Lespedeza bicolor

INTRODUCTORY

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AUTHORSHIP AND CITATION:
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FEIS ABBREVIATION:
LESBIC

NRCS PLANT CODE [86]:
LEBI2

COMMON NAMES:
bicolor lespedeza
bicolor bushclover
shrubby lespedeza

TAXONOMY:
The scientific name of bicolor lespedeza is *Lespedeza bicolor* Turcz. (Fabaceae) [32,47,54].

SYNONYMS:
None

LIFE FORM:
Shrub
Shrub-forb

DISTRIBUTION AND OCCURRENCE

SPECIES: Lespedeza bicolor

GENERAL DISTRIBUTION:
As of 1998, bicolor lespedeza occurred as an escaped nonnative from Virginia south to northern Florida and west to Louisiana and Kentucky [42]. Although plants also occur as far north as New York, Ontario, Michigan, and Iowa and as far west as Nebraska and Texas [54,61,86], abundance of bicolor lespedeza in natural areas is greatest in the southeastern United States [32,42]. Bicolor lespedeza is native to the temperate areas of China, Korea, and Japan [25,42]. Plants Database provides a map of bicolor lespedeza's distribution in North America.

Bicolor lespedeza was originally introduced to the United States as an ornamental in 1856 [22,25]. Beginning in the 1930s, bicolor lespedeza was promoted and widely planted for erosion control and wildlife conservation [60]. Plants were also used in mine reclamation [35,81]. From the late 1930s through the 1950s, wildlife managers and the USDA Soil Conservation Service in the Southeast began producing and distributing millions of bicolor lespedeza seeds and seedlings annually [60]. In the mid- to late 1930s, 3 to 4 million bicolor lespedeza were planted for gully stabilization [21]. In 1939, a little over 1.2 million bicolor lespedeza were grown on Civilian Conservation Corps camps; by 1950, there were over 50 million seedlings [69]. More than 400 acres (160 ha) were used to produce bicolor lespedeza seed in the early 1940s [21]. Bicolor lespedeza's use in mine site reclamation has occurred as recently as the 1980s in Fairfield, Texas [35]. Eighteen years after planting bicolor lespedeza on a surface coal mine site in Laurel County, Kentucky, researchers considered it "naturalized" and noted spread beyond the planting area [81].

In the 1940s and 50s, the USDA recommended bicolor lespedeza to private land owners to improve northern bobwhite habitat [22]. In the 1940s in Kansas, a nursery was established in Kingman County State Park to produce plants and seed for wildlife habitat improvement [49]. From 1948 to 1953 in Virginia, nearly 7 million bicolor lespedeza plants and 17,000 pounds of seed were planted as an attempt to increase northern bobwhite populations in and around farms [30]. In the 1950s, state agencies in Arkansas distributed 775,000 bicolor lespedeza plants and 2,200 pounds of seed for wildlife improvement [40]. In the 1960s, bicolor lespedeza was planted along a 1.3-mile (2.1 km) stretch of Maryland's eastern shore to increase wildlife and particularly northern bobwhite habitat and food availability [11]. For information on northern bobwhites and their use of bicolor lespedeza, see Birds.

When plantings failed in dry or cold habitats, researchers began developing new strains and cultivars with increased drought tolerance, higher seed production, and earlier ripening dates so that bicolor lespedeza would establish and persist at higher elevations and latitudes [5,12,22]. This topic is also discussed in the Botanical description section.

HABITAT TYPES AND PLANT COMMUNITIES:
In the southeastern United States, bicolor lespedeza occurs in old fields, thickets, savannas, pine forests, and woodlands, and along creek banks [42]. In the Upper Midwest, where escaped plants are less common, bicolor lespedeza is generally limited to old fields and prairies [20,72]. According to a silvicultural management handbook for the South, bicolor lespedeza occurs in meadows, prairies, pastures, old fields, savannas, and orchards, and on mine

spoils, ditch banks, and highway embankments. Plants are considered "extremely aggressive" in open areas on the Upper Coastal Plain [28]. In Alabama, bicolor lespedeza populations are scattered in managed forests, natural areas, and parks [1]. In Georgia, bicolor lespedeza is particularly invasive in the Upper Coastal Plain and Piedmont [27]. Plants were reported in pine forests on Panola Mountain, southeast of Atlanta [7]. In the Fort Bragg and Weymouth Woods areas of North Carolina, bicolor lespedeza occurs in longleaf pine/scrub oak (*Pinus palustris*/*Quercus* spp.) sandhills vegetation [73]. Plants were reported in the oak-hickory-pine (*Quercus* spp.-*Carya glabra*-*Pinus* spp.) forest type in the Rock Creek Natural Area in Laurel County, Kentucky [80].

