**Underburning a sapling loblolly pine plantation to reduce hardwood competition.**

## 1) Reason for study

a) Even with intensive site preparation, invading hardwoods on Piedmont sites present strong competition to planted pines, overtopping them thereby reducing pine growth, and often resulting in sapling mortality. Pines that survive will eventually push through the hardwood canopy, resulting in a mixed pine/hardwood stand. The lack of topsoil on Piedmont sites means hardwoods are typically of little economic value, but managing for pine is economically attractive. Site preparation is mandatory after harvest or the ubiquitous hardwoods will immediately capture the site until a destructive fire again creates a mineral soil seedbed conducive to establishment of a doghair loblolly stand from nearby trees. Loblolly is a pioneer species that produces copious amounts of light-weight, wind disseminated seed almost every year.

b) Herbicides are typically used before, or within a few years after a loblolly stand is established (planted or natural) to release the pines which is an effective but expensive treatment.

c) Fire will top-kill young hardwoods but it is generally withheld until a newly established loblolly stand is 10-12 years old to make sure the young pines will not be damaged. By this time, however, the pines are already overtopped and many hardwoods are large enough to survive low-intensity fire. Ga Kraft personnel asked us to determine the feasibility of introducing fire at younger age.

d) Research by Wade & Johansen showed loblolly pine becomes fairly immune to thermal stem damage once it reaches a basal diameter of 2 inches. But Intensive mechanical site preparation means there is little litter to carry a fire so cured herbaceous fuels most be relied on. A potential problem is that evergreen vines such as cat briar and honeysuckle often form a fairly continuous ground cover that stifles fire spread and intensity This study was designed to determine if fire can be safely and efficiently introduced in 5-year old loblolly plantations to release the juvenile pine.

## 2) Study Site

a) Land lot 70 of 11$^{th}$ Land District, Jones County Georgia about 20 miles north of Macon.

b) Historically the Piedmont from Virginia to the Mississippi River burned every few years resulting in a fire climax dominated by longleaf pine until cleared for cotton, generally before the Civil War. Our study site, like virtually all Piedmont lands was row-cropped for 100+ years and finally abandoned prior to WWII. Succession resulted in a mixed pine-hardwood stand on this study site which was clearcut, drum chopped and root raked prior to planting on a roughly 6x10 spacing with 1-0 loblolly pine stock in 1978. A fairly large amount of cull hardwood material remained after harvest which was windrowed.

c) This study was established in 1982, comprised of 2 backfire fire treatments (different fireline intensity levels) and a control, each replicated 4 times for a total of twelve 0.9 acre (3 x 3-chain) plots in a completely randomized design.

d) Percent slope ranged from 2.5 to 9% with no major erosion gullies. Aspect was Southerly. Permanent photo points were established. Study duration was 3years with fire the first yr and hardwood and pine vegetation recorded preburn, and for 2 years postburn in the autumn after the last growth flush, but prior to leaf fall.

**3) Vegetation measurements**

a) Two 200ft permanent diagonal transects were established on each plot with end points about 25ft in from plot corners. Steel reinforcing rods were driven into the ground with the tops at 4.5 ft so a tape could be stretched taught across the stakes. Each 200 ft transect was divided into 50ft runs, which were in turn divided into 10 ft runs (for analysis), and then into 1 ft measurement segments. All woody plants less than 4.5 ft tall that intersected the vertical plane between ground-level and the tape at 4.5ft were tallied within each 1-ft segment of a 50ft unit. The plant species that occupied most of each 1 ft segment was also tallied (not necessarily the vertically dominant species).

   i) Grasses and vines tended to be an almost universal component and thus were tallied ONLY when they comprised most of a 1ft segment. Thus a segment might contain several small trees, but vines recorded as the 'dominant species if they occupied most of the 1ft segment distance. When no woody plants occurred in a segment and vines and herds did not occupy at least 6-inches, the segment was declared VOID, even though it might, and likely did, contain non-woody growth.

   ii) Since we were primarily interested in hardwood competition, we typically did not record vine or herbaceous species.

