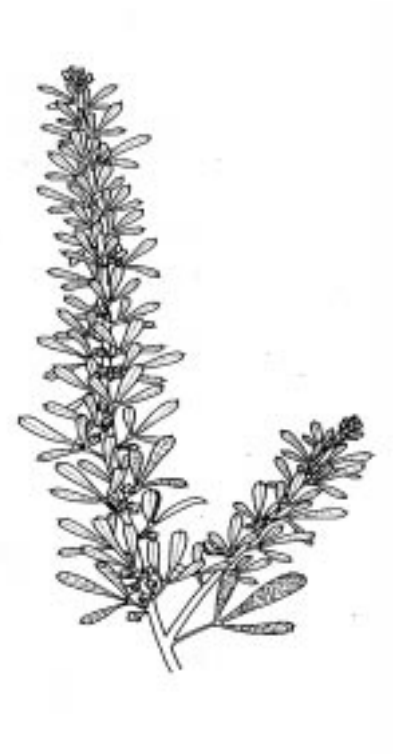
Sericea Lespedeza and the Future of Invasive Species

A Symposium With a Look to the Future



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RESEARCH AND EXTENSION

EMPORIA STATE UNIVERSITY

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SERICEA LESPEDEZA, AN EXAMPLE OF A FUTURE PROBLEM [1]

Paul D. Ohlenbusch
Extension Specialist, Range and Pasture Management
Kansas State University

Sericea lespedeza (Lespedeza cuneata) or Chinese bush clover is an introduced perennial legume native to eastern Asia. It was first recognized as a potential weed problem in southeast Kansas in the early 1980s. Sericea lespedeza is most common in the eastern third of Kansas, but has spread westward, with more than 50 counties reporting its occurrence (Figure 1). Counties began declaring it a "county option" noxious weed in the late 1980s. More than 300,000 acres are currently infested by sericea lespedeza. The Kansas Legislature passed legislation making it a statewide noxious weed July 1, 2000. Sericea lespedeza is the first federally listed crop to be declared a noxious weed.

Sericea lespedeza was first planted in the United States in 1896 by the North Carolina Agricultural Experiment Station. Little study or use of sericea lespedeza was done until 1924 when the USDA secured some seed from Japan and planted it at the Arlington Experiment Farm in Virginia. Its value for erosion control, hay, wildlife, and seed production were soon demonstrated. It was not widely used for pasture until the late 1940s.

Sericea lespedeza is adapted to climatic conditions extending from Florida to Texas, north to Nebraska, and east through Michigan and New York to the Atlantic Coast. It grows best where annual precipitation is 30 inches or more and has survived winter temperatures of -17 $_{o}$ F.

It is recognized for its tolerance of drought, acidity and shallow soils of low fertility. It will tolerate soils ranging from very acidic to slightly alkaline, but is best adapted to a pH of 6.0 to 6.5.

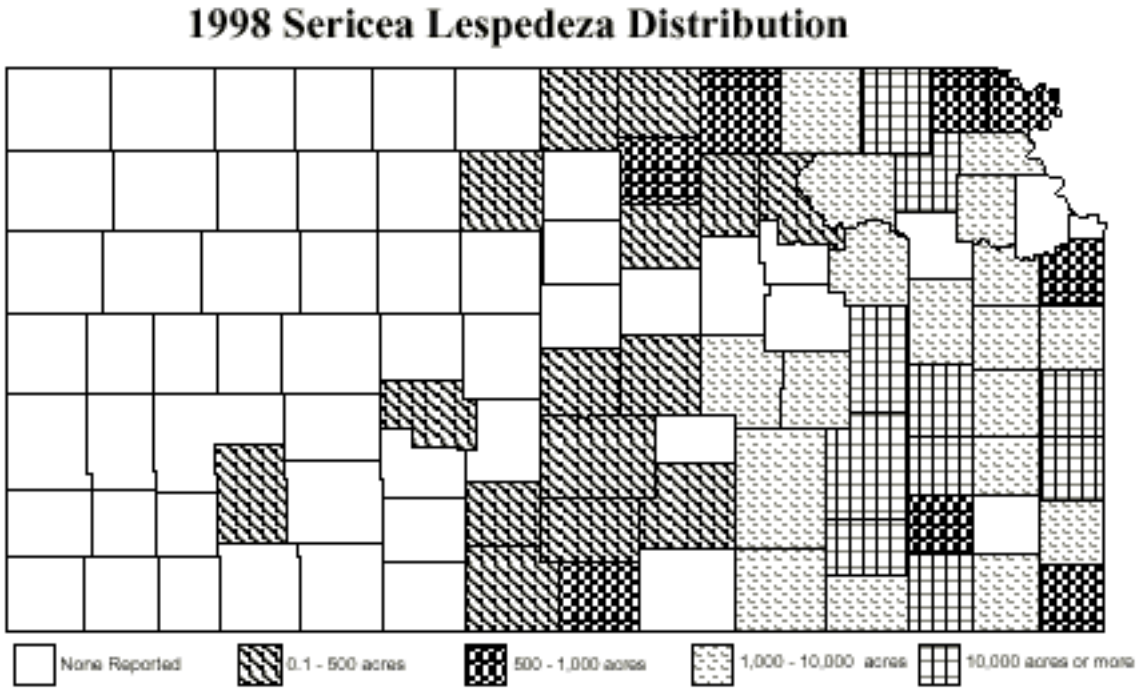

Figure 1. The distribution of sericea lespedeza. (Source: Kansas Department of Agriculture)

[1] Material taken in part from Sericea Lespedeza: History, Characteristics, and Identification (MF2408)

It does best on clay and loamy soils that are deep, fertile and well drained, but will also grow on poor sites. It has few insect and disease problems.

In Kansas, it was grown at Hays in the 1930s and planted on strip-mined areas in southeast Kansas. Plantings were made on federal and state reservoirs for wildlife habitat in the 1940s and 50s. It was also used in Soil Bank plantings along with tame grasses in the 1950s. Most recent introductions of the plant occurred while establishing native grass on Conservation Reserve Program (CRP) acres, a provision of the 1985 Farm Bill. The native grass seed harvested from rangeland and used in these plantings contained sericea lespedeza seed. Sericea lespedeza was not recognized as a potential weed at that time.

Noxious Weeds and Kansas Agriculture

Noxious weeds in Kansas have been a legal fact since 1937. The current noxious weeds are shown in Table 1. Kansas grazing lands are least concerned with Johnsongrass, field bindweed, and bur ragweed because they are palatable to most grazing livestock. Another interesting observation is that only two of the noxious species are native to Kansas: pignut and bur ragweed. The rest are introduced.

The noxious weeds of most concern to grazing lands are musk thistle, leafy spurge, and Canada thistle. Among the county option list, sericea lespedeza, multiflora rose, and bull thistle are of concern.

Sericea lespedeza is a new kind of invader to grazing lands. Previous species unpalatable to livestock respond to combinations of herbicides and grazing management practices. As an example, musk thistle, a biennial or winter annual, is a poor competitor with the desirable grasses and can be limited in its invasion by management that allows the grass plant to be competitive. This limits the space available for musk thistle to invade.

Sericea lespedeza is similar to leafy spurge in that it is extremely competitive and, being less palatable than the grasses, can replace grasses over time. Leafy spurge has been found in Kansas, but has been vigorously attacked and limited in its spread. The advantage we had was that it had been identified as a serious problem in states to the north and was readily identified and managed.

