SPECIES: Lespedeza cuneata

Choose from the following categories of information.

INTRODUCTORY

SPECIES: Lespedeza cuneata

Fred Fishel, University of Missouri 2002.

AUTHORSHIP AND CITATION:
Munger, Gregory T. 2004. Lespedeza cuneata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: http://www.fs.fed.us/database/feis/ [2007, September 24].

FEIS ABBREVIATION:
LESCUN

SYNONYMS:
None

NRCS PLANT CODE [88]:
LECU

COMMON NAMES:
sericea lespedeza

sericea
Chinese bush clover
Chinese bushclover
Chinese bush-clover
Chinese lespedeza
common lespedeza

TAXONOMY:
The currently accepted scientific name for sericea lespedeza is *Lespedeza cuneata* (Dum.-Cours.) G. Don. (Fabaceae) [10,21,28,30,42,49,60,71,75,91,95,98].

Several cultivars of sericea lespedeza have been developed for agricultural and other uses (see Importance To Livestock and Wildlife and Other Uses) [2,32,57,63,73].

Hanson and Cope [33] determined sericea lespedeza does not hybridize with the native North American species creeping lespedeza (*L. repens*), tall lespedeza (*L. stuevei*), or slender lespedeza (*L. virginica*).

LIFE FORM:
Forb

FEDERAL LEGAL STATUS:
No special status

OTHER STATUS:
Sericea lespedeza is declared a noxious weed in Kansas [79].

DISTRIBUTION AND OCCURRENCE

SPECIES: Lespedeza cuneata

- GENERAL DISTRIBUTION
- ECOSYSTEMS
- STATES/PROVINCES
- BLM PHYSIOGRAPHIC REGIONS
- KUCHLER PLANT ASSOCIATIONS
- SAF COVER TYPES
- SRM (RANGELAND) COVER TYPES
- HABITAT TYPES AND PLANT COMMUNITIES

GENERAL DISTRIBUTION:
Sericea lespedeza is native to eastern and central Asia [3,21,37,84,85]. It was initially planted in the U.S. in 1896 by the North Carolina Agricultural Experiment Station [67], and has since been widely planted in the U.S. Sericea lespedeza has escaped cultivation in many areas, and now occurs from southern New England, west to southern Wisconsin, Iowa and Nebraska, and south to Texas and Florida [6,18,21,26,28,37,41,60,75,76,81,88,89,91,95,98]. Kartesz and Meacham [49] also include Hawaii and Ontario on their sericea lespedeza distribution map. Guernsey [32] indicated a "range of adaptation" from southern New Jersey, west through the southern portions of Pennsylvania, Ohio, Indiana, and Illinois, into eastern Kansas, and south to eastern Texas and Florida. While this "range" was originally meant to indicate where sericea lespedeza might be successfully cultivated in the U.S., it could also describe a general range where it is likely to be invasive. Plants database provides an online sericea lespedeza distribution map.

Sericea lespedeza appears to be spreading westward in the central Great Plains. Ohlenbusch and others [67] indicate it has spread westward in Kansas and Oklahoma on Conservation Reserve Program (CRP) lands via contaminated native grass seed mixtures collected from sericea lespedeza-infested rangelands. The Colorado Weed Management Association
considers sericea lespedeza a "potential invader", but as of this writing (2004) there are no published accounts of its occurrence in Colorado.

The following biogeographic classification systems are presented to demonstrate where sericea lespedeza is likely to be present, based on reported occurrence and biological tolerance to factors likely to limit its distribution. Precise distribution information is unavailable. Therefore, these lists are speculative and may be imprecise.

ECOSYSTEMS [27]:
FRES10 White-red-jack pine
FRES12 Longleaf-slash pine
FRES13 Loblolly-shortleaf pine
FRES14 Oak-pine
FRES15 Oak-hickory
FRES16 Oak-gum-cypress
FRES17 Elm-ash-cottonwood
FRES18 Maple-beech-birch
FRES31 Shinnery
FRES32 Texas savanna
FRES38 Plains grasslands
FRES39 Prairie
FRES41 Wet grasslands

STATES/PROVINCES: (key to state/province abbreviations)
UNITED STATES

AL	AR	CT	DE	FL	GA
HI	IL	IN	IA	KS	KY
LA	MD	MA	MI	MS	MO
NE	NJ	NY	NC	OH	OK
PA	SC	TN	TX	VA	WV
WI					

CANADA

ON

BLM PHYSIOGRAPHIC REGIONS [5]:
14 Great Plains

KUCHLER [52] PLANT ASSOCIATIONS:
K065 Grama-buffalo grass
K067 Wheatgrass-bluestem-needlegrass
K069 Bluestem-grama prairie
K070 Sandsage-bluestem prairie
K071 Shinnery
K074 Bluestem prairie

K075 Nebraska Sandhills prairie
K076 Blackland prairie
K079 Palmetto prairie
K080 Marl everglades
K081 Oak savanna
K082 Mosaic of K074 and K100
K083 Cedar glades
K084 Cross Timbers
K085 Mesquite-buffalo grass
K086 Juniper-oak savanna
K087 Mesquite-oak savanna
K088 Fayette prairie
K089 Black Belt
K092 Everglades
K100 Oak-hickory forest

SAF COVER TYPES [25]:
40 Post oak-blackjack oak
42 Bur oak
46 Eastern redcedar
64 Sassafras-persimmon
66 Ashe juniper-redberry (Pinchot) juniper
67 Mohrs (shin) oak
68 Mesquite
70 Longleaf pine
71 Longleaf pine-scrub oak
72 Southern scrub oak
74 Cabbage palmetto
75 Shortleaf pine
76 Shortleaf pine-oak
78 Virginia pine-oak
79 Virginia pine
80 Loblolly pine-shortleaf pine
81 Loblolly pine
83 Longleaf pine-slash pine
84 Slash pine
109 Hawthorn
110 Black oak
111 South Florida slash pine

SRM (RANGELAND) COVER TYPES [78]:
601 Bluestem prairie
602 Bluestem-prairie sandreed
604 Bluestem-grama prairie
605 Sandsage prairie
606 Wheatgrass-bluestem-needlegrass
611 Blue grama-buffalo grass
615 Wheatgrass-saltgrass-grama
704 Blue grama-western wheatgrass
709 Bluestem-grama
710 Bluestem prairie
711 Bluestem-sacahuista prairie

715 Grama-buffalo grass
717 Little bluestem-Indiangrass-Texas wintergrass
718 Mesquite-grama
722 Sand sagebrush-mixed prairie
727 Mesquite-buffalo grass
728 Mesquite-granjeno-acacia
729 Mesquite
730 Sand shinnery oak
731 Cross timbers-Oklahoma
732 Cross timbers-Texas (little bluestem-post oak)
733 Juniper-oak
734 Mesquite-oak
735 Sideoats grama-sumac-juniper
801 Savanna
802 Missouri prairie
803 Missouri glades
804 Tall fescue
809 Mixed hardwood and pine
810 Longleaf pine-turkey oak hills
811 South Florida flatwoods
812 North Florida flatwoods
815 Upland hardwood hammocks
820 Everglades flatwoods

HABITAT TYPES AND PLANT COMMUNITIES:
Sericea lespedeza is found within many habitats across North America (see Site Characteristics), and may be associated with a variety of plant taxa, functional guilds, and communities. While not intended as an exhaustive or definitive summary, the following information describes habitats and plant communities in the U.S. where sericea lespedeza is known to occur.

