stands in central West Virginia (includes all trees 5.0 inches d.b.h. and larger).**

| Stand | No. trees | Volume[a] | | d.b.h. | Basal area | Sawtimber stumpage value[b] | |
|---|---|---|---|---|---|---|---|
| | | *bd ft* | *cu ft* | *in.* | *sq ft* | *$/ac* | *$/Mbf* |
| Initial | 154 | 16,720 | 3,148 | 12.2 | 128.8 | 1,019.05 | 60.94 |
| Cut | 141 | 13,095 | 2,604 | 11.4 | 108.4 | 626.21 | 47.82 |
| Residual trees | 13 | 3,626 | 544 | 16.9 | 20.4 | 392.84 | 108.34 |
| Residual trees after 5 years | 12 | 4,400 | 650 | 18.5 | 24.1 | 478.15 | 108.67 |

[a] Board feet for trees 11.0 inches d.b.h. and larger.
[b] Based on 1986 prices, USDA Forest Service, Monongahela National Forest, WV.

*Table 1* lists per-acre stand data before logging and immediately after logging, and residual tree data 5 years later. The stand had not been previously thinned.

*Stand characteristics.* Before logging, sawtimber trees (11.0 inches d.b.h. and larger) averaged 16,720 board feet (International log rule) per acre. The average basal area of sawtimber trees was 100 square feet and of poletimber (trees 5.0 to 10.9 inches d.b.h.) was 29 square feet. Immediately after logging, about 13 deferment trees per acre averaged 16.9 inches d.b.h., with an average basal area of 20.4 square feet and an average volume of 3,625 board feet *(table 1).* Five years after logging, the deferment trees averaged about 12 trees per acre with an average basal area of 24.1 square feet, 18.5 inches d.b.h., and a volume of 4,400 board feet.

*Logging damage.* Before logging, 361 deferment trees (an average of 12.9 per acre) were selected on the two study areas. A USDA Forest Service crew logged one area, and an industrial crew logged the other area. Logging crews were instructed to be careful not to damage any deferment trees. Trees were skidded tree length with either rubber-tired skidders and crawler tractors or a truck crane. Logging was done during the late winter and spring when the bark was loose and trees were more susceptible to injury.

Five deferment trees (1 percent) were lost during logging. Two years after logging, 11 additional deferment trees (3 percent) had died; 5 years after logging, a total of 19 trees (5 percent) had been lost. The primary causes of mortality were sunscald and windthrow. Many of the residual trees were wounded; 112 of the deferment trees (31 percent) had at least one exposed sapwood wound. Skidding caused most of the wounds, and many trees had more than one wound. Forty-five deferment trees (13 percent) had at least one wound larger than 100 square inches. In sugar maple, wounds of this size are likely to develop significant rot; however, for yellow birch significant rot can develop from a wound that is 50 square inches or larger (Hesterberg 1957, Lavallee and Lortie 1968, Ohman 1970). A total of 67 deferment trees (19 percent) had sapwood wounds smaller than 100 square inches, and 53 of these wounds were smaller than 50 square inches. Exposed sapwood wounds on the tree bole and along the surface roots at the stump averaged 187 square inches for all damaged deferment trees.

Five years after logging, exposed sapwood wounds on the damaged deferment trees were reexamined. A total of 42 (12 percent) still had at least one wound of 100 square inches or larger. Many of the wounds were developing good callous growth, but decay was developing in some of the larger wounds.

*Growth response.* Diameter growth of the 337 surviving deferment trees (12.1

***"Both intolerant and tolerant commercial species were abundant, and the overstory deferment trees did not appear to hinder stand development"***

**Table 2. Five-year d.b.h. growth response for deferment versus control trees (all sites pooled or combined).**

| Species | Treatment | No. trees | Initial d.b.h. | 5-year d.b.h. growth[a] | Percent difference |
|---|---|---|---|---|---|
| | | | ........ in. | ........ | |
| Yellow-poplar | Defer | 117 | 18.7 | 1.8 | 100 |
| | Control | 55 | 16.7 | 0.9 | |
| Red oak | Defer | 89 | 17.2 | 1.7 | 89 |
| | Control | 106 | 18.3 | 0.9 | |
| Black cherry | Defer | 9 | 17.6 | 1.4 | 40 |
| | Control | 63 | 16.2 | 1.0 | |
| Basswood | Defer | 18 | 15.4 | 1.4 | 100 |
| | Control | 11 | 17.6 | 0.7 | |
| White oak | Defer | 59 | 14.5 | 1.3 | 117 |
| | Control | 17 | 19.6 | 0.6 | |
| Chestnut oak | Defer | 12 | 14.4 | 0.9 | 80 |
| | Control | 49 | 15.3 | 0.5 | |
| Others | Defer | 33 | 15.1 | 1.5 | 114 |
| | Control | 184 | 17.5 | 0.7 | |
| All | Defer | 337 | 16.9 | 1.6 | 100 |
| | Control | 485 | 17.3 | 0.8 | |

[a]The mean difference of d.b.h. growth between deferment and control trees is statistically significant at the 1% level for all sets of data.

per acre) was measured 5 years after the initial cutting. The average d.b.h. was 18.5 inches, an increase of 1.6 inches d.b.h. over those 5 years *(table 2)*. Yellow-poplar and red oak grew 1.8 and 1.7 inches, respectively, while basswood, black cherry, and white oak growth averaged about 1.3 inches. Chestnut oak grew only 0.9 inch.