Current Status of Sericea Lespedeza

Research efforts have been underway at Kansas State University and Emporia State University since the mid-1980s. Funding for the research was from various sources, mainly commercial companies. In 1998, the Legislature appropriated some resources to Kansas State University. In 1999, The Kansas Department of Agriculture received funding for research by Kansas State University and Emporia State University to expand the research effort.

July 1, 2000, sericea lespedeza will become a state-wide noxious weed in Kansas. Control measures are only now being defined and are limited to herbicide control. Some promise is being shown with the use of meat goats to suppress sericea lespedeza. The full extent of how useful goats will be is not known.

Our goal in these symposia is to review and update what is known and not known about managing and controlling sericea lespedeza. This introduced legume is changing how we will manage Kansas grazing lands, in particular, the Kansas Flint Hills, which have been and are important to the future of agriculture in Kansas.

Table 1. The current noxious weeds species designated in the The Kansas Noxious Weed Law.

State-wide	
kudzu	*Pueraria lobata*
field bindweed	*Convolvulus arvensis*
Russian knapweed	*Centaurea repens*
hoary cress	*Cardaria draba*
Canada thistle	*Cirsium arvense*
quackgrass	*Agropyron repens*
leafy spurge	*Euphorbia esula*
bur ragweed	*Ambrosia grayii*
pignut	*Hoffmannseggia densiflora*
musk (nodding) thistle	*Carduus nutans L.*
Johnsongrass	*Sorghum halepense*
County option	
multiflora rose	*Rosa multiflora*
sericea lespedeza	*Lespedeza cuneata*[1]
bull thistle	*Cirsium vulgare*

[1] State-wide noxious weed effective July 1, 2000.

Kansas Noxious Weed Law and Sericea Lespedeza

William T. Scott
State Weed Specialist
Kansas Department of Agriculture

INTRODUCTION AND SPREAD

Sericea lespedeza (Lespedeza cuneata (Dumont) G. Don) was introduced into the United States in 1896 by the USDA for study as a forage crop and for erosion control. In the 1930s sericea lespedeza was planted on strip-mined areas in southeast Kansas for wildlife habitat and erosion control. Sericea lespedeza contains 5 to 12 percent tannin, making the plant unpalatable to livestock except sheep and goats. Cattle may graze this plant early in the season when the plants are succulent and the tannin content is at its lowest levels; however, typically sericea lespedeza is the least preferred plant.

Eleven species of lespedeza are known in the Great Plains. Eight are native species and three are introduced. Sericea lespedeza is the only undesirable species among the group. All the native species and the introduced Korean and Common lespedeza are readily grazed by livestock. Sericea lespedeza is sometimes confused with slender lespedeza, a desirable native plant.

Sericea lespedeza is found from Texas north to Nebraska and east from Nebraska to the Upper New England States. It serves as a minor forage crop in Louisiana, Mississippi, Alabama and Georgia. Sericea lespedeza was considered desirable for wildlife but research has shown the aggressive nature and hard seeds make this plant undesirable under most conditions.

The reported acreage in Kansas has grown from less than 25,000 acres in 1989 to nearly 350,000 acres in 1998 (Figure 1). While part of the increase is due to better recognition and reporting, sericea lespedeza has spread rapidly in native rangeland. Sericea lespedeza is found primarily in the eastern half of Kansas with the greatest acreage and density in southeast Kansas. A survey in 1996 found sericea lespedeza in 10 percent of the CRP fields in central Kansas. Infestations have also been found in southwest Kansas (Figure 2). These infestations have the potential to spread to native rangeland and increase rapidly.

LEGAL ASPECT

Sericea lespedeza was declared a county option noxious weed during the 1988 session of the Kansas Legislature. Impetus for the declaration came from several ranchers in Osage County. In 1997, HB 2289 proposed making sericea lespedeza a state-wide noxious weed. This bill was carried over to the 1998 session where it was amended and passed. Sericea lespedeza will become noxious throughout Kansas and be a prohibited noxious weed in the Kansas Seed Law on July 1, 2000.

The current statutes define infested livestock feed as infested with the seeds of noxious weeds. Infested feed material must be processed to destroy the viability of the noxious weed seeds or be fed on the farm where grown. The best approach is to avoid harvesting infested feed. Treating the noxious weeds or harvesting the feed before the weeds produce viable seed will do this. Sericea lespedeza blooms and sets seed in early August. Harvesting native grass before the sericea lespedeza sets seed eliminates the possibility of infested hay.

Another approach is to have the proposed haying site inspected and certified noxious weed free before harvest. The North American Weed Free Forage Certification Program provides a voluntary means of certifying and labeling forage and mulch as noxious weed free. Forage and mulch used on Federal lands and mulch on some State Department of Transportation lands is required to be certified to these standards. Certification allows the forage to move freely into other States and may add to the value of the crop.

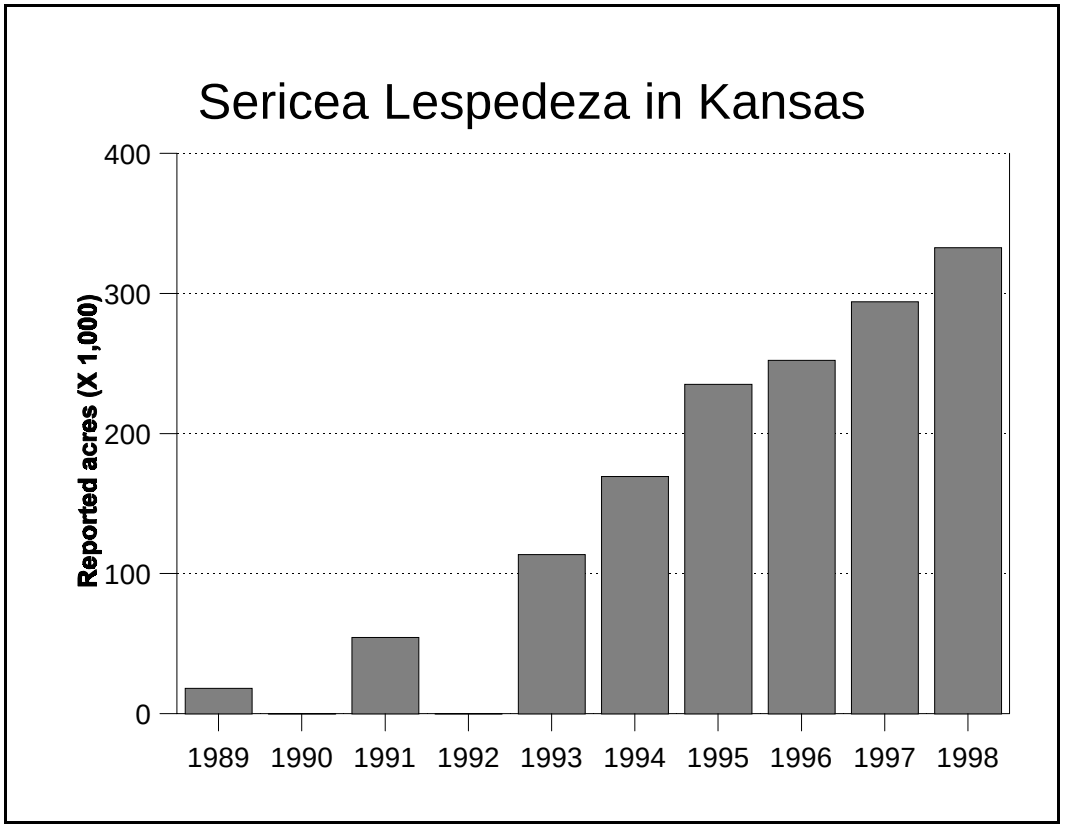

Figure 1. The acres of sericea lespedeza reported to the Kansas Department of Agriculture through 1998.