BOTANICAL AND ECOLOGICAL CHARACTERISTICS

SPECIES: Lespedeza bicolor

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GENERAL BOTANICAL CHARACTERISTICS:

Botanical description: This description covers characteristics that may be relevant to fire ecology and is not meant for identification. Keys for identification are available (e.g., [32,54,65,91]).

Bicolor lespedeza is an erect, multibranched shrub that can reach 10 feet (3 m) tall and wide [25,32,54,60]. Stems from the root crown may have diameters of 1.2 inches (3 cm) [33,57,65]. Shrubs may be less robust in cold climates. Entire bicolor lespedeza stems or just the tips can be winter killed, but when the current year's growth survives the winter, plants develop stems that are 1 inch (2.5 cm) or more in diameter [33,64]. Bicolor lespedeza leaves are

deciduous, alternate, and comprised of 3 oval leaflets that are 0.75 to 2 inches (1.9-5 cm) long. Leaflets are about 2/3 wide as long [25,42,60]. Flowers are about 0.5 inch (1.3 cm) long and occur in 2- to 5-inch (5-13 cm) long racemes. Racemes typically support 5 to 15 pea-like flowers and occur on the upper 2 feet (0.6 m) of stems [25,57]. Legumes are flat, indehiscent, 1-seeded pods that measure up to 8 mm long [54,57,65,78]. Bicolor lespedeza does not produce a taproot but develops a "heavy, much-branched root system". Partial excavation of a 4-year-old shrub revealed a dense root system that extended 4 feet (1.2 m) wide and 2 feet (0.6 m) deep. This shrub was likely part of experimental plantings made in Beltsville, Maryland [15].

There may be considerable variation in bicolor lespedeza's botanical characteristics. In eastern Asia, shrubs are highly variable and there were probably several Asian introductions to the United States [33]. Bicolor lespedeza seeds that came to be known in the US as 'Natob' cultivars were collected from the northwestern Shanxi Province of China where winters are cold and dry and growing seasons are short [15]. United States breeding programs also produced several different bicolor lespedeza strains. Strains were often selected for high seed production, retention of ripe fruits, increased winter hardiness, and rapid seed maturation (review by [12]).

Raunkiaer [66] **life form:**
Phanerophyte

SEASONAL DEVELOPMENT:
A long growing season is required for successful bicolor lespedeza seed production [60]. Flowers are most common in August and early September but may appear as early as May to July [21] and as late as October [32,61]. Seeds are generally mature in October or early November [26,60]. Some seeds drop when ripe, but the rest fall off gradually through the fall and winter [26,60].

REGENERATION PROCESSES:
Bicolor lespedeza reproduces from seed. Following top-kill or aboveground damage, bicolor lespedeza regenerates by root crown sprouts (see Vegetative regeneration).

Pollination and breeding system: Bicolor lespedeza produces perfect cleistogamous and chasmogamous flowers [12,25]. Chasmogamous flowers can be self- or cross-pollinated [12], but Crider [15] suggests that bicolor lespedeza is primarily self-sterile and that cross-pollination by bees is most common. Vogel [89] reports that bicolor lespedeza flowers attract honey bees. Attempts to cross bicolor lespedeza with related North American species failed to produce viable seed. Crosses were tried with nonnative sericea lespedeza (*Lespedeza cuneata*) and native tall lespedeza (*L. stuevei*) [38].

Seed production: High seed yields have been reported for bicolor lespedeza, but droughts and frosts can lead to seed failures. Shrubs generally produce seed once they reach 3 or 4 years old. When bicolor lespedeza was seeded on Maryland's eastern shore, they "furnished considerable amounts of seed" by their 4th year [11]. Edminster [26] reports that shrubs "reliably" produce seed at 3 years old and sometimes at 2 years old.