Location	General Habitat Description	Dominant Plant Species (if known)	References
eastern Arkansas	prairie remnant		[41]
Florida	open hammocks and disturbed sites		[98]
northern Florida	ruderal habitats		[10]
Kansas	tallgrass prairie within oak savanna	blackjack oak (*Quercus marilandica*) and post oak (*Quercus stellata*)	[23]
eastern Kansas	rocky prairie and roadsides		[3]
southwestern Kentucky	abandoned pastures	tall fescue (*Festuca arundinacea*) and broomsedge bluestem (*Andropogon virginicus*)	[93]
Missouri	woodlands, thickets, fields, prairies, disturbed open ground, borders of ponds and swamps, meadows, and especially along roadsides		[81]

Long Island, New York	native grassland remnant		[45]
Oklahoma	old-fields and disturbed areas		[37]
South Carolina	pine savanna	longleaf pine (*Pinus palustris*)	[26]
South Carolina	old-field	broomsedge bluestem	[29]
West Virginia	fields and roadsides		[84]
Carolinas	fields, roadsides, and waste places		[71]
Great Plains	open woodlands, thickets, stream valleys, around lakes and ponds, waste places and roadsides		[30]
southern New England	roadsides and disturbed areas		[28]

Helm and Etheridge [37] provide a vegetation classification describing plant communities in Oklahoma where sericea lespedeza is a dominant species.

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Lespedeza cuneata

James H. Miller, USDA Forest Service, www.invasive.org, 2004

GENERAL BOTANICAL CHARACTERISTICS:
Sericea lespedeza is a nonnative, warm-season, perennial forb [3,10,21,30,57,71,84,85]. Plants may be 1.6 to 6.6 feet (0.5-2 m) tall [3,21,30,57,71,84,85] and multi-stemmed [3,21,28,85], becoming increasingly so with age. Two- to three-year-old plants may have 20 to 30 stems [88]. Sericea lespedeza has an erect growth habit, with numerous, long, coarse to fine, ascending stems arising from a caudex. Plants have a somewhat shrubby appearance due to multiple stems [3,21,28,57,85].

Leaflets are 0.2 to 1 inch (0.5-2.5 cm) long [3,21,28,30,71,85] and 0.06 to 0.2 inch (1.5-6 mm) wide [3]. Leaves are densely distributed on branches and main stem [3,28,30,57].

Inflorescences are solitary or in clusters of 2-4 on short peduncles in the axils of upper and median leaves [28,30,71,85]. Flowers may be chasmogamous and/or cleistogamous (see Breeding System) [57,85]. The Great Plains Flora Association [30] indicates cleistogamous flowers are common. Cleistogamous flowers are perfect, and nearly always self-fertilized [34].

Fruits are single-seeded [21,30,85], 0.10 to 0.14 inch (2.5-3.5 mm) long [3,21,30,71,85], indehiscent [21] pods [30] or oval legumes [28,71,85]. Seeds are 0.06 to 0.1 inch (1.5-2.5 mm) long [3,85].

Sericea lespedeza develops a 3 to 4 feet (0.9-1.2 m) deep, profusely branched taproot [37,66,88].

The preceding description of sericea lespedeza provides characteristics that may be relevant to fire ecology, and is not meant for identification. Sericea lespedeza may be confused with desirable native legumes, including several native *Lespedeza* spp. Slender lespedeza may be the easiest to confuse with sericea lespedeza [67,89]. Kansas State University's Agricultural Experiment Station and Cooperative Extension Service and Oklahoma's Cooperative Extension Service
provide online information for distinguishing sericea lespedeza from slender lespedeza. Missouri's Conservation Commission
provides online information to help distinguish sericea lespedeza from roundhead lespedeza (*L. capitata*) and hairy lespedeza (*L. hirta*). To be certain, keys for identification are available (e.g. [3,21,28,30,71,84,85,91,95,98]). Photos and descriptions of sericea lespedeza are also available online at the Multi-State Sericea Lespedeza Work Group website.

RAUNKIAER [72] LIFE FORM:
Hemicryptophyte

REGENERATION PROCESSES:
Sericea lespedeza is a perennial forb, with new aboveground tissue originating each spring from caudices, located from 1/2 to 3 inches (1.3-7.6 cm) below ground [23,37,81]. Sericea lespedeza also produces substantial numbers of seeds that may remain viable in the soil for many years.

Breeding system:

Sericea lespedeza plants may contain both chasmogamous and cleistogamous flowers (see flower description) [57,85]. Cope [17] measured crossing in 3 populations of sericea lespedeza over 2 to 3 years. He found that crossing in chasmogamous flowers ranged from 16% to 43% across populations and years, and chasmogamous seed represented between 10% and 38% of total seed production. Proportion of chasmogamous flowers may be influenced by photoperiod length. Bates [4] studied growth and seed production in the greenhouse for 8 strains of sericea lespedeza under 4 different photoperiods. Greatest production of chasmogamous flowers among all strains was under a consistent 13-hour photoperiod. Although results varied by strain, treatments of consistent photoperiods less than 13 hours long generally resulted in reduced proportion of chasmogamous flowers, with chasmogamy negatively related to photoperiod length. No chasmogamy occurred for treatments with photoperiods of 14 hours, 15 hours, or "natural day" plus 3 hours of light beginning at midnight.

Pollination: Chasmogamous flowers are insect pollinated, often by bees [9,17].

Seed production:

Sericea lespedeza often produces substantial numbers of seeds. Seed production rates of 150 million to 300 million seeds/acre have been recorded on agricultural sites specifically cultivated for sericea lespedeza [32]. Although seed production in most natural areas and other uncultivated sites is likely to be less than above, it is a significant factor to consider regarding invasive populations of sericea lespedeza.

Seed production is greatest on sites with favorable fertility and (especially) moisture [32]. In particular, reduced flowering and seed production may result from low soil phosphorus levels [94].

Seed production may also be related to day length. Bates [4] found that, when subjected to treatments of consistent photoperiod length (treatments consisted of 8, 10, 12, 13, 14, and 15 hours and "natural day" plus 3 hours of light at midnight), greatest overall seed production occurred in the 13-hour treatment.

Seed dispersal:

As of this writing (2004) there is scant information about sericea lespedeza seed dispersal that is not related to anthropogenic activities. Birds may disperse seeds [81], but no information is available concerning seed viability following avian consumption and excretion, potential dispersal distances, or habitats at risk. More information is needed to determine if seeds are dispersed by wind or water.

Humans are probably most responsible for dispersing sericea lespedeza seed any significant distance. Haying activities will spread seed [81], and livestock can disperse seed in manure [89]. Ohlenbusch and others [67] indicate sericea lespedeza is spreading westward in Kansas and Oklahoma on Conservation Reserve Program (CRP) lands via contaminated native grass seed mixture collected from sericea lespedeza infested rangelands.

Seed banking:

While specific information on seed longevity is scant, there is some indication that sericea lespedeza can establish and maintain soil seed banks. Wheeler and Hill [94] indicated seed longevity is 4 years, while Ohlenbusch and others [67] and Smith [81] reported sericea lespedeza seeds may remain viable in the soil for 20 or more years. No research is provided to support these contentions. Others have noted that sericea lespedeza seed banks may occur [31,45,50], but again, few details are available. Research is needed to determine how long sericea lespedeza seeds can remain viable in soil.

Germination:

It has been suggested that sericea lespedeza seed requires scarification in order to imbibe water and germinate [67,86]. According to Tabor [86], only a portion of seed produced in a given year is immediately germinable. Remaining seed becomes scarified and pervious to water slowly over time. Theoretically, this strategy insures a supply of viable seed in future years when drought diminishes survival of immediately germinable seeds or established seedlings. USDA NRCS [88] reports that approximately 70-80% of sericea lespedeza seed is capable of germination in the 1st year, although supporting research is not cited. Research is needed to determine what proportion of seed germinates in subsequent years, and what factors influence these processes. (Also see discussions of Seed banking and Control).

