POWELL RIVER PROJECT

Conversion of Sericea Lespedeza-Dominant Vegetation to Quality Forages for Livestock Use

D. Wolf, Professor (retired), Crop and Soil Environmental Sciences, Virginia Tech
J. Fike, Associate Professor, Crop and Soil Environmental Sciences, Virginia Tech
C. E. Zipper, Extension Specialist, Crop and Soil Environmental Sciences, Virginia Tech

Introduction

Tens of thousands of acres suitable for grazing livestock have been created by surface-mining operations in southwestern Virginia and in nearby areas of eastern Kentucky, southern West Virginia, and northeastern Tennessee – where climatic and soil conditions are similar. Sericea lespedeza (*Lespedeza cuneata*) was commonly seeded by coal mining operations through the 1980s. Sericea was considered desirable because it is a hearty legume that can tolerate low fertility and low pH, it is resistant to limited soil moisture, and it may provide some nitrogen (N) to the soil. Although its seedlings are weak, sericea spreads easily because it faces little competition on new mine soils, and its small seeds are readily carried by winds and birds. As a result (and because it was widely planted on many older surface mines), sericea lespedeza is commonly found on reclaimed mine sites throughout the central Appalachian coalfields, even though it is no longer planted.

Sericea can be undesirable – particularly on sites with limited management – because it can become the dominant species by crowding out other plant types. Because mature stands of sericea are relatively unpalatable to livestock during much of the year, land managers with an interest in livestock production often wish to transform sericea-dominant stands to a more favorable mixture of forages.

The purpose of this publication is to describe recommended strategies for converting the sericea-dominant vegetation typically found on older surface-mined benches to more favorable forages that can be more effectively utilized by livestock. Techniques for suppressing the growth of sericea lespedeza in order to establish quality forage species and for managing the resultant pasture or hayland area were developed from research conducted at the Powell River Project Research and Education Center site.

Sericea Lespedeza as a Reclamation Species

Sericea was a favored species for reclamation plantings in Virginia and neighboring states in the early days of mined-land reclamation. Sericea has a long, deep taproot that is capable of penetrating deep into the overburden to extract soil water that is inaccessible to more shallow-rooted species (figure 1). As a legume, it is able to fix atmospheric nitrogen, and it thrives in low-fertility conditions where other non-nitrogen-fixing species are unable to flourish. Sericea is allelopathic to some grass and legume species, which means that it releases biochemical compounds that suppress certain other species.

Another factor that favors sericea on surface mines is its ability to grow vigorously during the summer's hottest months, when other forage species are semi-dormant. However – and unlike some favored pasture legumes such as alfalfa, red clover, and white clover – the excess nitrogen fixed by sericea is not readily available to

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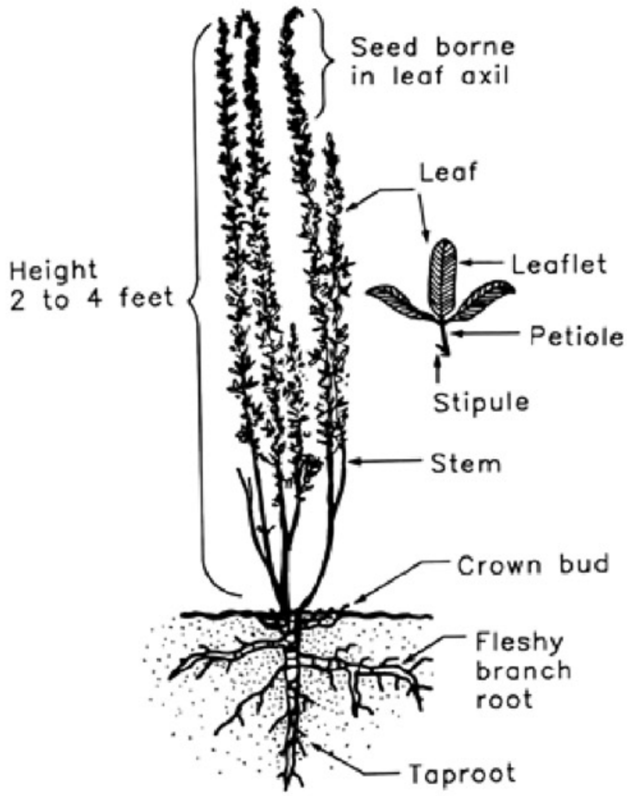

Figure 1. Sericea lespedeza: note that buds at the crown near the soil surface give rise to new stems. Fleshy branch roots and taproot are for food storage and overwintering. *(Figure drawn by George Wills)*

companion species in any substantial quantity. Thus, the dominance of the sericea is not threatened by invading grasses or other species capable of exploiting such excess organic nitrogen.