According to a handbook on silvicultural management guidelines for the South, bicolor lespedeza can produce as many as 300 million seeds/acre [28]. When grown as a crop, bicolor lespedeza produced seed yields of 336 to 447 kg/ha [12]. In some early plantings of bicolor lespedeza, ripe seed was not produced before the first frost, which led to seed production failures [24,40]. When seed production was compared in Virginia and North Carolina, production was less

in Virginia. Drought conditions during the study period delayed flowering and seed production and made seed more susceptible to frost kill [24]. Through selective breeding, researchers developed the 'Natob' cultivar that produced early-ripening seeds and stems that were more winter hardy. 'Natob' could produce about 350 lbs of seed/acre if the growing season was 145 days or more and if the first frost occurred on or after 25 September [5].

Seed dispersal: As of this writing (2010), information on the dispersal of bicolor lespedeza seed was lacking. One study reports that bicolor lespedeza seed is dispersed primarily by its own weight [36] and likely falls near the parent plant. Bicolor lespedeza seed and plant material are consumed by livestock and wildlife (see Importance to Wildlife and Livestock), but seed dispersal by these agents was not reported.

Seed banking: Detailed experimental burial and recovery studies on bicolor lespedeza seed were lacking. A weed control handbook reports that the bicolor lespedeza seed bank is long lived [57]. In weed management notes, Morisawa [62] suggests that bicolor lespedeza seed may still be viable after decades in the soil. Busing and Vogel [12] reported that seeds were viable after 20 years of storage. Storage conditions were not described.

Germination: Optimal conditions for germination of bicolor lespedeza seeds were not reported in detail in the available literature. Light is not required for germination, and under laboratory conditions, seed germination may average 76% [12]. Most sources indicate that a proportion of bicolor lespedeza seed is hard and requires scarification [15,44,60], although Davison [21] suggests that seeds are "not hard enough to require scarification". Two land management manuals report that fire may scarify and increase the germination of hard, soil-stored bicolor lespedeza seed [28,60].

In Japan, researchers found that as many as 85% (Sakamoto 1949 cited in [44]) and as few as 28% (Mitsui and Inoue 1952 cited in [44]) of bicolor lespedeza seeds were hard. More mature seed crops typically had fewer hard seeds and higher germination percentages than freshly ripe seed (Iwata personal observation cited in [44]). In a study conducted in Japan, 14% of untreated bicolor lespedeza seeds geminated. After 1 minute in 190 °F (90 °C) water, germination increased to 78%, and after 3 minutes at 160 °F (70 °C), germination was 84% (Mitsui 1949 cited in [44]). For more on heat and bicolor lespedeza seed germination, see Fire adaptations.

Seedling establishment and plant growth: During early plantings of bicolor lespedeza stands for wildlife habitat improvement, it became evident that moisture was important for seedling establishment. In the 1950s in Arkansas, bicolor lespedeza did not establish well from seed, and after 2 successive dry growing seasons, the majority of planted seedlings had died [40]. A USDA bulletin that encouraged landowners to use bicolor lespedeza to improve wildlife habitat and increase northern bobwhite populations recommended planting scarified seed at 0.5 inch (1.3 cm) depths when there was "good" ground moisture [22]. In a later land management publication, soil moisture was noted as critical to germination and establishment. In the Southeast, seeding was not recommended after 15 May [60].

Growth of bicolor lespedeza can be rapid. Conservation planting guidelines reported that bicolor lespedeza established easily by seed and grew rapidly on "fair to good" sites and "satisfactorily" on "poor" sites. On "good" sites, bicolor lespedeza could reach 9 feet (2.7 m) tall in 3 to 5 years and 12 feet (3.6 m) in 5 to 8 years. On "poor" sites, plants may be 6 feet (1.8 m) in 5 years and 9 feet (2.7 m) in 8 years [26].

Vegetative regeneration: Several sources report that bicolor lespedeza sprouts from the root crown following damage or removal of aboveground stems; however, no studies measured the abundance and rate of regrowth following aboveground damage. Davison [21] indicated that bicolor lespedeza withstands cutting and burning. In weed and silvicultural management reports, Evans and others [27,28] report that bicolor lespedeza sprouts are common after cutting or burning [28]. Dense stands can be formed through sprouting [27], and vegetative regrowth can be promoted by mowing [28].

SITE CHARACTERISTICS:

Bicolor lespedeza occurs along roads and fences, and in disturbed sites, old fields, clearings, savannas, woodlands, and forests throughout its nonnative range [33,65,72,92]. Bicolor lespedeza is much more common in natural areas in the Southeast than in the Northeast or Midwest [20,42,72].