   iii) The same 2 observers conducted all surveys. Both had decades of research experience, knew their trees and many 'step-overs', and spent the time required to correctly place the tape and meticulously determine borderline plants (marked with spray paint) and make field notes as appropriate.

b) The 50ft tape line also served as the midline for fifty 1 ft long by 2ft wide quadrats. All woody stems at least 4.5 ft tall originating below ground surface within 2ft either side of the midline were tallied by species. A sliding scale was used to record larger stems further out as explained on the quadrat worksheets.

c) Planted pine measurements were recorded on 21 pines in each of 3 rows on each plot (total of 63 pines per plot). Where a spot was double planted, only the stem judged best was left intact. Tip moth damage was epidemic on the study site confounding the results. Tip moth damage was only recorded if the terminal leader was infested. Although the pines were genetically improved stock, fusiform rust was also a common problem that, together with tip moth resulted in stunted trees, many of which were termally killed. Species noted on the study site but not in any transect included American holly, rough-leaved dogwood, hackberry, mimosa, and several vacciniums.

4) Fire treatment

   a) Backfires were chosen for 2 reasons

      i) They are hotter near the ground than headfires and thus do a better job of girdling woody stems.

      ii) Headfires require exacting burn conditions if used in young loblolly because the pine crowns are susceptible to thermal bud damage if flames are too high. This problem reared its head on plot 10M2 when the backfire hooked around due to a wind shift and headed through the pine transects killing many measurement trees. Although backup plots had been established, we made a decision not to use them as this is an operational hazard that should be factored into the potential use of fire in juvenile loblolly.

   b) Rates of spread measured and flame lengths visually estimated at 5 minute intervals.

   c) Fuel was discontinuous on some plots and coupled with the carpet of vines resulted in incomplete coverage.

   d) Plots 4L1, 2L2, and 8M1 had good, fairly continuous herbaceous cover and burned well. Some flanking and momentary heading was observed on several plots as fire meandered around looking for fuel. Winds somewhat squirrely on 3-4-83. Only backfire measurements used in data summary. (See slides).

   e) The fires topkilled large numbers of hardwoods, although many of them resprouted along the lower stem, at the base, and undoubtedly along lateral roots. Although these sprouts grew rapidly, the fires were effective in releasing the pines. In addition, many of the topkilled hardwoods had fallen during the 2$^{nd}$ postburn year, taking any bole sprouts with them which was an added benefit.

   f) The winter/early spring of 1982 was unusually wet. We waited as long as we dared before spring green-up, but eventually applied the burn treatments with the Keetch/Byram Drought Index much lower than we would have preferred. Low KBDI meant that little branchwood was consumed (see postburn photos). The fires thermally pruned many lower branches (See slides), which according to hand-pruning studies, should increase growth. Fire also killed fusiform galls on the lower fire pruned branches.

5) Concluding thoughts.

   a) Slides show fire behavior was variable. 1 hour timelag fuels were dry and burned well but *Smilax* and *Lonicera* had a major damping effect. Fire struggling through these vines resulted in much of the smoke (water vapor) apparent in some photos. The pines had already undergone their first spring flush and some ealy spring weeds were active. Greenup typically occurs the beginning of April

   b) Virtually all small hardwoods were topkilled, but more intense fires would have reduced the number of sprouts. On the other hand, perhaps the copious sprouting slowed height growth of all sprouts.

c) Good forb response to burns as evidenced by flowering in the fall of 83, (see slides)..

d) One needs to be careful when interpreting the results. The control plots started with more measurement trees in 1982 which gave the controls an advantage that carried trough the study. Stunted pines (from tip moth) on the control plots added to these numbers, but in reality, if they do survive (I suspect most will die from hardwood competition), they will not be large enough to be harvested if the stand is clearcut for pulp in next 10-15 years. If the stand is actively managed on a longer rotation, the suppressed pine will likely be felled and left in the first release cut. Thus to put the analysis on an even footing, all stunted trees that died during the study from whatever cause should be deleted from the analysis. Even better would be to delete all stunted trees (<0.5 in DBH or <4.5 ft high in 10/82).