AGROFORESTRY NOTES

AF Note — 26 September 2003

Converting a Pasture to a Silvopasture in the Pacific Northwest

Introduction

Forestry and livestock production are mainstays of the natural resource-based economies of many rural communities in the western United States and Canada. Regenerating mixed conifer forests may produce considerable amounts of ground vegetation that is suitable as livestock feed, while open-canopied pine forests in more arid conditions produce forage throughout their lives. Not surprisingly, there is a strong tradition of livestock grazing within western forests. Silvopasture, the combination of forest management and improved forage species, is a more intensive, controlled application of this traditional use. It is most often implemented to increase profitability, reduce risk, and augment environmental benefits from land management.

Synthesis of Experience

This note summarizes observations made by the authors while designing and operating four experimental silvopasture systems in western Oregon, using herded livestock to facilitate regeneration in conifer plantations, and establishing and managing forests and improved pastures. It also draws upon published experiences of other pasture, livestock, and forest workers. Site conditions studied vary from deep loamy soils with 40 inches to120 inches of precipitation on the west side of the Cascade Mountains to thin rocky soils with less than 20 inches of precipitation on the east side of the mountains. The intent is to share experiences and recommendations, not to provide a "cook-book" of suggested actions. Although, the examples are drawn primarily from western Oregon conifer/sheep systems, the underlying concepts will have some usefulness for other regions and types of livestock.

Site Selection

The ability of recently forested land to grow trees can be predicted from performance of the previous stand. However, the ability of pasture or rangeland to support commercial timber production is harder to predict. Many forage plants are more shallowly rooted than are trees, and a very productive pasture may have soils which are too thin or seasonally too wet to support commercial tree production. Since soils can change significantly over very small distances, the presence of the desired tree species near the proposed silvopasture site is no guarantee of successful tree establishment and growth. Local County Extension and the Natural Resources Conservation Service offices are good sources of information about soil suitability for specific pasture and tree species.

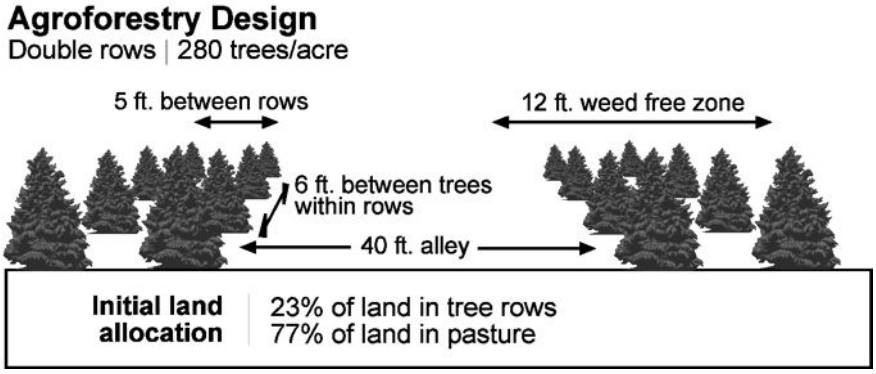
A single row Douglas fir silvopasture system. Pruning allows additional light under the trees and encourages forage production throughout the pasture.

Planting Silvopasture

Which should come first, the pasture or the trees? Most people prefer planting trees into either an existing or recently seeded pasture. However, vegetation control is critical, especially when planting trees into established pasture where grass roots form a fibrous mat throughout the upper soil layer. In dry summer climates conifer seedlings grow fastest when all competing vegetation is removed for the first three years. To obtain survival on dry sites, at least 20 to 30 percent of the planting area should be weed free. This translates into a vegetation-free zone around each seedling at least four to six feet wide. This zone is often maintained for two to three years by application of herbicide, vegetation control mats, or mechanical treatment. Zones less than four feet are less effective because of rapid reoccupancy of the soil by roots of adjacent plants. On moist sites seedling survival is not as significantly impacted by weed control. However, tree growth is significantly affected by competition and a four to six foot vegetation-free zone is still recommended.