Climate: One source indicates that bicolor lespedeza is hardy to USDA zone 4, which suggests a tolerance of temperatures as low as -20 °F to -30 °F (-29 to -34 °C) [25]. Another source indicates hardiness to USDA zone 6, which represents a low-temperature tolerance of -10 °F (-23 °C) [52]. These reports may reflect differences between bicolor lespedeza cultivars, some of which were developed to produce seed before first frosts. Reports may also reflect differences in top-kill damage in cold climates (see Botanical description). In the Northeast, shrubs often die back at the branch tips in winter, but winter damage ranges from no visible damage to complete top-kill [26].

Elevation: In a coal mine revegetation guide, planting of bicolor lespedeza is not recommended on sites above 2,500 feet (760 m) [89].

Soils: Bicolor lespedeza grows and persists on a wide variety of soil types, textures, and fertility levels, but shrub establishment and growth are typically limited on poorly drained soils [22,26,52,69]. Edminster [26] suggests that bicolor lespedeza does not grow well on acidic soils, but Evans and others [28] report that shrub establishment occurs on strongly acidic to neutral soils. In a coal mine revegetation guide, use of bicolor lespedeza is not recommended on soils with a pH below 4.5 [89]. In a resource management manual, Mitchell [60] indicates that bicolor lespedeza grows best on moist to well-drained sandy loams with pH levels of 4.4 to 5.6. Growth was poorer on deep sands, poorly drained lowlands, highly alkaline soils, and extremely eroded soils. After evaluating more than 600 bicolor lespedeza plantings in the Southeast, it was apparent that the shrubs grew best in highly fertile, well-drained soils, but several stands occurred along woodland edges with "poor", low-fertility soils [69].

SUCCESSIONAL STATUS:
While bicolor lespedeza is tolerant of disturbances and early-seral conditions [4,40,82], shrubs also persist beneath forest and woodland canopies [57,93].

Full sun to dense overstory conditions are described for bicolor lespedeza's nonnative habitats. According to the Native Plant Society in Virginia, bicolor lespedeza occupies full- and partial-sun sites [88]. A resource management manual indicates that bicolor lespedeza tolerates up to 50% shade [60]. In weed management notes published by The Nature Conservancy, bicolor lespedeza is reported as shade tolerant [62], and other weed management guides and meeting notes report that bicolor lespedeza establishes, reproduces, and spreads successfully beneath moderate to dense canopies [56,57]. However, along Roanoke River Basin transects in North Carolina that extended from the edge of agricultural fields into mixed hardwood forest interiors, bicolor lespedeza occurred at the forest edge but was absent from the forest interior [29].

Bicolor lespedeza is described in disturbed, early-seral, and mid-seral habitats in its native and nonnative ranges. When bicolor lespedeza field border plantings in Arkansas were evaluated, the researcher indicated that field borders tolerated cutting, disking, and burning [40]. In the Prentice Cooper State Forest and Wildlife Management Area of Tennessee, bicolor lespedeza was reported only in disturbed areas, which included roadsides, tornado paths, burned areas, pipeline clearings, or ditches [4]. Shrub abundance, however, may be reduced by heavy grazing [22].

In China and Japan, bicolor lespedeza grew on early-seral sites impacted by a volcanic eruption and in the forest stage of succession in old fields. Following the eruption of volcano Usu in northern Japan, bicolor lespedeza was intentionally seeded for erosion control. Within about 6 years of the eruption, plants were producing seed. The eruption deposited 3 to 10 feet (1-3 m) of volcanic ash and pumice in the study area [82]. When succession from grassland to climax forest communities was evaluated in subarctic to warm-temperate regions of Japan, bicolor lespedeza often dominated the shrub stage. Shrub communities followed the pioneer, short-grass, and tall- or perennial grass stages but preceded the pioneer tree and climax forest stages [63]. In the Yancun watershed in Shanxi Province, China, bicolor lespedeza was most common in the forest stage of succession that occurred on croplands abandoned 30 to 50 years earlier [93].

FIRE EFFECTS AND MANAGEMENT

SPECIES: Lespedeza bicolor

FIRE EFFECTS:

Immediate fire effect on plant: Bicolor lespedeza is probably only top-killed by fire. Two studies report sprouting from the root crown after fire [46,69].