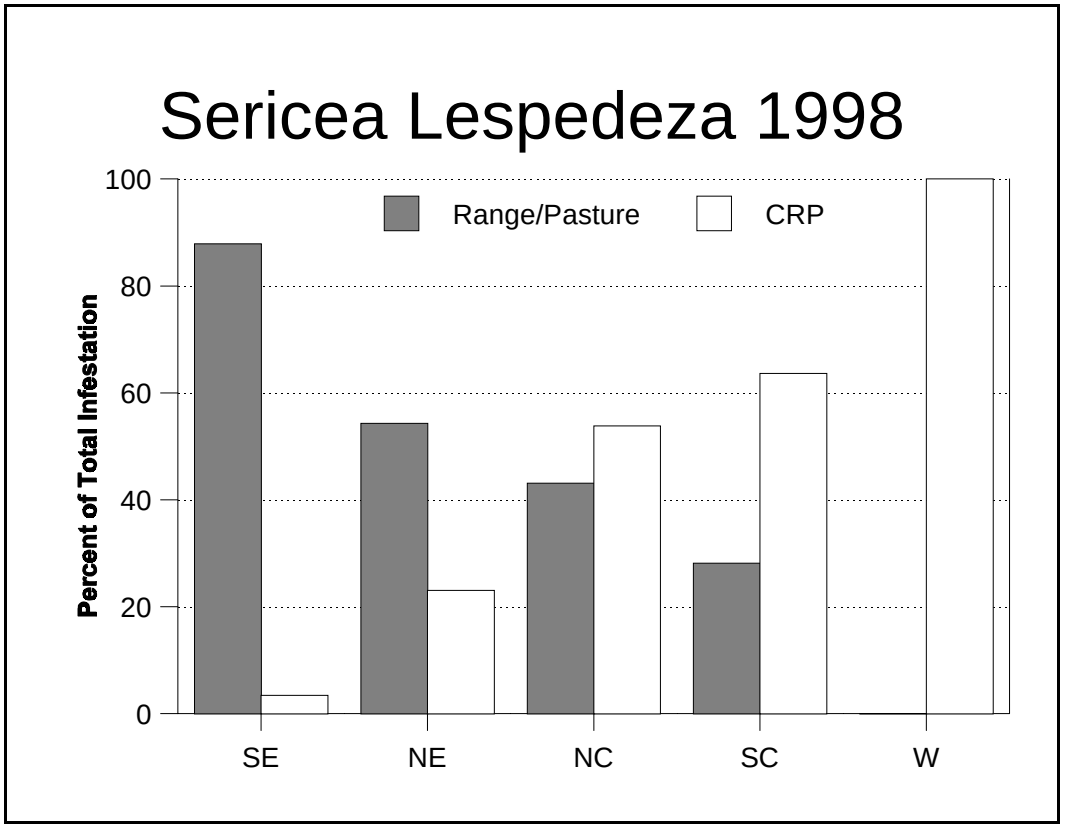

Figure 2. The relative distribution of sericea lespedeza between rangeland and pastureland versus CRP acreage.

Biology and Physiology of Sericea Lespedeza

Tom Benenati
Graduate Student
Division of Biology
Emporia State University

Lespedeza cuneata (commonly sericea lespedeza) is an exotic perennial legume introduced into Kansas in the 1930s for erosion control and forage. Naturalized varieties have become unpalatable to foragers, encouraging expansion of sericea's range. By Kansas statute, sericea will be a statewide noxious weed in 2000, requiring landowners to eradicate sericea infestations. To facilitate the management of this problem, the known general biology of sericea will be presented, focusing on plant discovery and identification using habitat cues and morphological characteristics. Seasonal growth habits and cleistogamous/ chasmogamous short-day flowering will also be discussed.

Physiology Responses of Sericea Lespedeza Under Various Control Methods

Joan Young
Graduate Student
Emporia State University

Summary:

Physiology Responses of Sericea Lespedeza Under Various Control Methods

- Clipping
- Burning

Sericea Lespedeza Seed Germination Responses Under Various Treatments

- High Temperatures
- Freeze/Thaw Regime
- Escort
- Remedy

Recommendations

Presentation Outline

Sericea Lespedeza
- Perennial legume.
- Many ramets (stems) emerging from root system.
- Frequent clipping reduces seed and forage yields. (Donnely and Patterson, 1969; Hoveland and Anthony, 1974.)

Physiology Responses of Sericea Lespedeza Under Various Control Methods
- Clipping
- Burning

Response of Sericea Lespedeza to Clipping
- Due to prior research, clipping studies were conducted in 1997 with comparison data collected in 1998.
- Clipped ramets starting in mid-June, one month prior to haying date.
- Plants were 70 percent grown when clipped to a two inch height.

Response of Sericea Lespedeza to Clipping – Number of Ramets

Response of Sericea Lespedeza to Clipping –

Weight of Ramets

Response of Sericea Lespedeza to Clipping
- Number of ramets go down.
- No treatment, number goes up.
- Two clippings, 30 days apart, are adequate.

Response of Sericea Lespedeza to Burning
- This research was in response to Fall River accidental burn in August, 1996.
- Pasture was burned in April and again in mid-August.
- Data was taken in 1997 with comparison data collected in 1998.

Response of Sericea Lespedeza to Burning – Number of Ramets

Response of Sericea Lespedeza to Burning – Weight of Ramets

Response of Sericea Lespedeza to Burning
- No treatment, number goes up.
- Spring burn, number of ramets go up 30 percent more than before treatment.
- Spring and August burn, number of ramets go down.
- Very dangerous.

Responses of Sericea Lespedeza – Ramet Count

Responses of Sericea Lespedeza – Ramet Weight

Sericea Lespedeza Seeds
- Each ramet (stem) could produce up to 1500 seeds. 10 - 15 percent germinate.
- Some are food for insects, rodents.
- Most make up a seed bank.
- Fire can release seed from dormancy.
- Emergence of a seedling is usually nine days. High temperatures are ideal.

Sericea Lespedeza Seed Germination Reponses Under Various Treatments

Sericea Lespedeza Seed
- This seed is classified as 80 percent hard.
- Under ideal conditions – how many will germinate?
  - 48% - Best germinations for 20 minutes in concentrated sulfuric acid
  - 42% - still viable (Tetrazolium Chloride test)
  - 10% - were not viable.
  - 30% - Heat at 104°F. (40°C.)
  - 57% - Freeze/Thaw at 86°F. (30°C.)
  - 23% - Light Germination was at 86°F. (30°C.)

Will form a seed bank until germination requirements have been met.
- How many years? - 20 years in seed burial tests.

Water/Temperature/Oxygen/Soil
- Microbes/Internal Chemistry
- Recommendations:
- Best treatment for reducing both number of ramets and biomass is two cuttings, mid-June and mid-July.
- Areas that cannot be mowed must be controlled by the innovative rancher using browsers, such as goats, in combination with cattle.
- Employ a rest/rotation method of pasture utilization in combination with post-emergence herbicides.
  - 1st season – graze cattle and goats, spray post-flowering sericea (Escort).
  - 2nd season – rest grass for vigor, spray emerging sericea (Remedy), browse with goats.