The phosphorus requirements of sericea are very low compared to those of common forage species; sericea is able to survive in soils that have very low levels of phosphorus in forms generally considered "plant available." In addition, sericea can utilize soil phosphorus bound in chemical forms that cannot be effectively utilized by other species. These characteristics enable sericea to thrive on many older surface-mine benches, especially where available soil phosphorus levels are low because of the high phosphorus fixation capacities of many mine soils.

Sericea's growth cycle begins in late spring, when it sends up new shoots from the "crown," which occurs where the root mass comes together, just below the soil surface. As these new shoots emerge and grow, they draw upon nonstructural carbohydrate energy reserves (sugars) stored in the fleshy taproot during the previous growing season (figure 2). Maximum growth rate occurs during June and July, after which shoot growth begins to decrease. The plant then begins to route the majority of nutrients synthesized through photosynthesis back into the taproot for winter storage. In late summer (early September), sericea begins to flower and the plant becomes increasingly stemmy. Tannin concentrations in the plant leaves also rise at this time. Tannins – plant compounds similar to those found in unripe fruit – reduce sericea's palatability to cattle; at high concentrations they may bind plant protein in the animal's gut. This effectively reduces the nutritional value of mature sericea plants.

Although low-tannin sericea varieties such as "Aulotan" are now available, most mine lands were sown to high-tannin varieties. As fall turns to winter, the leaves drop

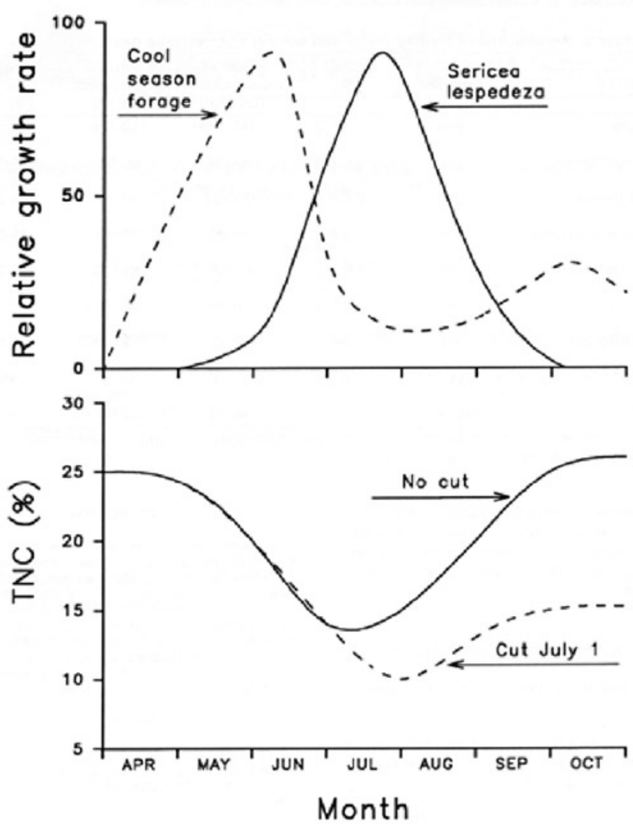

Figure 2. (*Upper*) Relative growth rates of sericea lespedeza and a typical cool-season forage crop; maximum production for sericea occurs later in the growing season. (*Lower*) Total nonstructural carbohydrates (TNC) in taproot and fleshy roots of sericea lespedeza when it is uncut during the season and when it is cut in midsummer. Note that a midsummer cutting causes carbohydrate storage in the roots to be low going into winter. Because sericea must utilize carbohydrate reserves to begin growth when the weather warms in the following spring, management actions that reduce those reserves aid in suppressing its growth so it can be supplemented or replaced by higher quality forage species.

and the remaining aboveground tissues are woody, high in tannins, and unpalatable to most forms of livestock. In succeeding years this biomass – which decomposes very slowly – may build up on the soil surface, further suppressing the growth of competing species. The dead, standing biomass often becomes a thicket that is difficult to penetrate on foot.

In pastures, greater utilization of sericea is possible by grazing earlier and with higher stocking density early in the growing season, before the plants become tall and stemmy. This changes the plant architecture and increases the number of emerging shoots. Without appropriate management, however, sericea vegetation is only moderately palatable to cattle and only during a brief portion of the year: the late-spring/early-summer period of rapid growth. During that time, cattle prefer the emergent portion of the shoots to many other foods that are available in a typical, unmanaged, reclaimed mine pasture. During the remaining portion of the year, cattle will eat the sericea only as a last resort, when all other food sources have been consumed. Because the nutritional value and palatability of such forage is low, livestock – and especially cattle – may not achieve optimum weight gains when sericea is the dominant forage, even when given access to large areas of pasture. The resultant low productivity adversely affects the production system's output efficiency – and economic returns.