Dominant and codominant control trees grew significantly less than the deferment trees *(table 2)*. The average 5-year d.b.h. growth for all control trees was 0.8 inch; the faster growing species such as black cherry, yellow-poplar, and red oak averaged about 1.0 inch. Chestnut oak in the control areas was again the slowest growing species, averaging 0.5 inch. During the 5-year measurement period, deferment trees grew 40 to 117 percent faster than the control trees.

Initially, deferment trees averaged 280 board feet per tree, for a value of $30.22 per tree. The average price (1986) was $108.34 per thousand board feet *(table 1)*. Based on the measured 5-year diameter growth, deferment trees earned a 4 percent real rate of return. If diameter growth continues at the current rate (assuming no real increase in prices), deferment trees can be expected to earn at least 3 percent per year for the first 20 years after treatment.

*Epicormic branching.* A major concern in the deferment concept is that it seems to stimulate epicormic branching, which can reduce log grade and tree value. The number of epicormic branches on all deferment trees before and 5 years after logging was noted. Prior to treatment, 76 of the surviving deferment trees (23 percent) had at least one epicormic branch on the first (butt) or second log: three trees had them on the first log only, and 14 trees had branches on both the butt and second logs. For red oak, 25 trees (7 percent) had epicormic branches on the first or second log; white oak had 19 trees (6 percent), and yellow-poplar had 10 trees (3 percent). However, butt-log grade before cutting was not reduced on any tree due to epicormic branches.

A 5-year summary of epicormic branches for 337 surviving deferment trees indicates that white oak, red oak, and basswood had more epicormic problems than the other species *(table 3)*. However, only 20 (6 percent) had a butt-log grade reduction for this reason. Because dominant-codominant trees were selected as deferment trees, epicormic branches generally did not affect the butt log—the most valuable log in the tree. However, based on this small sample, basswood produced more epicormic branching than any other species evaluated. Thus basswood should not be selected as deferment trees if the production of quality butt logs is an objective. In addition, when branches are present on the tree bole before logging, there is a risk these trees will produce epicormic branches when selected as deferment trees. For the 20 trees with a reduction in butt-log grade due to epicormic branching, 9 had branches on the butt log before the harvest.

After 5 years, stems from the newly regenerated stand were beginning to shade the butt logs, and no subsequent increase in branching was expected. In fact, the shading was beginning to protect the boles of deferment trees, and many of the epicormic branches will probably die.

*Reproduction.* Data from the two deferment areas indicate that reproduction after 5 years was similar to what would be expected if the areas had been completely clearcut. Both intolerant and tolerant commercial species were abundant, and the overstory deferment trees did not appear to hinder stand development. There were numerous seedling- and sprout-origin stems. Reproduction counts for commercial stems at least 1 foot tall ranged from 6,000 to 18,000 per acre. The most abundant species were yellow-poplar (3,600 stems per acre) and sugar maple (2,500 stems). About 30 percent of all stems larger than 1 foot tall were stump sprouts, and 250 commercial stems per acre were 1.0 inch d.b.h. or larger after 5 years; 90 percent were stump sprouts.

*Stand values.* Stand stumpage values for sawtimber were determined for each study area *(table 1)*. Merchantable volumes were determined from local volume tables developed for use on the Fernow Experimental Forest near Parsons, WV. The initial stand value was $1,019 per acre, and the average stumpage price for all merchantable sawtimber volume was $61 per thousand board feet. Harvested volume was valued at $48 per thousand board feet, while the residual stand averaged $108 per thousand board feet. The stumpage value of residual deferment trees averaged $393

Table 3. Number of logs in relation to epicormic branching on deferment trees when cut and after 5 years.

| Epicormic branching | Northern red oak (n=89) | White oak (n=59) | Yellow-poplar (n=117) | Chestnut oak (n=12) | Basswood (n=18) | Black cherry (n=9) | Other species (n=30) | Total (n=334) |
|---|---|---|---|---|---|---|---|---|
| | | | | no. logs | | | | |
| No branches, butt log | | | | | | | | |
| When cut | 89 | 51 | 115 | 12 | 16 | 9 | 27 | 319 |
| After 5 years | 49 | 34 | 103 | 12 | 1 | 7 | 23 | 227 |
| 0-2 branches, butt log | | | | | | | | |
| When cut | 89 | 55 | 117 | 12 | 18 | 9 | 29 | 328 |
| After 5 years | 89 | 42 | 112 | 12 | 6 | 7 | 27 | 284 |
| No branches, second log | | | | | | | | |
| When cut | 69 | 39 | 103 | 10 | 12 | 8 | 17 | 258 |
| After 5 years | 24 | 15 | 94 | 8 | 2 | 5 | 13 | 161 |
| 0-2 branches, second log | | | | | | | | |
| When cut | 89 | 45 | 115 | 11 | 18 | 8 | 25 | 311 |
| After 5 years | 46 | 22 | 111 | 8 | 5 | 7 | 21 | 220 |

per acre. Thus the value of trees left in the woods represents the investment cost of deferment cutting. As previously stated, the residual stands can be expected to earn competitive rates of return, at least in the near future.