STOP Seed Production!

Herbicides and Related Control: A Review

Walter H. Fick
Associate Professor
Range Management

Gary L. Kilgore
Crops and Soils Specialist
Southeast

Research in controlling sericea lespedeza has gone through several steps. The initial step was to screen existing herbicides, including application rates, for effectiveness. The second step was to investigate rates of herbicides and growth stage at application on effectiveness. The third stage was to combine herbicides with mowing in hopes of finding a combination that was effective.

Screening Studies

Herbicide research for the control of sericea lespedeza begin with screening trials in 1985 and 1988. Several studies were established to screen different herbicides and the results are in tables 1 and 2. Herbicides containing triclopyr or metsulfuron showed the best results when rated for control about one year after treatment. Applications of 2,4-D, chlorsulfuron, clopyralid, dicamba, and picloram generally provided less than 60 percent control. Addition of 2,4-D to dicamba or triclopyr did not enhance control.

Rate of Herbicides

Studies to determine the minimum herbicide rate to apply have been conducted since the beginning (tables 2 and 3). Based on the research available, triclopyr at 1.5 pints per acre and metsulfuron at 0.5 ounces per acre have been as successful as higher rates.

Application Date Studies

Date of application (growth stage) results varied during early studies probably due to variations in weather (tables 4 and 5). Applications in 1997-98 showed applications in July (between early vegetative and bud stages) were less effective than applications in June (early vegetative) and September (bud to bloom stage. Rates of metsulfuron at 0.6 ounces per acre and triclopyr at 1 pint per acre provided greater than 90 percent control of sericea 1 year after treatment.

A 1 pint per acre rate of triclopyr applied in 1998 near Maple Hill, Kan., was more effective on sericea treated in a late vegetative stage (July 8) than during the bloom stage (September 18) (Table 5). Metsulfuron applied at 0.4 ounces per acre was equally effective at both stages of development and was more effective than 1 pint per acre triclopyr applied at the bloom stage (September 18).

Combined Treatments

Studies conducted since 1995 have considered the use of burning, mowing, and herbicides used alone and in combination for sericea control. A single mowing in July or September has not provided effective control 1 to 2 years after treatment (Table 6). Likewise, a single burn in late spring (early May in Pottawatomie County) was not effective. However, a late spring burn (May 9 in Pottawatomie County) in 1995 when the sericea was 6 to 8 inches tall plus mowing 4 weeks after burning plus triclopyr at 0.5 pint per acre 4 weeks after mowing provided 95 percent defoliation the end of the first growing season and 86 percent control 1 year after treatment. Mowing at a vegetative stage (July 5) combined with a half rate of triclopyr (0.5 pint per acre) applied 7 weeks after mowing provided greater than 70 percent control of sericea 1 to 2 years after treatment (Table 6). Treatments of metsulfuron (0.3 ounces per acre) or triclopyr (1 pint per acre) applied at a late vegetative or bloom stage near Blaine, Kan., in 1995 provided greater than 83 percent control 2 years after treatment (Table 6).

An experiment conducted at Maple Hill in 1998 compared herbicides used alone with combinations of mowing plus herbicide (Table 7). Triclopyr and metsulfuron were applied at recommended rates on July 8 (late vegetativestage) and October 12, during seed production. Mowing also was done on July 8 followed by a half rate of the two herbicides 6 weeks later. Triclopyr at 1 pint per acre was more effective than metsulfuron at 0.4 ounces per acre when applied on July 8. The herbicide treatments were equally effective when applied on October

12 but provided less than 60 percent control. Mowing plus either 0.5 pint per acre triclopyr or 0.2 ounces per acre metsulfuron applied 6 weeks after mowing provided control equal to recommended rates of the two herbicides applied on July 8.

Recommendations

The following are the current recommendations for control of sericea lespedeza.

Application Conditions

Always read and follow the label when applying herbicides. Poor growing conditions, such as extended dry periods and high temperatures, may stress sericea and reduce the effectiveness of herbicide applications. Freezing temperatures will brown sericea leaves and cause leaf drop, making herbicide applications ineffective. Applications should be made when wind speeds are less than 10 mph and avoid applying triclopyr when temperatures are expected to exceed 90°F. Ground applications should be made in 20 gpa spray solutions and aerial applications with 3 to 5 gpa. There are no grazing restrictions for metsulfuron or triclopyr at rates of 2 quart per acre or less.

Herbicide Recommendations

Early detection and spot treatment prior to stand expansion is critical for controlling sericea lespedeza. Once seed production occurs long term frequent treatment may be necessary to keep sericea at manageable levels. At the very least, try to prevent sericea lespedeza from producing viable seed.

- Triclopyr at 1.0 to 1.5 pints per acre during vegetative stage (mid-June to mid-July) and early bloom (August).
- Metsulfuron at 0.3 to 0.5 ounces per acre during late vegetative stage (mid-July) and from early bloom to early seed set (August-October).
- Mowing in early July plus metsulfuron at 0.2 ounces per acre or triclopyr at 0.5 pint per acre applied 4 to 6 weeks after mowing.

Current Research and Future Studies

1. screening additional herbicides.
2. effect of herbicides on seed viability.
3. determination and monitoring of sericea seed banks.
4. effect of burning on seedling establishment.
5. use of herbicides for seedling control.
6. absorption and translocation of herbicides applied at different growth stages.

The trade names of the herbicides used in the sericea lespedeza research. [No endorsement is intended, nor is any criticism implied of similar products not mentioned.]

Product	a. i. per gallon	Trade name
2,4-D amine	various	various
2,4-D LVE	various	various
Chlorsulfuron		**NOT LABELED**
Clopyralid	3 lb	Stinger
Dicamba	4 lb	Banvel, Clarity
Dicamba + 2,4-D	0.25 lb + 1 lb	tank mix
Metsulfuron	60% dry flowable	Ally, Escort
Picloram	2 lb	Tordon 22K
Triclopyr	4 lb	Remedy
Triclopyr + 2,4-D	1 lb + 2 lb	Crossbow

Table 1. Sericea lespedeza herbicide screening results in Coffey County applied in 1985.

Treatment	Rate	Application Date 6/28 % Control[1/]	8/21 % Control[1/]
2,4-D LVE	2 qt.	15	16
dicamba	1 pt.	39	66
picloram	1 pt.	59	28
triclopyr	1 pt.	99	94
triclopyr + 2,4-D	1 pt. + 2 qt.	100	89
metsulfuron	0.5 oz.	99	98
LSD .05		8.6	10.1

[1] Evaluated July 10 the following year.

Table 2. Herbicide screening studies in Woodson County, 1988-90.

Treatment	Rate (product/A)	% control[1] Range	Average
2,4-D amine	2 qt	0-24	7
2,4-D LVE	2 qt	12-47	21
Chlorsulfuron	0.67 oz	5-68	36
Clopyralid	0.33 pt	17-37	28
Dicamba	1 pt	39-66	48
Dicamba + 2,4-D	0.5 pt + 1 qt	36-54	42
Metsulfuron	0.83 oz	63-99	90
Picloram	0.5 pt	3-41	22
Picloram	1 pt	28-59	48
Triclopyr	0.5 pt	49-85	70
Triclopyr	1 pt	70-99	91
Triclopyr	1 qt	85-100	97
Triclopyr + 2,4-D	0.5 pt + 1 pt	40-94	68
Triclopyr + 2,4-D	1 pt + 1 qt	62-99	84
Triclopyr + 2,4-D	1 qt + 2 qt	89-100	93

[1] Percent control determined 1 YAT and averaged across 5 dates (late vegetative and early bloom stage).