Postfire regeneration strategy [76]:
Tall shrub, adventitious buds and/or a sprouting root crown
Ground residual colonizer (on site, initial community)
Secondary colonizer (on- or off-site seed sources)

Fire adaptations and plant response to fire:

Fire adaptations: Bicolor lespedeza is well adapted to survive fire. Seeds are heat tolerant, and several studies report abundant bicolor lespedeza seedlings on burned sites. Postfire sprouting is also common. Without additional fire studies, however, it is not possible to address potential differences in fire effects based on fire season or fire severity.

Bicolor lespedeza seeds are heat tolerant, and in some studies, seed germination increased with heat exposure. In a Japanese study, 14% of untreated bicolor lespedeza seeds geminated. After 1 minute in 190 °F (90 °C) water, germination increased to 78%, and after 3 minutes at 160 °F (70 °C), germination was 84% (Mitsui 1949 cited in [44]). In a US laboratory, bicolor lespedeza tolerated 4 minutes of moist-heat treatments of up to 208 °F (98 °C) but failed to germinate after 4 minutes of dry-heat treatments at 210 °F (100 °C). Although seeds may have been killed at 210 °F (100 °C), researchers did not test seeds for induced secondary dormancy. Results of the study are summarized below. Heat treatments were applied in winter and in summer, but differences between treatment seasons are unclear because seed source, seed collection dates, and/or seed storage conditions were not reported [18].

Percent germination of bicolor lespedeza seed treated with moist or dry heat for 4 minutes in the winter or summer [18]. Germination of unheated bicolor seeds averaged 64% (based on a very similar study by the same authors presented in another publication) [55].

Temperature (°C)	45	60	70	80	90	98-100
Germination of moist-heat-treated seeds (winter)	62	68	69	35	0	1
Germination of moist-heat-treated seeds (summer)	44	76	68	92	84	88
Germination of dry-heat-treated seeds (winter)	65	69	68	66	54	0
Germination of dry-heat-treated seeds (summer)	44	68	80	100	100	0

Plant response to fire: Many studies report bicolor lespedeza on burned sites. Increased abundance and spread of plants on burned sites from sprouts and/or seedlings is common, even on repeatedly burned sites. Although bicolor lespedeza is common following fire, more studies are needed to evaluate the effects of fire season and fire severity.

Many sources anecdotally indicate that bicolor lespedeza is tolerant of or even promoted by fire. Hunter [40] notes that bicolor lespedeza "will withstand .... burning". In guidelines for silvicultural management and weed control, fire is said to "promote" spread of bicolor lespedeza [28,57]. During burning operations in slash pine (*Pinus elliottii*) plantations in Alabama, bicolor lespedeza "spread progressively through the influence of fire" and was "showing a disturbing tendency to spread into the woods as a result of regular burning". In a portion of the Alabama Piedmont that burned each February or March for 7 years, bicolor lespedeza cover was 0.01% in the unburned and 0.73% in the burned area [75]. In pine-hardwood stands on the Georgia Piedmont, bicolor lespedeza occurred on a site burned about every 4 years for the last 30 years but was absent from sites with no prior burning history. Two years after an "intensive" fire in a pine beetle-infested stand in the periodically burned area, the density of bicolor lespedeza was 619 plants/ha [6]. Three years following a March prescribed fire in logged loblolly pine (*P. taeda*) and shortleaf pine (*P. echinata*) stands on South Carolina's Clemson Experimental Forest, cover of bicolor lespedeza was significantly greater (P=0.007) than prefire levels. Thinning reduced forest basal area to 18 m²/ha. The "low-intensity" fire burned when temperatures were 64 to 68 °F (18-20 °C), relative humidity was 22% to 56%, and wind speeds were 2 to 4 miles (4-7 km)/hour. The maximum temperature recorded at 26 feet (8 m) above ground was 487 °F (253 °C) [67].

While the above studies indicate greater abundance or spread of bicolor lespedeza on burned sites, they fail to report whether increases or spread were due to seedling establishment, postfire sprouting, or both. A study conducted in Chinese silvergrass (*Miscanthus sinensis*) vegetation north of Honshu, Japan, suggests that both sprouting and germination of bicolor lespedeza occurred after a late May wildfire. Density of bicolor lespedeza was significantly greater on burned than unburned sites within 2 to 4 months of the fire. Researchers reported a greater density of "stocks/area" on burned than unburned sites, but the density of "stocks/root crown" was not different between burned than unburned sites [41]. These findings suggest that seedlings contributed most to increased stem density and that if plants were top-killed, they sprouted after fire.