Temperature is perhaps the most-studied factor influencing sericea lespedeza seed germination. Qiu and others [69] determined optimum germination temperature for mechanically scarified seeds was between 68 and 86 ºF (20-30 ºC). Others have examined the effects of unusually high temperatures on germination, such as might occur during a fire, with conflicting results.

Results from a study by Segelquist [74] suggest that exposure of sericea lespedeza seeds to heat might increase germination rates. Seeds were moistened and exposed to high temperatures, then placed in moist Petri dishes where germination was subsequently observed. While details are limited, temperatures of 140, 176, and 212 ºF (60, 80, and 100 ºC) apparently enhanced germination. The effects of time of exposure varied. The 176 and 212º treatments enhanced germination after 1 minute of exposure, while the 140º treatment showed a response after 4 minutes.

Martin and others [55] found that seed germination was not enhanced by heating. They subjected sericea lespedeza seeds to dry (a low humidity oven) and moist (relative humidity 100%; over a water bath) heat for 4 minutes. A 4-minute interval was chosen to mimic duration of heating by a hypothetical surface fire. Germination rates of sericea lespedeza seeds were not significantly ($p<0.01$) different within a range of nonlethal temperatures, under either moist or dry conditions. Although discrete treatment temperatures were not clearly specified in the paper, it appears the range under which seeds readily germinated was from 77 to about 194 ºF (25-90 ºC).

More research is needed to determine the effect of exposure to elevated temperature on sericea lespedeza seed germination. This topic has important implications concerning the effects of fire on invasive potential of sericea lespedeza (see Fire Management Considerations).

Seedling establishment/growth:

Seedling emergence and establishment, as well as commencement of spring growth on established plants, are relatively slow compared with many competing plants. Growth allocation in newly established plants tends toward root development, with relatively little top-growth [37,56,67,96].

Temperature and day length may influence seedling establishment and growth. Mosjidis [62] tested the effect of temperature on emergence of sericea lespedeza seedlings. Emergence was significantly ($p< 0.01$),positively, and linearly related to day/night temperature. Average percent emergence increased by about 20% for each 6 ºF (3
ºC) temperature increase, with 55/46, 61/46, 66/57 ºF (13/8, 16/11, and 19/14 ºC) day/night temperature regimes. Mosjidis [62] also tested the effects of day length and temperature on seedling height and shoot dry weight. Day/night temperature treatments ranged from 64/57 to 86/79 ºF (18/14-30/26 ºC), and day length treatments were 11, 13, and 15 hours. Height and shoot weight were significantly ($p<0.01$), positively, and linearly related to day/night temperature and day length, with greatest seedling growth generally occurring at the highest temperatures and longest day lengths.

Additionally, young seedlings are also relatively cold tolerant and can withstand freezes severe enough to kill early-season sprouts on established plants. Maturing foliage becomes increasingly sensitive to freezing temperatures [32].

Fire, especially in spring, may enhance conditions favorable for seedling establishment and growth (see Fire Management Considerations).

Asexual regeneration:

The usual pattern of yearly regeneration of sericea lespedeza is by new shoots originating from caudices located 0.5 to 3 inches (1.3-7.6 cm) below ground [23,30,37,81,85]. This habit does not appear to result in broad dispersal of sericea lespedeza populations. Sericea lespedeza also sprouts in response to mechanical damage of aboveground tissue [37,67,89], although details describing the biology of this habit are sparse. It has been suggested that sericea lespedeza can sprout from "root buds" [82], but published evidence is lacking.

SITE CHARACTERISTICS:
Sericea lespedeza grows on a variety of sites throughout eastern North America. It is most likely found on or near sites where it was planted in the past (see Importance to Livestock and Wildlife and Other Uses). It generally occurs on relatively open sites with little tree or shrub competition (see Habitat Types and Plant Communities and Successional Status). According to Ohlenbusch and others [67], sericea lespedeza can establish at low population levels in such areas as "fence rows, brushy and grassy areas, and where fire and grazing have been excluded for years", although its long-term competitiveness on such sites is unclear.

Sericea lespedeza grows on a variety of soil types, with soil textures ranging from clays to sands [21,32,37,57,85]. Helm and Etheridge [37] reported that roots can penetrate heavy clay subsoils, and Guernsey [32] indicated that it will grow over hardpan, provided there is a minimum 18 inches (46 cm) of permeable surface soil for root development. Sericea lespedeza will also grow in deep sands that are well supplied with organic matter [32]. Diggs and others [21] indicate that it is especially invasive on sandy soils in north-central Texas. While some have noted that sericea lespedeza grows best on well-drained soils [32,85], it is apparently somewhat flood tolerant, especially in winter and if flood waters are cool and flowing [32].

Deep, well-developed root systems allow sericea lespedeza to grow on droughty or infertile sites [32,37,67]. It grows relatively well on infertile soils where many other plants do not thrive [43,57,85], and is probably less competitive on fertile soils. Sericea lespedeza apparently grows best in areas with >30 inches (760 mm) annual precipitation [32], although it has been found in western Oklahoma where average annual precipitation is less [89].

Sericea lespedeza grows on soils ranging from strongly acid to alkaline [32]. It has been grown on soils with pH as low as 4.0 [59]. Cline and Silvernail [11] found reduced growth in soils approaching pH 6.0 for the cultivar 'Serala', and concluded that at least 'Serala' has a preference for acidic soils. Guernsey [32] indicated sericea lespedeza grows best between pH 6.0-6.5. Sericea lespedeza is relatively tolerant of high levels of soil-soluble aluminum, typical in acidic soils. It appears that aluminum binds with phosphate groups in the DNA of growing root tips, accumulating on root cell walls. Sericea lespedeza thereby can avoid uptake of aluminum at levels that might otherwise be toxic [44]. Reduced growth in acid soil has been associated with toxic levels of manganese. Cline and Silvernail [11] found significantly ($P < 0.05$) reduced sericea lespedeza growth in acidified soil (pH 4.1-4.3) that was attributed to water-extractable manganese concentrations >1.3 mM and Mn^{2+} activity levels > 0.4 mM.

The effect of cold winter temperatures on sericea lespedeza survival is uncertain. Dormant plants have survived winter temperatures as low as -15 ºF (-26 ºC), and a stand subjected to -17 ºF (-27 ºC) showed "only a trace" of mortality [37]. However, according to the USDA Natural Resources Conservation Service [88], "prolonged freezing will contribute to winter kill." A late-spring freeze can damage plants, once winter-dormant buds have commenced growth and are exposed [37].

Vogel [90] recommends against planting sericea lespedeza above 2,000 feet (610 m) in northern West Virginia or 1,200 (366 m) feet in Pennsylvania, when revegetating surface mine spoils.

SUCCESSIONAL STATUS:
Understanding the successional status of sericea lespedeza is problematic. Predicting interactions between sericea lespedeza invasion and succession is hindered by a lack of information about which communities are most susceptible to invasion. A survey of literature that mentions occurrence of sericea lespedeza indicates it is often found in open areas that lack shrub or tree cover, such as grasslands, pastures, old fields, or prairies. Additionally, areas where sericea lespedeza grows in the presence of woody species may include open woodlands, savannas or thickets. (For more information see Habitat Types and Plant Communities.)