Table 3. Sericea lespedeza control with various rates of triclopyr and metsulfuron applied in 1993 and evaluated over two years in Bourbon County.

Treatment[1]	Rate Amt. of Product	% Control[2] 4 wat	32 wat	52 wat	104 wat
Metsulfuron	0.1 oz.	10	92	10	0
Metsulfuron	0.3 oz.	60	100	77	49
Metsulfuron	0.5 oz.	65	100	98	94
Metsulfuron	0.6 oz.	60	100	99	94
Triclopyr	1.0 pt.	100	100	69	58
Triclopyr	1.5 pts.	100	100	98	95
Triclopyr	2.0 pts.	100	100	99	93
LSD .05		16	5	21	19

[1] All treatments applied September 28, 1993. Sericea in full bloom, 20.9 GPA, 30 PSI.

[2] WAT = weeks after treatment. Evaluation at 4 WAT was based on plant color 0 = green, 100 = brown. Other evaluations based on tiller reduction compared to number before treatment.

Table 4.Time of application of triclopyr and metsulfuron and control of sericea lespedeza applied in 1997 in Neosho County.

Treatment	Rate	Application Date 6/15	7/15	9/15
		------ % Control[1] –-------		
Triclopyr	1.5 pts.	94	79	90
Metsulfuron	0.5 oz.	90	70	99

[1] Control ratings made 24 months after June application.

Table 5. Date of application on control of sericea lespedeza at Maple Hill, Kan. evaluated in 1999.

Herbicide	Rate (product/A)	Application Date[1] 7/8/98	9/18/98
		(% Control)[2]	
Triclopyr	0.25 pt	8^{cd}	25^{d}
Triclopyr	0.5 pt	82^{ab}	68^{bc}
Triclopyr	1 pt	90^{ab}	60^{c}
Metsulfuron	0.4 oz	79^{ab}	92^{a}
Check	–	0^{d}	8^{d}

[1] July 8 = late vegetative stage; September 18 = bloom stage

[2] Means within a row or column with different superscripts are different (P<0.10).

Table 6. Mowing and herbicide combination control studies near Blaine, Kan. in 1995.

Treatment	Rate (product/A)	% control 1 MAT V[1]	1 MAT B[2]	1 YAT V	1 YAT B	2 YAT V	2 YAT B
Triclopyr	1 pt	100	99	94	91	97	93
Metsulfuron	0.3 oz	25	18	86	89	83	92
Mow		63	95	35	47	43	58
Mow + Triclopyr 7 WAT	0.5 pt	73	99	72	31	84	39

[1] V = Vegetative stage (July 5)
[2] B = Bloom stage (September 13)

Table 7. Mowing and herbicide combination control studies at Maple Hill, Kan. in 1998 evaluated in 1999.

Treatment	Rate (product/A)	Application Date[1]	% Control[2]
Triclopyr	1 pt	July 8	87[a]
Metsulfuron	0.4	July 8	64[bc]
Triclopyr	1 pt	October 12	46[c]
Metsulfuron	0.4 oz	October 12	58[bc]
Mow		July 8	6[d]
Mow + Triclopyr	0.5 pt	July 8 August 22	68[ab]
Mow + Metsulfuron	0.2 oz	July 8 August 22	70[ab]
Check			6[d]

[1] July 8 = late vegetative stage; October 12 = seed production stage
[2] Means followed by different superscripts are different (P<0.10).

Stocker Goats for Controlling Sericea Lespedeza

Steve Hart
Assistant Research Professor
Langston University

More than 300,000 acres of land in Kansas are infested with sericea lespedeza and it is also a serious weed problem in 15 counties in Oklahoma. There are two main reasons for its explosive spread in these two states. The first is that it is extremely well adapted to these areas and the second is that nothing eats very much of it, except goats. Sericea is a deep-rooted perennial well able to compete for scarce plant nutrients. It is drought and heat tolerant, tolerant of acid soils, and produces an abundance of hard seed. It is an ideal forage with one exception. It contains high levels of tannin, which makes it unpalatable to cattle. Goats tolerate significant levels of dietary tannins as evidenced by their consumption of oak brush, also high in tannin.

When goats are placed on a new pasture, they eat the brush and weeds that they are familiar with, or other plants that are similar. As this herbage disappears, the goats start experimenting with eating new plant species including sericea lespedeza. If goats had grazed sericea earlier in the season, it would have been low in tannin and highly digestible. Once goats become accustomed to sericea lespedeza, they eat it into the ground, including seedling plants. Goats like the stems with seeds, which reduces the seeding rate dramatically (from 960 seeds per stem to 2 or 3 seeds per stem when grazed). During the first half of the season, it may look as if you do not have enough goats because they are not eating much of the sericea. However, goats ate as much herbage the last 6 weeks of the summer grazing season as they did the first 10 weeks and most of that consumed was sericea lespedeza.

Sericea lespedeza is such a tough plant that severe grazing the first year only kills one-fourth of the plants, but the growth of surviving plants the next year is depressed relative to ungrazed plants. By the end of the third year of grazing by goats, there are virtually no live perennial sericea plants remaining and very little top growth left on the seedling sericea lespedeza plants. The goat stocking rate can be reduced each year as the lespedeza dies off. The first year requires 6 to 8 stocker goats per acre of lespedeza in the pasture, 4 to 6 goats the second year and 3 to 4 goats the third year. At least a half of a goat per acre is required to keep seedling lespedeza controlled each year thereafter. Goats will start eating significant amounts of grass only when they run out of sericea lespedeza. Goats will eat a bite of nearly any plant. Plant species they consume include sumac, ironweed, leafy spurge, sunflower, post oak, eastern red cedar, blackberries, multiflora rose, ragweed, buckbrush, green briar and many, many more.

We chose to investigate a stocker goat system to control sericea lespedeza because, like cattle, goat stocker systems are relatively easy to manage. Spanish stocker goats weighing 35 to 65 pounds were purchased from Texas. Both does and wethers less than a year old were used to study the effect of initial weight and sex on stocker gains. Also, data on dietary preference were collected. Internal parasite burdens were monitored using fecal egg counts. We stocked 160 goats on 40 acres that had been grazed with goats the previous year. As they came off the trailer, goats were dewormed with 2 cc of Ivomec, vaccinated for enterotoxemia and tetanus and were turned out to pasture. Goats were observed daily by circling the animals on foot from a distance. They had the usual amount of pink eye and soremouth from shipping, but were not treated due to the difficulty of catching them. After about a month, all goats had recovered and could be observed from a truck driven through the middle of the herd.

The goats gained 7.6 pounds the first month (includes regaining lost fill), 2.7 pounds the second month, 6.7 pounds the third month and 5.1 pounds the fourth month for a total gain of 22 pounds for the summer. The low weight gains during the second month may have been due to high humidity (monthly average of 91 percent). Neither starting weight nor sex affected stocker gains. Only two goats were lost out of 160 head, but we never found a carcass or skeleton.