Advantages of Conversion

Although management strategies may improve the utilization of and output from sericea-dominated pastures, there may be advantages to converting these lands to other forage species. The major advantage of converting sericea-dominated stands to more palatable forage species is improved forage quality. When sericea is replaced with higher quality, more nutritious forages, fewer acres are needed to support each cow, and the livestock will put on weight more rapidly. Reducing each animal's acreage requirement will, as a consequence, reduce fencing and other management costs or increase the number of animals that can be stocked on a given acreage. These benefits, of course, are balanced by the cost of implementing a conversion strategy. Generally, the greater the productive capacity of an individual site, the greater the productivity increase that can be expected from converting sericea-dominated pastures to higher quality forages.

Methods for Conversion

Outlined below is a two-year program designed to suppress sericea and introduce an improved pasture species mix.

Year 1, June-July: Suppress the stand of sericea lespedeza. This can be accomplished by grazing or mowing the stand to the ground, or by applying a suitable herbicide. Producers should obtain and use currently approved herbicides and rates of applications for their area. These can be obtained from local Extension offices. This should be done during the period of maximum shoot growth, which will reduce the amount of nutrient reserves that can be directed to the crown and roots for regrowth the following spring. Without leaves, the plant is unable to carry out photosynthesis, and thus cannot generate carbohydrate reserves for storage. Rather, energy already stored in the taproot and other fleshy roots must be used to generate new growth.

Year 1, fall (late September-early October): The first step in fall management will be to mow the sericea close to the ground or burn the area. Mowing should be followed by a light disking if possible. Both activities should precede application of fertilizer and seed, as required to establish an annual cover crop.

Fertilization rates should be determined by a soil test, which can be conducted by the Virginia Tech Soil Testing Lab. Those unfamiliar with soil-testing procedures should contact their local Extension agent for details on how to sample, where to send the sample, and how to interpret the results. See *Creation and Management of Productive Mine Soils,* Virginia Cooperative Extension publication 460-121, for guidance on how to interpret soil-test results for mine soils. Phosphorus (P) and potassium (K) are the primary fertilizer nutrients to be applied at this time.

A cover crop of a rapidly growing, annual species could be sown to establish organic matter in the soil (table 1). This crop will take up nutrients that have been applied by fertilization. When these plants are deposited on the soil as litter, nutrients are released and recycled to the roots of other plants growing in the area. The primary purpose for the cover crop – aside from holding the soil in place – is to take up as many fertilizer nutrients as possible into the aboveground biomass tissue.

Table 1. Recommended fall cover crop species and seeding rates

Common name	Scientific name	Seeding rate (lb/a)
Crimson clover	*Trifolium incarnatum*	20-25
Winter oats	*Avena sativa*	60-80
Rye	*Secale cereale*	90-100
Annual ryegrass	*Lolium multiflorum*	20-30

The cover crop should include both grasses and legumes. Grasses to be considered include annual ryegrass, cereal rye, winter oats, wheat, or barley. The purpose of the legume species (such as red or crimson clover, or hairy vetch) is to fix atmospheric nitrogen for recycling to next year's vegetation and to provide a more-balanced forage for grazing animals.

The fall seeding can be accomplished by broadcasting seed into the sericea stubble.

Year 2, spring (April or May): The cover crop should be removed by a close grazing or a mechanical cutting. Remnants of the sericea stand will generally shoot up at this time. The cover crop can be harvested for hay or straw, or mowed and allowed to remain as mulch.

Year 2, June-July: Suppress the sericea stand again, as during the previous year.

Year 2, fall: Fertilize and establish desired pasture species. Suitable species are listed in table 2. Phosphorus and potassium fertilizer should be applied. It is vital to establish one or more legume species if the pasture is to be a self-sustaining source of nutritious forage. Hence, the soil test should also check the levels of micronutrients necessary for the planned legume species. Lime also should be applied if the soil test shows a need to raise soil pH. Once again, seed can be broadcast into the sericea stubble.

Table 2 contains an example of a species mix that can be seeded in the fall of Year 2. The species to be planted can be varied, based on seed costs and availability. See *Creation and Management of Productive Mine Soils,* Virginia Cooperative Extension publication 460-121, for further information about mine-soil fertility, and *Revegetation Species and Practices,* Virginia Cooperative Extension publication 460-122, for further information about grass and legume species that can be utilized to revegetate reclaimed mine sites for pasture.