Shade tolerance and the ability of sericea lespedeza to compete for light are also not entirely clear. The tall, upright growth habit, multiple branches, and dense foliage typical of established sericea lespedeza plants would appear to confer considerable competitive advantage for light in grassland habitats [67,89]. Eddy and Moore [23] state that sericea lespedeza "shows low tolerance for shade." Ohlenbusch and others [67] provide a conflicting report of sericea lespedeza shade tolerance. One passage states that sericea lespedeza "tolerates shade quite well, establishing in dense shade where direct sunlight does not reach during the day." In a subsequent paragraph, the following statement is found: "It (sericea lespedeza) appears to establish best where competing vegetation is very short, and light is allowed to reach the germinating seed and seedlings."

Little is known about longevity of sericea lespedeza populations or impacts of invasion on floristic dynamics of affected communities. One review claims that a single plant can form a "large stand" that may persist for more than 20 years [82]. While more research is needed to determine the successional stages in which sericea lespedeza is most likely invasive in various plant communities, and the extent to which sericea lespedeza invasion may alter successional pathways, the following studies provide some insight.

Mays and Bengston [56] studied the effects of different fertilization treatments, alone and in combination with different herbaceous cover crops, on loblolly pine (*Pinus taeda*) growth on an Alabama coal mine spoil. In experimental plots, sericea lespedeza was established from seed simultaneously with outplanting of pine seedlings. The other herbaceous cover crops were tall fescue and Bermuda grass (*Cynodon dactylon*). While sericea lespedeza was still "in a vigorous condition" after 9 years, tall fescue and Bermuda grass had mostly disappeared after 4 or 5 years, apparently due to shading from pines. After 13 years, some sericea lespedeza still persisted in the stand despite complete closure of the pine canopy. It is apparent from this study that, while sericea lespedeza is unlikely to become invasive in closed-canopy forests, it may be persistent during succession from open grassland or old-field conditions to dominance by taller woody species. This seems particularly likely if woody plant establishment is sparse enough to preclude a closed canopy of trees or shrubs. In addition, these results provide some evidence that sericea lespedeza may be more shade tolerant than grass competitors such as tall fescue and Bermuda grass.

Hartley and others [36] studied woody plant invasion of 20 "disposal areas" associated with construction of the Tennessee-Tombigbee Waterway, located in central Tennessee, northwestern Alabama, and northeastern Mississippi. These areas were initially seeded with 5 grass mixtures (various combinations of weeping lovegrass (*Eragrostis curvula*), bahiagrass (*Paspalum notatum*), Bermuda grass, tall fescue, and Italian ryegrass (*Lolium multiflorum*)). Four of these mixtures also contained sericea lespedeza seed. Monitoring of woody plant succession began 2 years after initial seeding and continued for 7 consecutive years. Sericea lespedeza-dominated areas (>60% coverage) exhibited significantly ($p<0.01$) less woody plant encroachment than areas dominated by grasses. Inhibition of woody plant succession in sericea lespedeza-dominated areas was attributed, in part, to constraints on woody plant seed germination due to substantial sericea lespedeza leaf litter. Litter layer depth in sericea lespedeza-dominated areas ranged from 1 to 2.5 inches (2.5-6.4 cm), and these areas had <1% bare soil exposure. In contrast, grass-dominated areas had less litter (<1 inch (2.5 cm)) and greater bare soil exposure (≥5%). In addition, woody seedling establishment probably was also inhibited by intense competition from dense sericea lespedeza populations. This study provides evidence that sericea lespedeza can alter succession in communities transitioning from herbaceous to woody plant dominance.

SEASONAL DEVELOPMENT:
Seedling emergence and commencement of spring growth on established plants may both be relatively slow compared with many competing plants [37,96], although Guernsey [32] indicates that sericea lespedeza is one of the first plants to begin growth in spring. Germination occurs from early April to June in Oklahoma [89], and growth of established plants begins in mid- to late-April in Missouri [81].

Reported flowering dates for sericea lespedeza	
Location	Dates
Alabama	July to September [9]
northern Florida	July to September [10]
Kansas	late August to early October [3]
Michigan	September to October [91]
Missouri	late July to October [81]
North Carolina	early August to mid-September [99]
South Carolina	September [26]
north-central Texas	July to October [21]
West Virginia	July to September [84]
southern Appalachians	July to September [95]
Carolinas	July to September [71]
Great Plains	July to October [85]
southeastern Great Plains	June to August [30]

Sericea lespedeza fruits in October and November in the Carolinas [71]. Senescence occurs following exposure to freezing temperatures, when plants die back to the caudex [32].

FIRE ECOLOGY

SPECIES: Lespedeza cuneata

FIRE ECOLOGY OR ADAPTATIONS:

Fire adaptations:
As of this writing (2004) there is no published information specifically describing adaptations of sericea lespedeza to fire. In general, established plants will likely respond to fire damage by sprouting from the caudex. Sericea lespedeza is a perennial forb, with new aboveground tissue originating each spring from root crown buds located 0.5 to 3 inches (1-8 cm) below the soil surface. It also sprouts in response to mechanical damage of aboveground tissue (see Asexual regeneration). Consequently, individual plants are likely to survive the heat of most surface fires, despite damage or destruction of aboveground tissue, because these live perennating tissues lie protected below the soil surface.

Sericea lespedeza may also be well adapted to postfire regeneration from on-site seed sources. Germination and establishment of sericea lespedeza seedlings may be favored in postfire environments [31,89]. In general, seed production is often prolific, and seed banking may be possible. There is also some conjecture that heating from fire may enhance sericea lespedeza seed germination (see Germination and Immediate Fire Effect on Plant). More information is needed about sericea lespedeza postfire seedling establishment.

Fire regimes:
Information about sericea lespedeza and fire regimes is lacking. Research is needed that examines the interactions of fire and sericea lespedeza, effects these interactions may have on native communities and ecosystems, and effects on their respective fire regimes. For example, sericea lespedeza may be present in remnant or restored native prairie communities [23,41,45]. Historically, fire has been an important ecological influence in prairie ecosystems [51]. Understanding the response of sericea lespedeza (and other nonnative species) to periodic fire could be critical for management and restoration efforts in these and other areas.

Irving and others [41] studied the botanical composition of 3 prairie remnants in eastern Arkansas with a long history of annual prescribed burning. Sericea lespedeza was absent from 2 of these sites. The 2 sites where it did not occur were mowed for hay (summer) and prescribe burned (winter) on an annual basis for about 65 years prior to the study. A 3rd prairie remnant was hayed and "presumably" prescribe burned annually (for a period similar to the above sites, though unspecified) until 1960, after which it was neither hayed nor burned for 17 years, prior to the study in 1977. At this latter site, sericea lespedeza formed "thick stands around the prairie border." It represented an estimated 1.6% of total plant density on the site and was found in 25% of sampled quadrats. Results of this study are inconclusive regarding the effects of annual burning on presence of sericea lespedeza in these prairie ecosystems. This study was not designed to assess the effects of annual burning on sericea lespedeza invasion. The history of plant community dynamics within these 3 tracts is unknown. Yet it is interesting to note that, of the 3 sites studied, sericea lespedeza was absent from the 2 sites that were annually burned for over 60 years, but did occur at the site where fire was excluded for the last 17 years.

The following table lists fire return intervals for communities or ecosystems in North America where sericea lespedeza may occur. This list is presented as a guideline to illustrate historic fire regimes and is not to be interpreted as a strict description of fire regimes for sericea lespedeza. For further information on fire regimes in these communities or ecosystems see the corresponding FEIS summary for the dominant taxa listed below. If you are interested in the fire regime of a plant community that is not listed here, please consult the complete FEIS fire regime table.