Attached is a sample budget for a stocker goat enterprise using data collected in this study

(Table 1). Line A shows the purchase price of a 50 pound goat at 75¢ per pound. Transportation from a sale in Texas to Kansas costs $2.00 per head (line B). Lines C and D are for dewormer and vaccination, respectively. In our study we took fecal samples for worm egg determination. It was not necessary to deworm the goats again during the summer. Trace mineralized salt cost is shown in line E. The cost for a guard dogs (spread over 3 years) and dog food was estimated at $1.00 per head. Fencing costs were based on the use of two strands of electric fence on the inside of a five-wire barbed wire fence around a section of land spread over a 4-year period. Included also is a high quality fence charger. Fencing is very important because goats can get out a ten inch hole and, unlike cattle, all 500 head will follow the first one out as well as back in. However, if goats have plenty to eat and someone checks on them, they pretty much stay put. Electric fencing can also help with predator problems. Interest on capital for the enterprise was $1.80 per head. Transporting the animals to the sale (in Texas) cost $2.00 per head although if animals are sold on private contract, the buyer often provides trucking. We calculated a 2 percent death loss (ours was 1.25 percent) on what we sold at 74¢ per pound. There is little roll-back on goats and, if kept until December, there can be a price roll-up. The net profit was nearly $5.00 per head. While the profit was not large, we produced a saleable product from the lespedeza and cleaned weeds and brush out of a pasture, which increased the carrying capacity for cattle.

Goats can control serecia lespedeza very effectively. The number of goats needed declined over the 3-year period as the lespedeza lost vigor and died. Thereafter, a smaller number of goats should be maintained to eat seedlings and prevent lespedeza from reseeding. However, one of the best opportunities to use goats for lespedeza control is when the lespedeza is just becoming established in a few spots. A pasture can be fenced for goats as cheaply as spraying the pasture once ($12 to 18 per acre), which you would have to spray in several years to control the lespedeza if you did nothing. The goats will seek out the patches of sericea lespedeza and eat it into the ground, preventing it from spreading by seed. They will also eat the seedlings that come up from seed produced the previous year or dropped by wildlife. In 3 years they will have killed all the perennial lespedeza plants and the native grasses will not have been damaged by the sericea lespedeza. In addition, the amount of other weeds and brush will be greatly reduced.

Table 1. A sample budget for a stocker goat enterprise based on data collected in this study.

Stocker Goat Budget	Each	500 hd
A. Purchase spring kids in June - 50 lb kid at 75¢lb	$37.50	18,750.
B. Transportation TX to KS	2.00	1,000.
C. Deworming 1.5 cc. Ivomec	.40	200.
D. Vaccination enterotoxemia and tetanus	.40	200.
E. T-M salt 5 lbs, 8¢/lb	.40	200.
F. Guard dogs (3 yr working life) including dogfood	1.00	500.
G. Electric fence, 2 strands, 4 mi. standoffs, charger, 4 yr life	1.60	800.
H. Interest 10% on $43.30 for 5 mos.	1.80	900.
I. Transportation to sale (KS to TX)	2.00	1,000.
J. Total Expense	47.10	23,550.
K. Sell Kids in October 72 lb less 2% death loss = 70.5 lb 74¢ lb	52.00	26,000.
L. Net Profit	4.90	2,450.

The Effects of Goat Grazing on Sericea Lespedeza

James M. Mayo
Associate Professor
Division of Biology
Emporia State University

This paper reports the results of a two-year study of goat grazing on sericea lespedeza at the Melvern wildlife area near Reading, Kan. This project is a cooperative study with The Kansas Department of Wildlife and Parks , Langston University (Langston, Okla.), and a private rancher, Don Rogers , of Lebo, Kan. The Kansas Department of Wildlife and Parks fenced 40 acres goat tight in 1998. During the summer of 1998, 150 goats were grazed from June 26 to Sept 15. During the 1999 season, 140 goats were grazed from May 15 to Sept 15. Permanent meter square plots were established in the grazed area and an ungrazed control area. Additional transects were run as needed. The following measuments were made during the two year study:

1. Stem or ramet counts.
2. Seed production per ramet and per square meter.
3. Utilization of sericea by the height - weight method.
4. Seed bank size and germination.
5. Seedling counts.

Results and Discussion

1. Stem (ramet) counts.

1998 71 ramets/m^2 Summer and fall. No change during 1998
1999 49.5 ramets/m^2 Stem reduction p=0.004

Even though there were 59.9 seedlings/m^2 counted in May,1999. There are significantly fewer ramets per meter at the end of the 2- year period.

2. Seed production.

	Grazed area	Control area
	-------- seeds/ramet ----------	
1998	3.5	979.0
1999	.02	being counted

The reduction in seed production is statistically significant

3. Utilization of sericea height - weight method

	July		September	
year	west	east	west	east
1998	48%	18%	77%	56%
1999	50%	58%	78%	73%

It was noted that the goats used the east half of the pasture less than the west half, so utilization was measured separately in the two halves. Use was heavier in 1999. Over 70 percent of the sericea biomass was taken by goats. This explains why seed and ramet production were reduced by the fall of 1999. Other woody plants were heavily used as well.

4. Seed bank size and germination.

	Seeds/M^2	Seeds / acre	Seed germination
Grazed	3,350	13,556,982	63.9%
Control	5,500	22,313,703	14.5%

There were fewer seeds in the seed bank in the grazed area after two years, but they showed a much higher germination rate. This may be due to the reduction of seed rain of dormant seeds.

Conclusions

1. Goat use has reduced the ramet density, probably due to reduced root reserves.
2. Goat use has reduced seed production dramatically.
3. The seed bank is much smaller after two years of goat use.
4. It is not yet clear if continued goat use could eradicate Sericea.
5. We do not know how few goats it would take to manage sericea in a pasture with goats and cattle.
6. Goats offer a viable means of sericea control.

The Effects of Lespedeza Webworm on Seed Production in Sericea Lespedeza

Tom Eddy
Division of Biological Sciences
Emporia State University

This paper reports a 1999 study of the effectiveness of the larvae of the lespedeza webworm (Tetralopha scortealis) in reducing seed production of sericea lespedeza (Lespedeza cuneata) in Kansas and the establishment of webworms transplanted into uninfested populations of sericea lespedeza. Study sites were located in seven counties (Chase, Chautauqua, Cowley, Greenwood, Lyon, Nemaha, and Osage). Site selection was based on regional (eastern Kansas) distribution of the lespedeza webworm, vegetative composition of the infested sites, density of webworm infestations and size of the area infested. Five criteria were determined for each county study area (Table 1).

Study area infestations of the lespedeza webworm affected approximately 10 percent of the sericea lespedeza ramets in the sample quadrants, with the exception of the Greenwood county site, where almost 50 percent of the ramets were infested. Damage to the infested ramets reduced seed production in excess of 98 percent.

Twenty sericea lespedeza ramets infested with lespedeza webworms were transplanted into sericea lespedeza populations (lacking the lespedeza webworm) in four counties (Chautauqua, Greenwood, Lyon, and Osage) during September 1998. The Osage County transplant was successful with 32 infested ramets occurring at the site in the summer of 1999. The successful establishment of this population indicates the potential for increasing the frequency of the species over the range, thereby reducing plant vigor, seed production and slowing dispersal of the affected plants.

Table 1. Effect of Lespedeza Webworm Infestations on Seed Production of Sericea Lespedeza.