The Importance of Fertilization

Although fertilization is the most expensive conversion cost, meeting plant-fertility needs is essential for creating viable pastures on mine soils.

Typically, both P and K fertilizer are necessary to bring the mine soil up to adequate fertility levels. Liming will also be desirable in some situations, as soil pH should be at least 5.7. The potential productivity of the soil will be a key determinant of the economic benefit of fertilizer and lime expenditures. In general, it will only make good economic sense to invest in fertilization and/or liming on soils where productivity is **not** limited by physical factors, such as heavy compaction and/or shallowness to bedrock. As a general rule, if the sericea

Table 2. Recommended fertility levels and soil pH levels for various pasture species*

Species	Legume	Soil pH	P-fertility requirement** (lb/a)	K-fertility requirement** (lb/a)	Seeding rate (lb/a)
Alfalfa	yes	6.5-7.0	110-140	110-140	10-15
White clover	yes	6.0-6.5	90-120	60-90	1-2
Red clover	yes	6.0-6.5	90-120	60-90	4-6
Annual lespedeza	yes	5.8-6.2	60-90	30-60	15-20
Tall fescue	no	5.6-6.2	90-120	90-120	20-30
Ryegrass	no	5.8-6.2	30-50	30-50	10-15
Switchgrass	no	5.8-6.2	75-100	75-100	4-6
Sweet clover	yes	6.5-7.0	40-70	50-80	15
Birdsfoot trefoil	yes	6.0-6.5	40-70	50-80	4-5

*See Virginia Cooperative Extension publication 460-122 for further information about establishing grasses and legumes on mine soils.
**Fertilizer application rates required to achieve these fertility levels should be determined based on the results of a soil test.

and associated vegetation are **not** thriving on a particular area, it will **not** make economic sense to invest in fertilization and liming.

Fertilization and liming are vital components of the conversion process for a number of reasons. First, low fertility (especially low P) favors sericea over other legume species, because sericea is well adapted to low P conditions. Secondly, most agronomic legume species do best at moderate pH and high-soil fertility conditions. If these conditions are not established, then the agronomic legumes will not thrive. A healthy legume species is vital to any forage-crop production system.

A Less Costly Approach

Many reclaimed areas can be improved as forage production areas simply by reducing the sericea component of the vegetation mix. Although sericea tends to dominate old strip benches, it rarely dominates to the extent of eliminating other species. Sericea was often sown with tall fescue, a hearty competitor in its own right. Such a vegetation mix can be improved as a forage/pasture production system simply by increasing the fescue component of the vegetative mix and adding a second legume.

Where present in small quantities, the tall fescue component can be increased at the expense of the sericea by keeping the pasture closely grazed or mowed during the May-June-July portion of the year. The area should be fertilized with as much P as the owner can afford, up to the recommended level from the soil test. If possible, an alternative legume should be established, with the objective of supplementing the forage-protein content during times when sericea and fescue are both low in nutritional value. Recommended legumes for these situations are ladino clover, red clover, and annual lespedeza.

Management of Converted Stands

Key components of the management strategy must be:

- Maintain soil fertility and pH sufficient to maintain the nonsericea legume components of forage mix.
- Keep the stand grazed or cut, especially in late spring or early summer. Do not allow sericea to go through the critical June-July period into maximum nonstructural carbohydrate storage without close grazing or cutting.

Conclusion

The experience of numerous people in raising livestock on surface-mined lands in Virginia and neighboring states has shown that cattle can thrive on mined lands when pastures are properly managed. This publication provides guidelines for converting the sericea-dominated vegetation typically found on unmanaged surface-mined lands to more favorable forage species and for managing those pastures.

References

Powell River Project/Virginia Cooperative Extension publications: Available from Powell River Project (*www.cses.vt.edu/PRP/*) and Virginia Cooperative Extension (*www.ext.vt.edu*).

Daniels, W. L., and C. E. Zipper. Revised 2009. *Creation and Management of Productive Mine Soils.* Virginia Cooperative Extension publication 460-121; *www.pubs.ext.vt.edu/460/460-121/460-121*.

Skousen, J., and C. E. Zipper. Revised 2009. *Revegetation Species and Practices.* Virginia Cooperative Extension publication 460-122; *www.pubs.ext.vt.edu.460/460-122/460-122*.

Other References

Dove, Dennis. 1985. Dry matter and nutrient loss from legume litter grown on mine soils. M.S. thesis, Department of Agronomy, Virginia Tech.