Community or Ecosystem	Dominant Species	Fire Return Interval Range (years)
bluestem prairie	*Andropogon gerardii* var. *gerardii*-*Schizachyrium scoparium*	< 10 [51,68]
Nebraska sandhills prairie	*A. gerardii* var. *paucipilus*-*Schizachyrium scoparium*	< 10
bluestem-Sacahuista prairie	*Andropogon littoralis*-*Spartina spartinae*	< 10 [68]
plains grasslands	*Bouteloua* spp.	< 35
blue grama-buffalo grass	*B. gracilis*-*Buchloe dactyloides*	< 35 [68,97]
juniper-oak savanna	*Juniperus ashei*-*Quercus virginiana*	< 35
Ashe juniper	*J. ashei*	< 35
cedar glades	*J. virginiana*	3-7 [68]
Everglades	*Mariscus jamaicensis*	< 10
melaleuca	*Melaleuca quinquenervia*	< 35 to 200 [65]
wheatgrass plains grasslands	*Pascopyrum smithii*	< 5-47+ [68,70,97]
shortleaf pine	*Pinus echinata*	2-15
shortleaf pine-oak	*P. echinata*-*Quercus* spp.	< 10
slash pine	*P. elliottii*	3-8
slash pine-hardwood	*P. elliottii*-variable	< 35 [92]
South Florida slash pine	*P. elliottii* var. *densa*	1-5
longleaf-slash pine	*P. palustris*-*P. elliottii*	1-4 [65,92]
longleaf pine-scrub oak	*P. palustris*-*Quercus* spp.	6-10
loblolly pine	*P. taeda*	3-8
loblolly-shortleaf pine	*P. taeda*-*P. echinata*	10 to < 35
Virginia pine	*P. virginiana*	10 to < 35
Virginia pine-oak	*P. virginiana*-*Quercus* spp.	10 to < 35 [92]
mesquite	*Prosopis glandulosa*	< 35 to < 100 [58,68]
mesquite-buffalo grass	*P. glandulosa*-*Buchloe dactyloides*	< 35 [68]
bur oak	*Quercus macrocarpa*	< 10 [92]
oak savanna	*Q. macrocarpa*/*Andropogon gerardii*-*Schizachyrium scoparium*	2-14 [68,92]
shinnery	*Q. mohriana*	< 35 [68]
post oak-blackjack oak	*Q. stellata*-*Q. marilandica*	< 10
black oak	*Q. velutina*	< 35 [92]
cabbage palmetto-slash pine	*Sabal palmetto*-*Pinus elliottii*	< 10 [65,92]
Fayette prairie	*Schizachyrium scoparium*-*Buchloe dactyloides*	< 10 [92]

POSTFIRE REGENERATION STRATEGY [83]:
Caudex/herbaceous root crown, growing points in soil
Ground residual colonizer (on-site, initial community)

Secondary colonizer (on-site or off-site seed sources)

FIRE EFFECTS

SPECIES: Lespedeza cuneata

IMMEDIATE FIRE EFFECT ON PLANT:
Fire probably top-kills established lespedeza cuneata plants and may kill seedlings. However, as of this writing (2004), there is very little published information describing the immediate effect of fire on established sericea lespedeza plants. According to Vermeire and others [89] spring burning "has no negative effect on established plants", but no further details are provided. Stevens [82] indicates that established plants will sprout following fire (see Plant Response to Fire below), which implies that at least some damage can occur to aboveground tissues from fire exposure. Cooperative Quail Study Association [16] indicates fire that occurs after germination can eliminate that season's germinants.

Heat exposure from fire can be lethal to sericea lespedeza seeds. Cushwa and others [19] reported that germination ceased after seeds were exposed to treatment temperatures >194 ºF (90 ºC) with "high" humidity, and a germination rate of 2% occurred following treatment at 212 ºF (100 ºC) with "low" humidity. In an experiment by Martin and others [55], exposure to temperatures >194 ºF (90 ºC) for 4 minutes, whether moist or dry, was apparently lethal to seeds. Segelquist [74] found that exposure to a temperature of 212 ºF (100 ºC) for >16 minutes resulted in a dramatic decline in germination rate, and seed death appeared to result after 32 minutes of exposure. While these results are difficult to extrapolate within the context of field conditions during a fire, it is apparent that sericea lespedeza seeds exposed to fire can sustain lethal damage.

There is some evidence suggesting heat from a fire may scarify dormant seed, leading to enhanced germination [74].

DISCUSSION AND QUALIFICATION OF FIRE EFFECT:
No additional information is available on this topic.

PLANT RESPONSE TO FIRE:
It is likely that established sericea lespedeza plants will sprout following damage to aboveground tissues from fire (see Fire adaptations and Asexual regeneration). According to Stevens [82] "new shoots sprout immediately after fire" following spring burns. Cooperative Quail Studies Association [13] wrote that late-winter or early spring burning, just after initiation of spring growth, slows seasonal development but "does no permanent damage." Studies are needed that characterize response of established sericea lespedeza plants to fire, under a range of burn conditions and seasons.

Germination and establishment of sericea lespedeza seedlings may be favored in postfire environments [31,89], in part due to seed scarification from fire-caused heating [67,81,82]. As of this writing (2004), research investigating heating-enhanced sericea lespedeza seed germination provides conflicting evidence (see Germination). More research is needed to determine the effects of elevated temperature, similar in magnitude and duration to that produced by field conditions during a fire, on scarification and enhanced germination of sericea lespedeza seeds.

DISCUSSION AND QUALIFICATION OF PLANT RESPONSE:
No additional information is available on this topic.

FIRE MANAGEMENT CONSIDERATIONS:
Prescribed fire may provide some control of sericea lespedeza, although as of this writing (2004), few published studies are available that document the results of prescribed fire in areas with sericea lespedeza populations. For more information about controlling invasive sericea lespedeza populations, see the Control discussion.

Spring burns are thought to promote seed germination and improve conditions for seedling establishment [31,67,81,82]. Spring burning may also "stimulate resprouting" of established plants [82]. Under these circumstances, a useful strategy might be to promote spring growth with a prescribed burn and follow up with an aggressive control measure that focuses on eradication [81]. For instance, inducing greater seed bank germination may be preferable to allowing long-term seed bank persistence, especially if managers are prepared to eliminate newly established plants before more seed is produced. According to Vermeire and others [89] increased seed germination following fire should increase effectiveness of herbicide treatments later in the growing season. Smith [81] recommends a late-spring burn (mid-May to late June) to increase utilization of sericea lespedeza by cattle (see grazing as a control measure). Cushwa and others [18] studied the response of several legumes to prescribed fire in South Carolina loblolly pine stands. In plots that were spring burned (April-May), sericea lespedeza occurrence appeared unaffected, occurring in 2 out of 131 plots in the years both prior to and following fire. It is not known if prefire and postfire plots where sericea lespedeza was found were the same 2 plots.

Cooperative Quail Study Association [16] provides some indication that seedlings may be susceptible to a spring burn. They indicate that, while burning prior to germination is likely to enhance seedling establishment, if fire occurs after germination has started in spring, "complete eradication" of seedlings may result. It is unclear at what age newly established plants can survive fire damage by sprouting. In addition, this control method may be ineffective if fuels become too moist or green in spring.

Effectiveness of summer prescribed burns for controlling sericea lespedeza is unclear. According to Stevens [82], "late summer burns" can inhibit adult plant vigor, destroy the current-year seed cohort, and decrease seedling survival. Cushwa and others [18] studied the response of several legumes to prescribed fire in South Carolina loblolly pine stands. In plots that were summer burned (late July-August), sericea lespedeza was not found prior to burning, but was recorded from 17 of 70 postfire plots.

