Improving tree establishment with forage crops

Abstract: Weed competition and economics are two common barriers to Iowa farmers’ investing in tree plantings. This project examined seven weed control strategies and investigated productivity of small grain/forage combinations raised with trees in an effort to suggest management options that would encourage tree planting in the state.

Background

Trees are identified as important parts of the agricultural landscape and are often used in riparian buffer strips. However, intense weed competition often occurs within months after planting and can kill almost any planted tree within one or two years if not controlled. Research has been done on what weed control techniques are most effective, but techniques are site-specific and have not been characterized for use in Iowa.

Farmers also are reluctant to plant trees because newly planted trees generally will not produce market or non-market values (timber, biomass, aesthetics, etc.) for several years. A potential solution to this economic dilemma is to raise another crop between the tree rows during the years of establishment, which would increase the value during the first years after planting.

The project objectives were to:
- Evaluate the influence of seven weed control treatments on the survival and growth of two groups of tree species,
- Evaluate the influence of the two groups of species listed in objective 1 on the productivity of small grain/forage crop combinations for up to three growing seasons, and
- Determine the cost effectiveness of planting trees with different weed control treatments.

Approach and methods

In spring 1998, work began at the ISU Rhodes Research Farm where moderately uniform upland and bottomland pasture sites were selected for planting. Seven weed control techniques were tested for the effects on the survival and growth of two groups of tree species: fast-growing hardwoods (the two hybrid popular clones Crandon and Eugenii and silver maple), and high-value hardwoods (red oak and black walnut seedlings and from seed). The fast-growing hardwoods were only from seedlings. The weed control treatments consisted of four small grain/forage crop combinations (oats and red clover; oats, red clover, and red fescue; oats, red clover, and orchardgrass; and oats and hairy vetch), herbicides, mowing, and a control.

Each site was divided into six blocks: three for the fast-growing hardwoods and three for the high-value hardwoods. Forages were seeded in the spring and within a few days, tree seedlings and seed were planted. Two rows of seedlings and seed were planted about 6 inches apart. In all, 3,538 seedlings and 5,800 seed were planted.

Initial plans were to harvest oats at grain maturity and subsample forages to determine yield. However, inclement weather and weed problems resulted in low forage production, so no samples were taken of forage production. Plots were mowed in an attempt to promote forage growth and coverage in the plots, but this made...
it impossible to estimate forage production later in the project.

In October 1998, the researchers weeded a row of trees in each plot except the herbicide and control plots. Weeding was done to head off expected damage by mice and to evaluate its impact on subsequent tree growth. During the winter months, many of the trees suffered from deer browsing and girdling by mice and other rodents. Both the weeded and non-weeded rows experienced similar damage. Since weeding appeared to offer no real advantage to tree growth and development, it was discontinued.

Beginning in June 1999, forage yield was estimated by subsampling three of the four small grain/forage combinations. Subsampling was not performed on the hairy vetch treatment because the species was not able to withstand the winter conditions and had effectively disappeared from the plots.

In spring 1999 tree seedlings were thinned to approximately four or five trees per species in a row, depending on the number of species surviving and the spacing of the trees. Trees planted from seed were not thinned to allow for study of the competition in relation to rate of growth.

The height of all surviving seedlings and the height of all seedlings from seed were measured each autumn. The number of living seedlings from seed was used to calculate germination success.
Results and discussion

At the end of the 1999 growing season on the bottomland site, 56 percent of the red oak from seed that were alive at the end of the 1998 growing season remained alive. Meanwhile 97 percent of the black walnut seed alive at the end of the 1998 growing season remained alive. For the upland site, 58 percent of the red oak from seed that were alive at the end of the 1998 growing season were still alive. The black walnut trees from seed showed a 115 percent survival rate, meaning that some seeds germinated during the 1999 growing season. By the end of the 2001 growing season, much of the red oak from seed had died, decreasing to 16 percent of the 1999 levels in the upland site and 21 percent of the 1999 levels in the bottomland site. The red oak seedlings also fared poorly in the bottomland area with only 20 percent surviving from 1999 totals. However, 80 percent of the trees on the upland site survived from the 1999 season.

By the end of the 2001 growing season, trees on the bottomland site were taller than on the upland site, particularly the Eugenii and silver maples. The Eugenii is not well suited for the drier upland conditions and grows at a much slower rate. Many of the silver maples in the bottomland were finally able to grow above the deer’s browse line, and these trees should be able to maintain higher growth rates for the following years. All trees in the bottomland showed an increase in height for the 2001 growing season, except for the red oak (seed and seedling). Averages for the upland site showed most tree species experienced an increase in height; however the silver maple and red oak (seed and seedling) remained roughly the same size. The trees that did not experience much growth suffered from significantly higher levels of browsing by deer in the upland site, as well as elimination of the taller trees due to thinning and winter kill in the case of the red oak trees grown from seed.

Conclusions

For both tree species groups on upland and bottomland sites, survival was about the same for all treatments. Over four years of growth, the establishment treatment does not appear to be very important for seedling survival but had a definite impact on growth. The usage of herbicides resulted in the fastest tree growth and the use of small grain/forage crops resulted in greater growth than either mowing or the control treatment.

Although the herbicide treatment resulted in significantly greater average tree growth than the other treatments, the percentage increase in growth is not large (an average of 17 percent) compared to the growth on the small grain/forage treatments. Thus, the concern about lost productivity due to using small grain/forage crops as a way to help establish trees would appear from this research to be a minor concern in a situation where tree growth is not a primary consideration.

Although the herbicide treatment resulted in significantly greater average tree growth than the other treatments, the percentage increase in growth varied among the treatments. For Crandon and Eugenii, herbicides increased growth an average of only about 15 percent compared to the growth on the forage treatments. The other species averaged about a 50 percent greater growth on the herbicide treatment compared to the forage treatments.

Thus, the concern about lost productivity due to using small grain/forage crops as a way to help establish trees would appear from this research to be a minor concern in a situation where tree growth is not a primary consideration. In riparian plantings, growth is less important than having good ground cover.
No usable information about forage production was obtained from this study, and no conclusion can be drawn about the influence of trees on forage production or associated economics. But given the small loss in tree growth due to the usage of small grain/forage crops, it is reasonable to assume that given a reasonable level of production from grain and forage crops, using such crops to help establish trees could be a viable technique.

**Impact of results**

Additional analyses should be done on the data and some cost estimates need to be developed. At this point the use of small grain/forage crops appears to be a viable technique for establishing trees in settings in which some loss in tree growth compared to the use of herbicides is acceptable. Groups dealing with riparian buffer strips will find this information useful. An ISU graduate student has done an economic analysis of the project. It is weak in that four years of growth don’t extrapolate well, but it has “indication” value. The upland site will be abandoned and the lowland site probably will be continued for a year or two.

**Education and outreach**

Two Iowa State University M.S. theses were prepared based on this project. A poster explaining the project was presented at the 13th Annual Central Hardwoods Conference in Carbondale, Illinois. A paper is being prepared for the *Northern Journal of Applied Forestry*. 