Several studies report only seedling establishment following fire. In the Hitachi National Forest in central Japan, there were no bicolor lespedeza sprouts but abundant seedlings following a March wildfire in Japanese red pine (*P. densiflora*) stands. Six months after the fire, there were 10.2 seedlings/m² 12 to 16 inches (30-40 cm) tall. Researchers indicated "remarkable population expansion by seedlings" after fire [36]. After a wildfire on 22 April in oak woodlands in northeastern Japan, bicolor lespedeza seedlings formed a dense thicket that persisted 3 years. The researcher supposed that germination was promoted by the high soil temperatures and that establishment was promoted by the open conditions created by burning [43].

A study from the Piedmont of South Carolina illustrates that increases in bicolor lespedeza on burned sites may not necessarily be caused by fire. In this study, bicolor lespedeza established after a spring fire and also increased in frequency on unburned plots. "Moderate intensity" prescribed fires occurred in loblolly stands in May and consumed up to 50% of surface fuels. The average pre- and postfire frequencies were 0% and 4% on spring-burned plots and 8.7% and 12% on unburned plots, respectively [19]. Findings from this study are also presented in another publication by Cushwa and others [17].

While bicolor lespedeza seedlings maybe common on burned sites, postfire sprouting may also contribute to population increases. Kang and Iizumi [46] reported in a review that postfire sprouting often produces dense shrublands on frequently burned demilitarized zones in Korea. Rosene [69] reported that bicolor lespedeza produced many root crown sprouts after a winter fire, and on sites with "sufficient fertility", burned plants were "thicker" than unburned plants.

FUELS AND FIRE REGIMES:

Fuels: A southern silvicultural management guide reports that bicolor lespedeza is not a fire hazard [28]. However, in the photograph below it appears that establishment and spread of bicolor lespedeza could increase the height and density of woody fuels in pine savannas.

Photo © Chris Evans, River to River CWMA, Bugwood.org

Abundant litter is also common in bicolor lespedeza stands. Five-year old plants mowed the previous spring had accumulated litter 3 inches (8 cm) deep by the following winter [15]. Whether these litter accumulations would affect fire frequency or behavior in invaded communities, however, is unknown.

Fire regimes: As of 2010, there was no information available on the fire regimes typical in bicolor lespedeza's native habitats or the effects of large bicolor lespedeza populations on fuel characteristics or fire behavior in invaded US habitats. See the Fire Regime Table for more information on fire regimes in plant communities where bicolor lespedeza may occur.

FIRE MANAGEMENT CONSIDERATIONS:

Potential for postfire establishment and spread: There is considerable potential for postfire establishment and spread of bicolor lespedeza on burned sites. A handbook that describes silvicultural management guidelines for southern forests and woodlands indicates that bicolor lespedeza is promoted by fire. High light levels and soil disturbances encourage establishment [28], and shrubs may sprout from the root crown following fire [46,69]. Population expansion on burned sites was reported by several researchers [28,57,75]. Because bicolor lespedeza sprouting and spread have been reported after fire (see Plant response to fire), prescribed fire management options in prairies and pine savannas may be limited by bicolor lespedeza's presence [28].

Preventing postfire establishment and spread: Preventing invasive plants from establishing in weed-free burned areas is the most effective and least costly management method. This may be accomplished through early detection and eradication, careful monitoring and follow-up, and limiting dispersal of invasive plant propagules into burned areas. General recommendations for preventing postfire establishment and spread of invasive plants include:

- Incorporate cost of weed prevention and management into fire rehabilitation plans
- Acquire restoration funding
- Include weed prevention education in fire training
- Minimize soil disturbance and vegetation removal during fire suppression and rehabilitation activities
- Minimize the use of retardants that may alter soil nutrient availability, such as those containing nitrogen and phosphorus
- Avoid areas dominated by high priority invasive plants when locating firelines, monitoring camps, staging areas, and helibases
- Clean equipment and vehicles prior to entering burned areas
- Regulate or prevent human and livestock entry into burned areas until desirable site vegetation has recovered sufficiently to resist invasion by undesirable vegetation

- Monitor burned areas and areas of significant disturbance or traffic from management activity
- Detect weeds early and eradicate before vegetative spread and/or seed dispersal
- Eradicate small patches and contain or control large infestations within or adjacent to the burned area
- Reestablish vegetation on bare ground as soon as possible
- Avoid use of fertilizers in postfire rehabilitation and restoration
- Use only certified weed-free seed mixes when revegetation is necessary

For more detailed information on these topics, see the following publications: [2,9,34,85].