There are concerns that fire can result in sericea lespedeza increases. Griffith [31] cited annual burning among reasons for spread of invasive sericea lespedeza. Burning was attributed with removal of residual biomass, apparently providing favorable site conditions for establishment of seedlings. Ohlenbusch and others [67] wrote that burning is assumed to enhance sericea lespedeza establishment, perhaps by increasing light availability to germinating seeds and seedlings and by scarifying seeds. Postfire invasion is probably not likely in areas where sericea lespedeza does not grow in the immediate vicinity, due to lack of long-distance seed dispersal, but this is speculative. Research is needed to determine the potential for postfire increases in sericea lespedeza, as well as postfire colonization from off-site seed sources.

MANAGEMENT CONSIDERATIONS

SPECIES: Lespedeza cuneata

IMPORTANCE TO LIVESTOCK AND WILDLIFE:

Livestock:

Sericea lespedeza was introduced as a hay and pasture species in the eastern U.S. around the 1920s-1940s [2,57,67]. Although its subsequent use as hay and forage has apparently not been widespread, contemporary advocates for its utilization still exist (e.g. [2]). Sericea lespedeza has been recommended as a pasture species in the southeastern U.S. in particular, where its deep rooting habit improves vigor and survival during summer drought [32,73]. According to Joost and Hoveland [43] root growth in acid soils is less inhibited than that of alfalfa (*Medicago sativa*). Hay from cultivated sericea lespedeza often cures more rapidly than many other common hay species [32]. In addition to utilization by cattle [31,32,67,73], domestic goats also make good gains grazing sericea lespedeza [24].

A number of sericea lespedeza cultivars have been developed, such as 'Arlington', 'Serala', 'AU Lotan', 'AU Donnelly', 'AU Grazer' and 'Interstate', for low-input cattle forage and other uses [2,32,57,63,73]. Stems on these plants are generally shorter, finer, leafier, and more numerous [32,57]. Many of these cultivars were developed with the intent to create a more palatable forage, with lower levels of undesirable tannins (see Palatability/nutritional value below) [2,61,63].

Wildlife: Sericea lespedeza has been characterized as valuable for wildlife food and cover [3,30,32]. Foliage is eaten by white-tailed deer, rabbits, and wild turkeys [67,85], and seeds are eaten by birds and rodents [85]. According to Sheldon and Causey [76] sericea lespedeza is a "good deer food." Grasshopper sparrows and meadowlarks nest in sericea lespedeza [20].

In the southeastern U.S., sericea lespedeza plantings for wildlife habitat, especially for northern bobwhite, have been studied [12]. Recommendations are not consistent. Northern bobwhite sometimes feed on sericea lespedeza seed in the southeastern U.S., particularly in late spring after native food sources have become scarce [13,14]. There are also observations of northern bobwhite rejecting sericea lespedeza seed in these same areas [15]. Over time, sericea lespedeza plantings can become thick and "rough", particularly on "rich lands", and must be burned frequently to retain habitat value for quail. Without burning, sericea lespedeza thickets become "havens" for hispid cotton rats and other "objectionable" rodents. Northern bobwhite will readily feed on residual sericea lespedeza seeds following burning of dead growth [12]. Dimmick [22] implied that dense stands of sericea lespedeza reduce habitat value for nesting northern bobwhite. In a review of the importance of *Lespedeza* spp. for wildlife, Davison [20] indicates that although sericea lespedeza seeds may be eaten by northern bobwhite, it is probably of little importance as a food source, at least in the "deep south".

In recent years, sericea lespedeza appears to have fallen out of favor as a wildlife plant. While specific examples of wildlife utilizing sericea lespedeza may be found, research supporting its importance is lacking [66,89]. Vogel [90] reported that sericea lespedeza is "considered low in value for wildlife by most biologists." Moreover, food and cover are also provided by native plants, or even nonnatives that are not invasive. Where sericea lespedeza is invasive (see Impacts below), it can reduce development of other plant species, particularly natives, that might provide a diversity of food and cover for a variety of native wildlife [67].

Palatability/nutritional value:

While sericea lespedeza has been promoted as a hay and pasture species [2,57,67], it often produces low quality forage. Sericea lespedeza forage contains condensed tannins that can reduce digestibility by inhibiting cellulolytic enzymes [85]. Suitability for grazing and hay occurs mostly when plants are young and tender (<12-18 inches (30-46 cm) tall) [32,88,90]. Maturing shoots become tough and fibrous with development. As plants mature, protein content and leaf:stem ratio decrease and tannin content increases. The height to which shoots retain palatability is positively related to site fertility [32]. Early cultivars (1920s-1940s) available for hay and pasture were generally high in tannins, making them relatively unpalatable to livestock [2]. Low-tannin cultivars subsequently have been developed that can produce acceptable forage for livestock [85], but they are more sensitive to overgrazing [2].

The following table provides biomass composition data for sericea lespedeza derived from composites of samples from 4 Alabama growing sites. These sites represent 3 major physiographic regions of the southeastern U.S.: the Appalachian Foothills, the Piedmont Plateau, and the Coastal Plain. The table is adapted from Bransby and others [7].

	Composition of sericea lespedeza biomass (g kg^{-1})
Nitrogen	23.9
Neutral-detergent fiber	560
Acid-detergent fiber	386
Lignin	139
Hemicellulose	174
Cellulose	242
Holocellulose	416

Cover value: Sericea lespedeza can provide cover for wildlife [3,20,30,32], including rabbits and northern bobwhite [20]. Although it may provide cover for some wildlife species during part of the growing season, it may also inhibit establishment of native plants that could provide a diversity of cover habitat throughout the year [89].

OTHER USES:
Sericea lespedeza has been used for revegetation, erosion control, and soil improvement in many areas of the eastern U.S. [3,21,30,32,67]. It has been planted on disturbed soils in areas such as highway embankments, utility rights-of-way, and disposal areas associated with construction sites [32,35,36,85]. It has been used for reclamation of surface coal mine sites in the eastern U.S. [32,39,53,64,90]. For revegetation purposes, sericea lespedeza can provide long-term cover with little to no maintenance requirements [90]. It often survives on poor soils where other legumes will not [3].

Sericea lespedeza has also been planted as a cover species around borders of agricultural fields [32].

Sericea lespedeza is considered a good honey plant [85].

IMPACTS AND CONTROL:
Impacts:
Sericea lespedeza can escape cultivation and become self-establishing and potentially invasive in many areas of the eastern U.S. [2,21,30,60] (see Distribution and Occurrence). Because it is generally not palatable to cattle for much of the growing season and is of doubtful worth to wildlife (see Importance to Livestock and Wildlife above), invasion can degrade forage quality in rangelands, pastures, and other plant communities [89]. Sericea lespedeza can also diminish native plant diversity. An example of the impacts of sericea lespedeza on native plant diversity is at the Hempstead Plains Grassland, Long Island, New York. Invasive sericea lespedeza and Cypress spurge (*Euphorbia cyparissias*) are threatening to displace "the best population" of sandplain false foxglove (*Agalinis acuta*) [46]. Sandplain false foxglove is federally listed as endangered and state listed as endangered in New York, Massachusetts, Maryland, Connecticut, and Rhode Island [88].