	# ramets/m^2		% of ramet encased in web	# flowers/ramet		# seeds/ramet	
	Mean (1)*		Mean (2)*	Mean (3)*		Mean (4)*	
Study Area**	infested	uninfested		infested	uninfested	infested	uninfested
Chase (1)	9	97	65	11	621	8	580
Chautauqua (2)	1	102	55	17	361	4	392
Cowley (1)	17	118	70	14	1,003	10	977
Greenwood (3)	30	64	75	10	978	2	894
Lyon (3)	11	98	65	11	615	5	606
Nemaha (2)	8	85	70	9	554	5	507
Osage (1)	6	63	60	16	537	11	565

*(1) 30 m sq quadrats/site (August 1999)
*(2) all infested ramets in sample (August 1999)
*(3) 20 randomly selected ramets/site (early September 1999)
*(4) 20 randomly selected ramets/site (mid October 1999)
**Acres

SERICEA LESPEDEZA INVASION AND CONTROL: A PRELIMINARY ECONOMIC IMPACT ESTIMATE

Gary May
Extension Assistant
Grazing Land Water Quality

Rodney Jones
Extension Agricultural Economist
Livestock Production

Kansas State University

Introduction

Sericea lespedeza is a shrubby, deciduous perennial weed threatening Kansas grazing land, particularly the Flint Hills region. Current herbicide control options include triclopyr or metsulfuron-methyl. Research suggests weed suppression using chemical control lasts approximately three years. Application costs are estimated at $16 per acre. The most commonly discussed alternative control option is goat grazing. While sericea lespedeza is unpalatable to cattle, goats will selectively graze it down. The objective of this paper is to present preliminary projections of the economic impact of a sericea lespedeza invasion and the estimated profitability of controlling it.

The long-term economic consequence of controlling sericea lespedeza depends on its dynamic invasion patterns and desirable forage suppression characteristics. Biological data documenting this relationship is limited. Figure 1 depicts one expert's projection of a likely growth pattern in stem concentration over a 30-year period. The invasion begins slowly after the initial infestation, increases rapidly after approximately 10 years, and then levels off at a high density. Applying herbicides beginning at first detection and repeating every three years is projected to maintain stem density at a relatively low level for the entire 30 years. Figure 2 shows linear and curvilinear forage suppression scenarios of sericea lespedeza. Since the actual forage suppression scenario in Kansas is unknown, we examined these two plausible scenarios in this very preliminary study.

Forage released by controlling sericea lespedeza was valued at the 20-year average annual pasture rental rate, in 1998 dollars, listed in the Bluestem Pasture Reports. The estimated rental rate used in this analysis was $18 per acre for pasture producing 3,500 pounds of grass forage per acre. For purposes of illustration, fixed

ownership costs, which included property taxes and fence maintenance, were estimated at $6 per acre. In accordance with standard capital budgeting techniques, the value of desirable forage released by controlling sericea lespedeza each year was discounted at a 6 percent interest rate and summed to generate net present value (NPV) estimates.

Herbicide Control

Figures 3 and 4 show the estimated NPV of net cash flows (rental income minus the fixed cost component) generated by various infestation and control options assuming linear and curvilinear sericea lespedeza/grass production tradeoff. For comparison, under the ideal no-invasion scenario, the NPV of the estimated 10, 20, and 30 year income for a pasture free of sericea lespedeza was estimated at $89, $122, and $135 per acre, respectively. Assuming a linear sericea lespedeza/grass production tradeoff depicted in Figure 2, the estimated NPV of income on a pasture with an uncontrolled sericea lespedeza invasion is $81, $86, and $80 after 10, 20, and 30 years. The estimated NPV of the 20 and 30-year income streams generated by pasture was reduced by $36 and $55 per acre. According to Figure 3, the NPV associated with chemical control never exceeds the NPV of no control. This suggests chemical treatment costs are not recovered during the 30-year time period. The unfortunate implication, if the underlying assumptions are close to correct, is that the landowner would never have a large enough private incentive to warrant control. Without public financial assistance or regulation, the economically optimal choice would be to allow sericea lespedeza to overtake the pasture.

The assumption of a curvilinear relationship between sericea lespedeza and grass production generates a greater economic benefit associated with control during early infestation than the linear relationship, thereby improving the profitability of applying chemical control. The NPV of rental income from a pasture infested with uncontrolled sericea lespedeza was estimated at $63, $53, and $47 per acre after 10, 20, and 30 years, respectively. The NPV of rental income generated after chemically controlling sericea lespedeza was $41, $59, and $47 per acre after 10, 20, and 30 years. Chemical control costs were recovered after year 19 and generated a NPV of $6 per acre over no control after 20 years. This suggests long-term chemical control is preferred to no control when the lespedeza/grass production relationship is curvilinear, as depicted in Figure 2.

Goat Grazing

Cost and revenue data for goat grazing is not widely available. In addition, due to the small size of the industry, historical cost and return projections can be unreliable when trying to project economic outcomes associated with practices that would induce large changes in the size of the meat goat industry. Preliminary studies, however, suggest controlling sericea lespedeza with goats offers promise. Based on the assumptions used in the chemical control analysis, a landowner could lose up to $5 per acre annually on a goat grazing system that yields similar weed suppression and still control sericea lespedeza at a lower cost than by appliying herbicides.

Conclusion

Future economic analysis of the sericea lespedeza invasion problem will need to be based on refined estimates of growth patterns and forage suppression. A better understanding of the biological and physiological characteristics of sericea lespedeza will provide a better understanding forage release and improve the prospect of controlling sericea lespedeza. For example, if the initial inflection point of the growth curve in Figure 1 occurs later than pictured, it will reduce the adverse impact of a sericea lespedeza invasion and the profitability of controlling it. To develop more precise economic impact estimates, case specific costs and forage values as well as discount rates will need to be examined. Alternative assumptions regarding public willingness to assist in the control of this weed will greatly impact the resulting optimal strategy of the landowner.

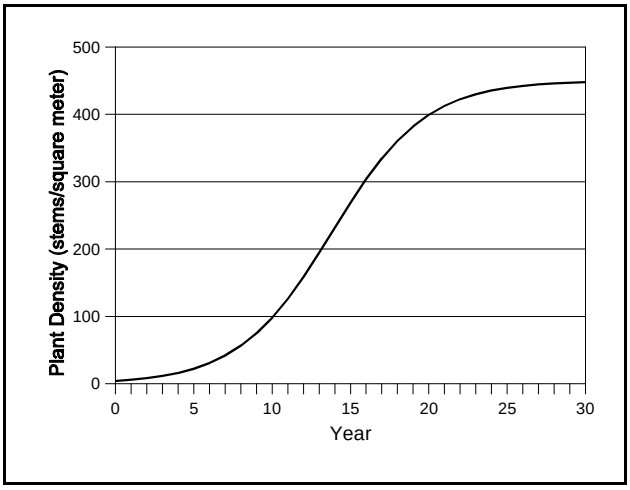

Figure 1. Projected 30 year sericea lespedeza invasion pattern.

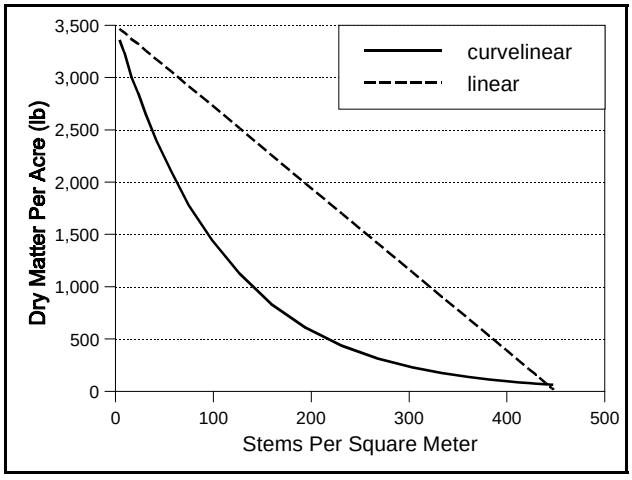

Figure 2. Alternative desirable forage suppression characteristics of sericea lespedeza.

