Responses of Herbage, Pines, and Hardwoods to Early and Delayed Burning in a Young Slash Pine Plantation

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Highlight: *Early burning in slash pine plantations on southern forest ranges did not prevent herbage yields from dropping sharply as the overstory developed. Unburned plots and plots burned initially at ages 5, 9, or 12 had 90% less herbage at age 13 than at age 6. Early burning prevented most scrub hardwoods and shrubs from reaching a size uncontrollable by fire, kept browse accessible to cattle and deer, and prevented pine litter from eliminating herbaceous plants from the understory. Burning had no effect on pine survival and growth.*

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Burning in slash pine (*Pinus elliottii* Engelm.) plantations on southern forest ranges usually begins when the trees are large enough to escape fire damage and continues at regular intervals. Satisfactory survival has been reported after burning as early as age 4 (Mann and Whitaker, 1955; Wolters, 1973). The present study investigated the influence of early burning on herbage yield; pine survival and the growth of the shrub and hardwood canopy were also observed.

Study Area and Methods

The study area was a 5-year-old slash pine stand planted in January 1961 on the Palustris Experimental Forest, near Alexandria, La. About 900 trees per acre were planted; spacing was 6 by 8 feet. The soil was an imperfectly drained, very fine

sandy loam. Before pines were planted, the site was typical cutover longleaf pine-bluestem (*Pinus palustris* Mill.-*Andropogon* spp.) range that had been regularly burned and that produced over a ton/acre of herbage annually. Principal woody dominants were southern waxmyrtle (*Myrica cerifera* L.) and blackjack oak (*Quercus marilandica* Muenchh.). Many of the hardwoods were topkilled by herbicide injection before the pines were planted, and previous fires had kept hardwood sprouts and shrubs small. More than half of the herbage was bluestem grasses, primarily pinehill bluestem (*Andropogon scoparius* var. *divergens* Anderss. ex Hack.) and slender bluestem (*A. tener* (Nees) Kunth). Brahman crossbred cattle grazed the study area yearlong; average utilization was 40 to 50%.

Four burning treatments were applied in four replications to randomized blocks of plots 3 chains square (0.9-acre). Treatments consisted of an unburned control and initial burns at ages 5, 9, and 12. Burning was repeated at ages 9 and 12 on plots initially burned at age 5 (age-5 plots). Burning of age-9 plots was repeated at age 12. Backfires were applied in February or March on days when windspeeds were 8 to 10 mph and relative humidity was above 40%.

Each plot contained a central measurement subplot 2 chains square (0.4 acre). For all treatments, pine heights and stems per acre were measured immediately before the initial burn and one year afterward. The controls were measured at the same time as the age-5 plots. The measurement sequence was repeated with each subsequent burn. At ages 12 and 13, diameters were measured at 4.5 feet and basal areas were calculated.

Herbage yields were measured at the end of the growing season following the initial burn. Thereafter yield was determined at the end of the growing season preceding the repeat burn and at the end of the season following the burn. Total herbage yield was estimated by clipping ten 9.6 ft² quadrats on each subplot; quadrats were protected from grazing by agronomy cages. Each sample was oven-dried at 100°C until the weight remained constant.

At age 14, the hardwood and shrub canopy cover was measured for five 0.01-acre circular samples per subplot.

Differences in height and herbage yield were evaluated by analysis of variance; the relationships between basal area and herbage yield were evaluated with analysis of covariance and by regression. Differences at the 0.05 level were considered significant.

Results and Discussion

Herbage Production

Herbage yield never differed significantly among burning treatments but was significantly related to plot basal area at ages 12 and 13. However, plot basal area accounted for only part of the yield differences; covariance analysis indicated that unknown factors were also contributing. When measurements were taken after the initial age-5 burn, burned and unburned plots produced over 1 ton of herbage per acre, and the pine overstory did not influence herbage yield greatly (Fig. 1). By age 9, however, the developing overstory had reduced herbage yield by 40% and had obscured any possible influences of burning. During the season following age-9 fires, pound-per-acre yields were 1,144 for age-9 plots, 1,205 for age-5, and 604 for the unburned; following the age-12 fires, pound-per-acre yields were 342 for age-12 plots, 312 for age-9, 303 for age-5, and 97 for the controls.

By age 12, bluestems no longer dominated the herbaceous understory of either burned or unburned plots; herbage was primarily scattered plants of broomsedge (*Andropogon virgini-*

Fig. 1. Relation of herbage yield on burned and unburned plots to tree age and height.

cus L.), creeping panicum (*Panicum rhizomatum* Hitchc. and Chase), and shade-tolerant forbs such as weak tephrosia (*Tephrosia onobrychoides* Nutt.) and grassleaf goldaster (*Chrysopsis graminifolia* (Michx.) Ell.).

Pine Survival and Growth

Burning treatments did not significantly affect tree survival or growth through age 13. Survival was high for all treatments: when burning began at age 5, plots averaged about 750 stems

Fig. 2. On unburned plots, waxmyrtle grew into large shrubs and made up more than half of the woody understory.

Fig. 3. An age-5 burned plot at age 13; waxmyrtle was kept knee-high by the repeated fires.

per acre; at age 13, mortality ranged from 5% on control plots to 10% on age-9 plots.

For all treatments, height averaged 44 feet at age 13, and little variation was observed. Height growth averaged 4.2 feet per year for all treatments.

Although basal areas of individual plots varied widely at age-13—from 91 to 134 ft² per acre—treatment averages ranged from 114 to 119, and the differences were not significant. Average basal area was 107 ft² per acre at age 12 and 116 ft² per acre at age 13.

Hardwood Cover and Shrubs

The cover of hardwoods and shrubs below a height of 6 feet averaged from 6% on age-5 plots to 9% on age-12 and control plots, but the differences were not significant. Cover above 6 feet tall averaged 4% on unburned plots and 2% on the burned ones—a significant difference. Blackjack oak and southern red oak (*Quercus falcata* Michx.), the most abundant hardwoods, made up about 25% of the cover above 6 feet tall. About half of the cover below 6 feet on all plots was southern waxmyrtle, which comprised about 20% of the cover above 6 feet on unburned plots (Fig. 2); no waxmyrtle above 6 feet tall was noted on burned plots.

Conclusion

By killing hardwood tops, early burning kept sprouts within browsing height of deer and cattle and gave the animals improved access to herbage by destroying litter and woody sprouts (Fig. 3). Burning at about age-5 may prevent hardwoods from eventually dominating the pines and thereby reduces the costs of timber stand improvement, harvesting, and regeneration. Since age-5 burns did not affect the survival and growth of young trees, early burning is recommended for optimum utilization of understory forage in slash pine plantations. Frequent removal of litter by burning may encourage the survival of enough grasses to ensure herbage recovery and a desirable species composition after thinning or clearcutting. However, without sufficiently wide initial spacings or thinning by age 10, grazing will not be feasible in slash pine plantations by age 13, regardless of the burning schedule.

Literature Cited

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