Negative impacts of sericea lespedeza generally derive from its ability to outcompete, displace, or inhibit establishment of native plants [88,90]. The tall, upright growth habit, multiple branches, and dense foliage typical of established sericea lespedeza plants confers considerable competitive advantage for light in grassland habitats [67,89]. Ohlenbusch and others [67] indicate cool-season grasses are more likely to withstand shading from invasive sericea lespedeza than warm-season grasses. Sericea lespedeza may also exclude associated species, particularly warm-season plants, through competition for water, but as of this writing (2004) no published data are available [67,89].

Sericea lespedeza is thought to be allelopathic, although mechanisms for this are largely unstudied. There is speculation that tannins leached from foliage may have negative effects on associated plants [67,82,89]. Root exudates may negatively impact germination and establishment of grasses [48,67,89]. In a greenhouse experiment, Kalburtji and Mosjidis [48] found that in the presence of sericea lespedeza root exudates: i) radicle and coleoptile length and aboveground biomass of bahiagrass and some cultivars of tall fescue were significantly ($p<0.05$) reduced and, ii) percent germination, percent emergence, and radicle and coleoptile length of Bermuda grass were significantly ($p<0.05$) reduced. Research is needed to determine possible mechanisms and biological significance of sericea lespedeza allelopathy on native North American plants in the field.

While determining particular mechanisms for invasion is difficult, the following examples nevertheless demonstrate the competitive potential of sericea lespedeza. Skousen and Call [80] found that stands of sericea lespedeza, planted in research plots in coal mine overburden at a rate 9 kilograms of seed per hectare, formed 100% aerial cover within 3 years. Others have similarly demonstrated that sericea lespedeza can dominate lower strata prior to crown closure in plantations of loblolly pine [56] and sand pine (*P. clausa*) [47] in the southeastern U.S.

Eddy and Moore [23] studied sericea lespedeza invasion of tallgrass prairie "clearings" within a Kansas oak savanna. Stem densities in invaded plots ranged from $141/m^2$ to $466/m^2$, with a mean value of $352/m^2$. Invasion resulted in reduced native plant cover and species diversity. Native grasses represented 5% and native forbs 10% of canopy coverage in invaded plots, compared with 79% and 28%, respectively, where sericea lespedeza was not present. Invaded plots contained 4 species of native grasses and 8 species of native forbs, while uninvaded plots contained 12 grass and 24 forb species. In addition to effects on native plants, sericea lespedeza invasion reduced macroinvertebrate diversity from 65 species representing 30 families, to 24 species and 14 families.

Despite reports of invasive potential, escaped populations of sericea lespedeza may not always be strongly competitive. Wright and others [96] characterized sericea lespedeza as "non-aggressive", when comparing seedling emergence of various grasses and legumes commonly used for erosion control. According to Hoveland and others [40], sericea lespedeza seedlings "are weak and compete poorly with spring and summer weeds." Indeed, slow germination and poor seedling establishment are cited as reasons for diminished popularity of sericea lespedeza as a crop species [54]. Even once established, sericea lespedeza may not necessarily become invasive. It can establish at low population levels in such areas as "fence rows, brushy and grassy areas, and where fire and grazing have been excluded for years", although its long-term competitiveness on such sites is unclear. Sericea lespedeza has been observed growing in ditches, fences rows, or pastures without invading adjacent "well-managed" rangeland and pastures [67].

Control:

Controlling populations of invasive sericea lespedeza will likely require multiple treatments, perhaps over several seasons. Established plants may sprout in response to mechanical damage of aboveground tissue (see Asexual Regeneration). A seed bank may be present, with the potential for establishment of new seedlings for many subsequent years (see Seed banking). Jordan and others [45] showed that, despite seemingly successful control of preexisting populations using several different methods, sericea lespedeza can quickly reestablish and increase to levels equaling or exceeding initial abundance. In this instance, it is not clear if reestablishment was due to sprouting and recovery of plants that had been established prior to treatments, or due to establishment of new plants from the seed bank. Nevertheless, subsequent monitoring and follow-up treatments will likely be required for long-term control. Where sericea lespedeza is slow to establish in new habitat, eradication efforts may be easiest prior to establishment of dense stands [67,89].

Where established sericea lespedeza populations have produced substantial numbers of seeds, it is important to anticipate and manage for subsequent populations of establishing seedlings. Two divergent strategies for dealing with seed banking and seedlings seem apparent.

One strategy is to suppress seed germination and seedling survival and establishment. Maintaining a substantial amount of plant residue or ground cover in early spring can reduce available light at the soil surface and thereby reduce establishment of sericea lespedeza seedlings [31]. Choice of methods for eliminating existing sericea lespedeza will be influenced by the degree of disturbance caused. Activities such as grazing or burning that remove substantial amounts of existing plant cover, especially when conducted early in the growing season, can result in conditions favorable to sericea lespedeza seedling establishment [31].

In part, the effectiveness of this strategy is probably linked to quantity and longevity of viable seeds in the seed bank. Effectiveness may be limited in areas that have held dense stands of sericea lespedeza for several years, due to the buildup of a large seed bank. Conversely, in areas where sericea lespedeza invasion is relatively sparse or recent this strategy may be useful. Inevitably, some seedlings may establish and survive at low population levels, even where ground cover and other plant competition is dense [67]. Frequent monitoring and periodic treatment of emergent sericea lespedeza seedlings should be anticipated for several years, especially following future disturbance events.

Alternatively, where a substantial seed bank is known or suspected, removing residual plant material in spring and encouraging a large flush of sericea lespedeza seed germination may be useful. The goal of this strategy is to rapidly deplete the seed bank so that restoration of a desirable native plant community may proceed. Again, activities such as grazing or burning that remove substantial amounts of existing plant cover, especially when conducted early in the growing season, can result in conditions favorable to sericea lespedeza seedling establishment [31]. Following stimulation of germination and seedling establishment, control methods such as grazing or herbicide application may be employed to eradicate as many new seedlings as possible. This method also provides opportunity to simultaneously control sprouts from established plants. Although the principal goal of this strategy is to purge the community of sericea lespedeza as rapidly as possible, diligent monitoring and continued treatments to eliminate recurrent sericea lespedeza will probably still be necessary during subsequent years [67].

Prevention:

The most efficient and effective method of managing invasive species is to prevent their invasion and spread [77]. Preventing the establishment of nonnative invasive plants in natural areas is achieved by maintaining healthy natural communities and by monitoring several times each year. Monitoring efforts are best concentrated on the most disturbed areas in a site, particularly along roadsides, parking lots, fencelines, trails, and waterways. The Center for Invasive Plant Management provides an online guide to noxious weed prevention practices.

Planting sericea lespedeza for any reason is probably ill-advised, especially where it can easily spread into adjacent natural areas [82]. When introducing native seed into natural areas, only seed that has been cleaned and tested for purity should be used. Sericea lespedeza has reportedly spread westward in Kansas and Oklahoma on Conservation Reserve Program (CRP) lands via contaminated native seed mixture collected from sericea lespedeza infested rangelands [67].

Integrated management:

A combination of complementary control methods may be helpful for more rapid and effective control of sericea lespedeza. Integrated management includes not only killing the target plant, but establishing desirable species and discouraging nonnative, invasive species over the long term.

Physical/mechanical:

Depending on site conditions and treatment frequency, mowing or cutting plants, especially early in the growing season, may result in vigorous regrowth [32]. Frequent mowing can reduce plant vigor. Plants should be mowed when they reach a height of 12-18 inches, and should be cut as close to the ground as possible [67,89]. Frequent cutting on droughty or infertile sites may be particularly effective [32].

Smith [81] suggests the optimum time to control sericea lespedeza by cutting or mowing is when plants are producing flower buds, because root carbon reserves are then at their lowest levels. He also suggests such cutting treatments will need to be repeated for several seasons. Stevens [82] suggests mowing in the flower bud stage for 2 to 3 consecutive years to reduce stand vigor and control further spread. According to Guernsey [32], cutting in late fall just prior to senescence may weaken plants by reducing carbon storage.