Use of prescribed fire as a control agent: In the available literature (2010), use of fire to control bicolor lespedeza was not studied and rarely discussed. A silvicultural management handbook reported that prescribed fire is not a control option [28]. However, others suggest that prescribed fire may be useful in controlling bicolor lespedeza "under certain circumstances and in combination with other control methods", but details regarding circumstances and other control methods were lacking [77]. Morisawa [62] suggests that fire could be used to stimulate germination and deplete the seed bank, but follow-up control of emerging seedlings would be a postfire priority.

Altered fuel characteristics: As of 2010, effects of large bicolor lespedeza populations on fuel characteristics in invaded US habitats were not described. This topic is also addressed in the Fuels section above.

MANAGEMENT CONSIDERATIONS

SPECIES: Lespedeza bicolor

FEDERAL LEGAL STATUS:
None

OTHER STATUS:
Information on state-level noxious weed status of plants in the United States is available at Plants Database.

IMPORTANCE TO WILDLIFE AND LIVESTOCK:
Bicolor lespedeza provides food for deer, rabbits, gophers, northern bobwhites, doves, and livestock and provides habitat or cover for northern bobwhites, doves, and woodcocks [21,22,26,67,69].

Deer: White-tailed deer feed on young bicolor lespedeza plants [21,60]. Some indicate that white-tailed deer consider bicolor lespedeza palatable [26,69]. Davison [22] suggests that bicolor lespedeza is susceptible to "overgrazing" by white-tailed deer.

Small mammals: Rabbits feed on bicolor lespedeza leaves, bark, and seeds, but seem to prefer seeds. Roots of bicolor lespedeza are eaten by Baird's pocket gophers [40]. In bicolor lespedeza border strip plantings in Arkansas, sign left by eastern cottontail was more common than that left by northern bobwhites. In this area, eastern cottontails ate bicolor lespedeza bark and leaves [40]. Eastern cottontails observed near Pineville, South Carolina, utilized bicolor lespedeza extensively in early winter. When shrub stems were 21 to 59 inches (53-150 cm) tall and had diameters that averaged 0.16 inch (0.4 cm), eastern cottontails often cut the stems to gain access to the seeds. On plants with large stems, bark was eaten, and sometimes stems were girdled [68].

Birds: Bicolor lespedeza was often planted to increase northern bobwhite populations in the eastern United States. Although bicolor lespedeza seeds are consumed by northern bobwhites, they may not be preferred over native foods, and bicolor lespedeza may not provide valuable nesting habitat.

On Maryland's eastern shore, bicolor lespedeza was among the top 10 items recovered from the crops of northern bobwhites shot from late November to mid-January [11]. In sandhill vegetation in North Carolina, bicolor lespedeza was important in the spring and early summer diets of adult male northern bobwhites. In one year, bicolor lespedeza accounted for almost 25% of crop volume, but in another year, it accounted for less than 4%. Researchers did not speculate about the annual differences in use [16]. In bicolor lespedeza border strips planted adjacent to crops as a means to improve wildlife habitat in Arkansas, the average annual distance between signs of northern bobwhite use was 0.4 mile (0.6 km), which was less than that for natural borders where the distance was 1.3 miles (2 km). The researcher reported that northern bobwhites used strips primarily for feeding [40]. After reviewing available literature, Davison [23] classified bicolor lespedeza as a "choice" northern bobwhite food, which indicated a good-quality, digestible, and nutritious food that was eaten readily when available. The food choice classification was not geographically or seasonally limited.

When evaluating bicolor lespedeza plantings on hunting preserves in Alabama and South Carolina, researchers found that although it was a preferred food of northern bobwhites the plantings did not provide valuable nesting habitat. In areas where native northern bobwhite foods were not limited, planting bicolor lespedeza did not increase northern bobwhite populations. Often populations concentrated in planted bicolor lespedeza stands in the winter, which may have increased their vulnerability to hunters [70]. After 7 million bicolor lespedeza plants and 17,000 pounds of seed were planted on Virginia farmlands in the 1940s and 50s, field census surveys conducted in some planting areas revealed "no practical benefits" in increasing northern bobwhite populations [30].