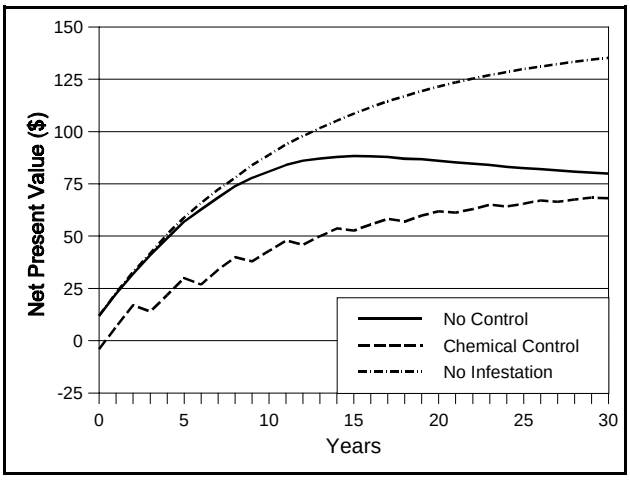

Figure 3. Net present value of pasture income assuming a linear sericea lespedeza/desirable forage trade-off.

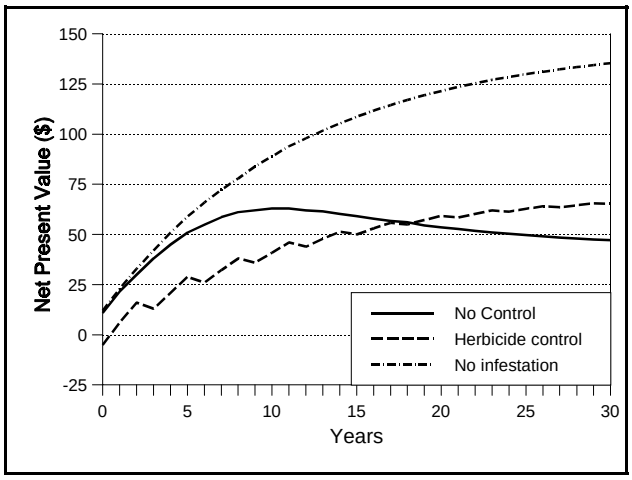

Figure 4. Net present value of pasture income assuming a curvilinear sericea lespedeza/desirable forage trade-off.

Summary and Future Direction

Paul D. Ohlenbusch
Extension Specialist
Range and Pasture Management
Kansas State University

Sericea lespedeza is an introduced forage legume that has escaped to become a problem in rangeland and pastureland. Its main problem is the low palatability to cattle after about 6 to 8 inches of growth. Tannin compounds are produced by the plant at that height making the forage undesirable to cattle. A prolific seed producer, it can quickly build a seed bank that will ensure future generations even if the existing mature plants are removed.

As we best understand the seed transport mechanism, any animal that grazes the plant following seed maturation can spread the seed in manure, which is a prime growth medium. The use of prescribed burning for rangeland management appears to stimulate germination and emergence. The combination of a tap and fibrous root system appears to give sericea lespedeza drought resistance. Its ability to establish and thrive in shallow soils of low fertility and to tolerate soils ranging from very acidic to slightly alkaline as well as to do well in loamy soils that are deep, fertile and well drained add to the complexity of controlling and limiting its spread. It has few insect and disease problems. Any plant with this broad adaptation will establish and thrive without doubt.

The Future

It will take time to develop the full understanding of how to manage and control sericea lespedeza. The traditional "spray and pray" approach we have relied on for several decades is limited today by economics and environmental factors. Innovative, non-traditional management options combining chemical, mechanical, biological, and cultural methods must be explored with a better understanding of the biology and physiology of the plant. A multi-state working group involving Kansas, Nebraska, Oklahoma, and Missouri is developing. Sharing the results of research and experience of resources other than what Kansas has will help.

The greatest barrier to developing the management and control strategies for sericea lespedeza has been the lack of an identification, research, and education system to "get ahead" of the problem rather than waiting until the problem is already at a "fever pitch." We need to have in place the ability to identify invading plants very early, develop an understanding of the biology and physiology of the plants, and develop management and control strategies appropriate to the level of invasion that exists. Without this system, every invading plant will be attacked on a "crisis basis" rather than having the ability to limit or even eliminate the invasion.

Sericea lespedeza is the first major invader that fits this pattern of "crisis attack." This invasive species is not only a research and management challenge, but puts the future of the tallgrass prairie region, including the Kansas Flint Hills, in doubt. Sericea lespedeza has the potential to replace the native big bluestem, Indiangrass, and switchgrass with a monoculture of sericea lespedeza. Other plants are probably in line that have a similar potential.

Managing and controlling invasive plants in the future will require the following steps to be in place:

1. We need a system that allows the early identification of invasive plants to potentially stop their establishment. An example of this is the current effort, spearheaded by the Plant Health Division of the Kansas Department of Agriculture, to confine and eliminate Grecian foxglove (*Digitalis lanata)* that was found in Woodson County. Grecian foxglove not only is an invasive plant but also is a threat to the health and well being of people and animals. It contains digitalis, a coronary stimulant.

2. We need stronger regulation and enforcement to prevent the importation of federal and state listed noxious and prohibited plants from entering Kansas,

regardless of their apparent value, profitability, or beauty.

3. We need a commitment by landowners, operators, commercial business, agencies, and the general public to aggressively require the management and control of existing noxious weeds and to accomplish item two. This would require a cooperative effort by groups that currently have differing goals for their unique endeavors.

4. We need the ability to develop economic impact assessments for consideration in determining which species will be attacked. A mechanism is needed to develop the economic impact of each invasive species.

5. We need incentives, including monetary and legal, if society values the native vegetation that is so much a part of the Kansas heritage. The Flint Hills, rich in history, folklore, tradition, and mystic, is already threatened by economic, political, and social pressures. Sericea lespedeza and other invasive species add more threats to the list.

6. We need a long term research and education program, for sericea lespedeza and other invasive species, to compliment the above steps.

This should be a cooperative effort with surrounding states to not only "tame" sericea lespedeza, but to also be prepared to aggressively attack other potential invasive plants such as purple loosestrife and Caucasian bluestem that we know are already here and have been identified as problems. Other species are probably in line that we are not aware of.

A Final Thought

The management and control of invasive plants as outlined above is not just for the benefit of the current "land users'" but for society as a whole, both today and in the future. President Clinton, on February 3, 1999, signed the *Invasive Species Executive Order* requiring federal agencies to develop guidelines and strategies for managing and controlling, not only plants, but all invasive species, including plants, animals, and insects. Many invasive species already are major problems. The longer we wait to begin a comprehensive approach to identifying, researching, and educating everyone involved, the more expensive management and control will be.

Notes

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Co-Chairs of the Symposium and Editors of the proceedings:

Paul D. Ohlenbusch
Extension Specialist
Range and Pasture Management
Kansas State University

James M. Mayo
Associate Professor
Division of Biology
Emporia State University

Local Arrangements:

Jeff Davidson
County Extension Agent, Agriculture
Greenwood County Extension

Doug Musick
County Extension Agent, Agriculture
Pottawatomie County Extension

Matt Pfeifer
County Extension Agent, Agriculture
Wabaunsee County Extension

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