Vermeire and others [89] indicate mowing alone may not control sericea lespedeza plants and could be damaging to desirable grasses, depending on timing. Complementary methods, in addition to cutting or mowing, are likely to improve control. For instance, Stevens [82] suggests mowing early in the growing season, followed by mid-summer herbicide application.

Digging or pulling sericea lespedeza plants is considered difficult because of extensive root development [82]. Although there is no evidence of root sprouting, sericea lespedeza does sprout from caudices, located 0.5 to 3 inches (1.3-7.6 cm) below the soil surface (see Asexual Regeneration). However, Ohlenbusch [66] indicates that hand digging can be effective for controlling small, scattered populations. It seems likely that digging or pulling activities that remove the root crown, but not necessarily the entire root system, would be sufficient to kill the plant.

Disking well established or "run down" sericea lespedeza stands may result in stand enhancement, rather than degradation [13,15], presumably due to enhanced seedling establishment combined with root crown sprouting.

Fire: See the Fire Management Considerations section of this summary.

Biological: Preliminary investigations indicate potential for lespedeza webworm (*Tetralopha scortealis*) as a biological control agent. For information about lespedeza webworm in Kansas see the Kansas Department of Agriculture Plant Protection and Weed Control Program website concerning sericea lespedeza.

Chemical:
Herbicides may provide initial control of a new invasion (of small size) or a severe infestation, but are rarely a complete or long-term solution to invasive species management [8]. Herbicides are more effective on large infestations when incorporated into long-term management plans that include replacement of weeds with desirable species, careful land use management, and prevention of new infestations. Control with herbicides is temporary, as it does not change conditions that allow infestations to occur (e.g. [100]). See The Nature Conservancy's Weed Control Methods Handbook for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Glyphosate has effectively controlled sericea lespedeza when applied at flowering time [81,99], but Yonce and Skroch [99] reported inconsistent results from early and mid-season applications. However, Jordan and Jacobs [46] had success using glyphosate in May/June to control sericea lespedeza on a Long Island, New York grassland site. They observed that spray application also resulted in substantial kill of neighboring, desirable plants. However, they were able to specifically target only sericea lespedeza plants using wick or glove applicator methods (see TNC Weed Control Handbook for descriptions of these methods).

Altom and others [1] achieved effective control with triclopyr, fluroxypyr, and metsulfuron. But similarly as with glyphosate, effectiveness of these chemicals may vary according to timing of application. Smith [81] recommends applying triclopyr or metsulfuron during the "vegetative stage prior to branching", or during flowering. Griffith [31] wrote that triclopyr applied "very late in spring" or metsulfuron-methyl applied in fall can provide good control.

Koger and others [50] examined reemergence of established sericea lespedeza plants following application of triclopyr or metsulfuron-methyl, at 3 different stages of plant development, from 2 different sites. Their results (see table below) indicate that a) triclopyr was generally more effective at controlling sericea lespedeza than metsulfuron-methyl, b) triclopyr was generally more effective when applied earlier in the growing season, while metsulfuron-methyl was more effective when applied closer to flowering, and c) no single herbicide application resulted in eradication of previously established sericea lespedeza plants.

Timing of herbicide application	Site type	Years after herbicide application	Percent of pre-treatment sericea lespedeza stems remaining after treatment	
			Triclopyr	Metsulfuron-methyl
Early vegetative	Bermuda grass	1	3	51
		2	10	87
	Tallgrass prairie	1	1	41
		2	17	95
Late vegetative	Bermuda grass	1	2	16
		2	13	25
	Tallgrass prairie	1	0	6
		2	6	69
Flowering	Bermuda grass	1	13	6
		2	29	26
	Tallgrass prairie	1	8	0
		2	55	36

In addition to survival of established plants subsequent to herbicide treatment, presence of a substantial seed bank is likely to yield new crops of seedlings following disturbance (e.g. [45]). Koger and others [50] examined effectiveness of various herbicides for controlling sericea lespedeza seedlings, which emerged 2 years after established plants were controlled using mowing plus herbicides. Seedling density, when observed approximately 5 months after spraying, was significantly ($p<0.05$) reduced by 71% with metsulfuron-methyl, compared with unsprayed plots where seedling densities declined by 25%. Herbicide treatments using triclopyr, picloram plus 2,4-D, and dicamba plus 2,4-D did not result in seedling densities that were significantly ($p<0.05$) different from untreated controls.

Cultural: Altom and others [1] suggest overseeding cool-season grasses in combination with herbicides for effective suppression of sericea lespedeza.

There is some suggestion that fertilizing infested areas may reduce sericea lespedeza abundance [81], but research supporting this assertion is lacking. Still, the concept of adding nutrients to the ecosystem, and thereby altering the competitive environment, may be worthy of further examination. Sericea lespedeza is considered by some to be more competitive on nutrient-poor sites than on fertile sites [3,32].

Grazing:

Grazing may provide some effective control of sericea lespedeza populations, especially when used in combination with other control methods. According to Ball and Mosjidis [2], sericea lespedeza "will not tolerate close, continuous grazing." Stocking rates that maintain sericea lespedeza at <3- to 4-inch (8-10 cm) height levels are recommended [67]. There are conflicting ideas about what season is best for using grazing as a control measure.

Ohlenbusch [66] recommends intensive stocking until mid-summer, followed by herbicide treatment for any remaining, actively growing plants. Intensive grazing with cattle has been recommended following a spring burn, as a means of removing or damaging resulting new growth [66,81]. Intensive early spring grazing can result in conditions conducive to enhanced seedling germination. Under these circumstances, managers should be prepared to control seedlings subsequent to heavy spring stocking [31].

Others indicate late-season grazing may be appropriate. According to Ball and Mosjidis [2], close defoliation in late summer and after "can be particularly damaging." Although grazing from mid-summer into fall may be recommended, cattle often reject sericea lespedeza at this phenological stage due to its high tannin content (see Palatability/nutritional value) [31].

There is some indication that domestic sheep or goats may be useful for controlling sericea lespedeza, especially later in the growing season when sericea lespedeza becomes less palatable to cattle [24,31,66,81]. Ohlenbusch and others [67] indicate sheep and goats graze sericea lespedeza more selectively than cattle. Following goat grazing on sericea lespedeza-infested pastures for 3 years, surveys indicated disappearance of mature sericea lespedeza plants [24].

In some cases grazing may hinder sericea lespedeza control efforts. In general, it may be difficult to promote desirable grasses when grazing cattle in sericea lespedeza infested areas, since cattle will usually select grasses over less palatable sericea lespedeza [89], particularly later in the growing season when sericea lespedeza is less palatable. If grasses are heavily grazed, sericea lespedeza may increase [67]. Koger and others [50] examined seedling emergence following herbicide treatments to control sericea lespedeza at 2 Bermuda grass pasture sites and 1 tallgrass prairie site. Substantially higher sericea lespedeza seedling densities at the Bermuda grass sites, compared with the tallgrass prairie site, were attributed to differences in grazing systems used at the sites. The Bermuda grass site experienced continuous intensive grazing, which apparently reduced competition for emerging sericea lespedeza seedlings. In contrast, the tallgrass prairie site was subjected to "light" grazing, which was linked to strong competition against emerging sericea lespedeza seedlings.

Managers who graze livestock in sericea lespedeza infested areas should be aware that animals can transport sericea lespedeza seed to other areas in manure [67,89].

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