What forage plants have been used? The selected pasture plants will vary with site characteristics and desires of the manager. Orchardgrass, tall fescue, and perennial ryegrass along with subclover and white clover are commonly used silvopasture forages. Nitrogen-fixing clovers are often seeded to provide high quality feed for livestock and to serve as a biological source of nitrogen for trees and associated grasses. Legumes often have more exacting nutrient requirements than do grasses, making soil nutrient testing and correction of deficiencies by fertilization an important part of their management. Shallow rooted, summer dormant forages such as subclover and perennial ryegrass are a good choice for dry sites or where one is willing to accept lower total forage yields in order to maximize late spring - early summer tree growth. Tall fescue and white clover will grow as long as soil moisture is available, making them suitable for deeper soils when one is willing to accept their competition with trees for dry-season moisture. The forage composition of silvopastures will change with time as trees grow and modify the environment. Orchardgrass and subclover seem to tolerate the environment under trees better than perennial ryegrass or Kentucky bluegrass. Although tall fescue also does well under trees, it has the lowest forage quality and highest degree of competition among the forages discussed here.

What trees are used? Douglas-fir and ponderosa pine are the two dominant timber species in the Pacific Northwest. Most current silvopasture experience is with these two trees. However, other locally adapted conifers or hardwoods may be used either alone, or in mixed species stands. For example, red alder has been grown as a quick rotation saw log between longer rotation Douglas-fir clusters in silvopastures. Shading from the conifers encourages tall straight alder logs which will be cut and sold when the growing Douglas-fir require additional space. Black walnut, KMX hybrid pine (*Pinus radiata x Pinus attenuata*), black locust, maple, cherry, and poplar also have potential as silvopasture trees. Regardless of the tree species used, it is generally worth the extra cost to purchase large healthy seedlings grown from a locally adapted seed source. Such seedlings are both quicker to establish and grow and are more tolerant of browsing and other damage.



What tree pattern is best? Commercially valuable timber trees are typically planted equidistant in a regular grid pattern. Conifer plantations are often planted 300 to 600 trees per acre in order to allow for some death loss, removal of poorly formed and subdominant trees, and to provide income from commercial thinnings prior to the final harvest. Silvopastures are often planted at lower initial tree densities, 200 to 300 trees per acre, and more attention is devoted to the care of each tree. A traditional grid pattern spreads the trees out, minimizing competition between trees, while maximizing

the competition between trees and ground vegetation. Planting trees into single rows, multiple rows, or clusters, provides wide-open alleys for forage production and easy access for livestock grazing, hay harvesting, fertilizer spreading, spraying, and other agricultural practices. Width of the alley between tree rows is often set by the size of farm equipment. For example, a 20-foot alley provides full easy access for cutting hay with a 16-foot swather. Trees grow best at higher densities than are often used for silvopastures. Grouping trees into rows or clusters may promote tree growth by providing a "forest effect". Single rows and double rows are often used in silvopastures because they greatly reduce tree/pasture competition. Triple or more row combinations of a single tree species are less common because of significant potential for the center row to be out-competed by the outer rows. However, there is plenty of opportunity for creativity to use multi-row culture for combinations of short and longer rotation trees, such as Douglas-fir Christmas trees and saw logs, and trees that have different growth requirements, such as conifers and hardwoods.

Silvopasture Management

Will the livestock eat my trees? Trees may be damaged by livestock or wild animals which eat, step on, or rub them. While multiple damage events may kill trees, most single events only slow tree growth. For conifers such as Douglas-fir, removal of over half of the current year's needles, or girdling of over half the circumference of the stem is required to noticeably reduce long-term tree growth. Conifers are especially sensitive to removal of the topmost "terminal leader." Loss of this leader can dramatically reduce tree height and diameter growth and stimulate the production of new multiple leaders. In general, planted trees are most likely to be damaged during their first two to three years when they are small and do not have their resinous chemical defense well established. Some agroforesters reduce the risk of damage during this period by haying rather than grazing for the initial couple of years. This approach does not solve problems of damage by native herbivores such as deer and elk. Young trees may be protected with chemical repellents, mesh or solid tubes, or electric fencing. Sheep, goats, and deer are more likely to eat conifer needles than are cattle or elk. Established conifers are not inherently very attractive to large herbivores when other acceptable forage is present. Since animals like variety in their diet, and trees are the only browse available in silvopastures, they are more likely to consume silvopasture trees than native forest or commercial timber plantation trees.