## Discussion and Conclusions

It is too early to judge the long-term success of deferment cutting. Few trees were lost during logging. However, logging damage that results in exposed sapwood wounds is a concern because about 13 percent of the residual trees were seriously wounded. After 5 years, several of the logging wounds had developed callus and were closing, but many of the larger wounds were prominent and are expected to develop butt rot. Some of the trees with larger wounds could be removed before the end of the planned deferment rotation or left for wildlife trees. Windthrow continues to be a risk.

Based on information from prior studies, red and white oaks were expected to have the best survival rate and make reasonable diameter growth when used as deferment trees. Intolerant yellow-poplar and black cherry deferment trees were selected because they were available, but in general black cherry was not expected to respond as well as yellow-poplar or red oak. Growth response for these 75- to 80-year-old deferment trees was surprisingly good. The available 5-year information indicated that growth averaged 1.6 inches d.b.h. for all deferment trees compared to 0.8 inch for control trees. Yellow-poplar and red oak produced the best growth response, while chestnut oak was the poorest. The 5-year d.b.h. growth response by species was 40 to 117 percent higher than that of control trees.

After 5 years, epicormic branching reduced the butt-log grade on only 6 percent of the deferment trees, primarily in basswood. Since trees in the new stand will be at least 30–35 feet tall after 10–12 years and shade will be cast on the first two logs on deferment trees, additional epicormic branching is not expected. Significant reductions in deferment tree butt-log quality due to epicormic branching are not likely. However, to minimize concern for branches, dominant and codominant trees should be selected as deferment trees. When possible, trees with bole branches present on the first two logs (16-foot log) before release should not be selected as deferment trees.

The 5-year reproduction data indicate that the number and kind of available stems are no different than would be expected from a clearcut. At this time, deferment trees do not appear to influence the development of reproduction.

Deferment trees in this study are not scheduled for harvest until the new stand developing around the deferment tree reaches rotation age—approximately 80 years after the initial harvest. At that time, deferment trees will be about 160 years old. However, some or all of the deferment trees could be harvested before the new stand reaches maturity. Deferment cutting thus provides flexibility. Once the new stand becomes established and esthetic objectives have been met, deferment trees could be harvested as seed tree or shelterwood cuts or after 20 to 30 years. Hard mast overstory trees could be retained for wildlife in stands that would regenerate to pure conifers if completely clearcut.

Damage to the residual stand should not influence the outcome of the future stand. Deferment trees damaged during the initial harvest could be salvaged before significant rot develops or could be harvested to take advantage of favorable market prices. Stumpage revenues from harvesting some of the deferment trees could pay for cultural work in the new stand. However, damage to the new stand could be a major concern in steep topography.

Some changes in application techniques could be considered. One possibility is increasing the residual basal area. Currently, we have a deferment area with a residual basal area of 30 square feet for red oak, yellow-poplar, and black cherry. Increasing the residual basal area might reduce the windthrow-sunscald-epicormic branching concerns, but more residual trees would have been damaged during log-

***"Deferment cutting may also be useful for other resource objectives"***

ging. In previous work, trees in all deferment areas were skidded tree-length. One way to reduce logging wounds could be to skid shorter bole lengths, even though this would increase logging costs. Logging could be done during the summer to late winter to minimize "barking" during skidding. However, sprout and seedling reproduction may be adversely affected (Trimble 1973). Deferment trees should be marked clearly so they are visible to the logger from all sides. Perhaps the base of the deferment tree could be shielded during winching. Because of the potential tree quality value of most deferment trees, changes in harvest techniques could provide significant monetary benefits that would offset the additional logging cost.

Deferment cutting has potential as an esthetically pleasing alternative to clearcutting in eastern hardwood stands. After 5 years of survival, d.b.h. growth, value of the deferment trees, and regeneration of the new stands were silviculturally acceptable. Deferment cutting may also be useful for other resource objectives. ■

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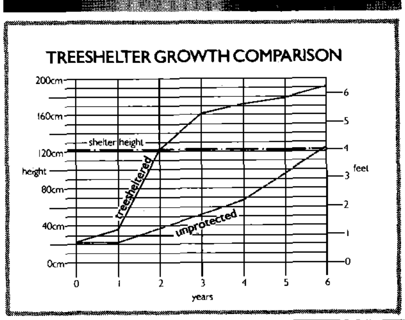


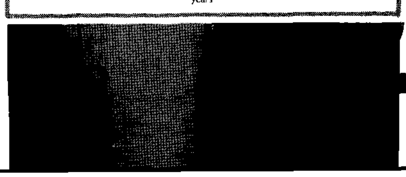






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