Rotational grazing is preferable to season-long grazing because it provides better control of forage utilization and restricts the time each set of trees is exposed to livestock. Severe tree damage is most often associated with a shortage of other preferred forage and immature conifer foliage that has yet to "harden off," juvenile animals (lambs), or unoccupied males (rams). A lot of animal behavior is learned. Animals with past experience eating conifer needles are likely to continue doing so. Removing a few habitual offenders before they teach bad habits to others can sometimes avert conifer browsing damage.

Should trees be pruned? Silvopasture trees are often pruned to increase the value of saw logs produced, to reduce tree/tree and tree/pasture competition, and to improve ease of movement through the plantation. Normal pruning practices would be aimed at producing one or two 18-foot long logs with a six-inch knotty core per tree at final harvest. The future value of pruned logs is uncertain. However, past experience has shown a significant price premium for the clear wood produced by pruning. Proper pruning technique and timing are critical to gaining the desired advantages. Check with local consulting or extension service foresters before proceeding with pruning.

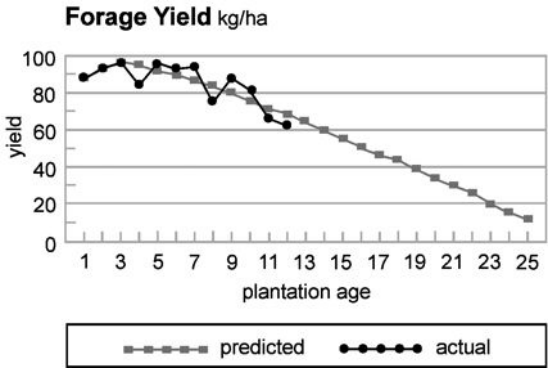


Figure 1 - Forage yield changes over time for a subclover / perennial ryegrass / Douglas-fir silvopasture in western Oregon.

What forest and pasture productivity should I expect? Most current silvopastures are designed to produce a full stand

Growth increases of Douglas-fir silvopasture trees compared to forest plantation trees in the Willamette Valley, Oregon			
Site Location	Height	Diameter	Stand Age
NW Hills	10 percent	7 percent	33 years
Peavy Arboretum	0 percent	1 percent	9 years
Witham Hill	16 percent	16 percent	12 years

of timber when mature. During the early years when trees are small, forage productivity is potentially the same as that of open pasture. In practice, 15 to 30 percent of the potential productivity during the first two to three years is lost in the vegetation control strips around trees. The actual point at which trees begin to reduce forage production will depend upon forage species and site characteristics. Once this point is reached, forage production will decline rapidly, although significant forage production may continue well into mid-rotation. Aggressive thinning and pruning of trees will maintain continued forage production by reducing shading and tree water use. Of the two resources, competition for water is probably more limiting than shading in open-canopied stands such as silvopastures. Selection of forage plants that either concentrate their growth in the rainy season or are drought tolerant should help maintain forage production. To maintain forage production, an aggressive thinning or management program should be applied when forage growth is 80 percent of production potential.

Although state-of-the-art high-yield forestry should out yield silvopasture, conifers in silvopastures often grow faster than those under more traditional forest management. Silvopasture trees benefit from pasture fertilization, nitrogen fixation by pasture legumes, and vegetation control by timely grazing. When forage plants are selected and grazed to reduce their competition for stored soil moisture and nutrients, tree growth increases may exceed 10 percent. This would allow for either a proportionately shorter timber rotation or for a larger volume yield at harvest. Additionally, landowners have the immediate advantage of an annual income from livestock grazing.

Additional Information

References

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