Other bird species that utilize bicolor lespedeza include sparrows and juncos that were said to "frequent" stands [21], and American woodcocks that utilize stands for cover (Sepik personal communication and Roberts personal observation cited in [67]). Doves utilized bicolor lespedeza stands for food and nesting habitat. Feeding on seeds was "exceptional" after January in Rock Hill, South Carolina, and ground nests were found in stands near Tallahassee, Florida [21].

Livestock: Some report that bicolor lespedeza is palatable to and eaten by livestock [26,69]. However, Davison [22] suggests that cattle and horses find bicolor lespedeza unpalatable.

Insects: In upland and wet longleaf pine savannas in southern Louisiana and Mississippi, bees were commonly collected from bicolor lespedeza shrubs. Fourteen bee species were collected from bicolor lespedeza including sweat bees (*Lasioglossum* spp.), leaftcutter bees (*Coelioxys sayi* and *Megachile* spp.), southern carpenter bees (*Xylocopa micans*), long-horned bees (*Melissodes bimaculata*), and bumble bees (*Bombus* spp.) [3]. Because bicolor lespedeza flowers in late summer, it can be important to honey bees, which have fewer food sources at this time of year [26].

OTHER USES:
No information is available on this topic.

IMPACTS AND CONTROL:
Impacts: Most predictions and descriptions of bicolor lespedeza's detrimental impacts on vegetation, wildlife habitat, and land management are anecdotal (e.g., [21,28,31,57]). Detailed study and documentation of the impacts of dense bicolor lespedeza stands are lacking. Bicolor lespedeza is most problematic in the southeastern part of the United States. In southern forests from Louisiana and Arkansas east to Virginia and Florida, bicolor lespedeza occupies an estimated 115,550 acres (46,760 ha), of which nearly 50,000 acres (20,230 ha) occurs in Georgia and Arkansas [59]. In Virgina, Kentucky, and Tennessee, bicolor lespedeza is not recognized as a "severe" threat and usually requires a disturbance to establish [48,79,88]. In South Carolina, bicolor lespedeza is considered a "severe threat" to the composition, structure, or function of native vegetation [74]. In Georgia, bicolor lespedeza is a "serious problem" and has replaced native species in wildland habitats [31].

Although bicolor lespedeza impacts were not quantified, several sources indicate that native vegetation, forest regeneration, wildlife habitat, and land management options can be negatively affected in heavily invaded areas. Even an early publication that highlighted the value of bicolor lespedeza for wildlife reported that once established, dense stands (≥50,000 or more shrubs/acre) could prevent grass growth and tree establishment [21]. In a field guide of plants invasive to southern forests, Miller [57] also reports that dense bicolor lespedeza stands prevent forest regeneration and can restrict land access. According to southern silvicultural management guidelines, bicolor lespedeza is "extremely aggressive" in open areas and can replace native vegetation, alter wildlife habitat, and reduce diversity. Because bicolor lespedeza sprouting and spread have been reported after fire (see Plant response to fire), prescribed fire management options in prairies and pine savannas may be limited by bicolor lespedeza's presence [28].

Control: Few studies reported on the best methods to control bicolor lespedeza populations; however, the potential of a persistent seed bank requires long-term monitoring in control areas [57]. General weed control theory suggests that control of biotic invasions is most effective when it employs a long-term, ecosystem-wide strategy rather than a tactical approach focused on battling individual invaders [53]. In all cases where bicolor lespedeza is targeted for control, the potential for other invasive species to its void must be considered [10].

Fire: For information on the use of prescribed fire to control this species, see Fire Management Considerations.

Prevention: Perhaps the best initial step to prevent establishment and growth of bicolor lespedeza in uninvaded areas would be to prohibit seeding or planting in nearby areas. As of 1991, however, bicolor lespedeza was still listed as a northeastern conservation plant useful to wildlife for food and cover [52].

It is commonly argued that the most cost-efficient and effective method of managing invasive species is to prevent their establishment and spread by maintaining "healthy" natural communities [53,71] (e.g., avoid road building in wildlands [84]) and by monitoring several times each year [45]. Managing to maintain the integrity of the native plant community and mitigate the factors enhancing ecosystem invasibility is likely to be more effective than managing solely to control the invader [39].

Weed prevention and control can be incorporated into many types of management plans, including those for logging and site preparation, grazing allotments, recreation management, research projects, road building and maintenance, and fire management [85]. See the Guide to noxious weed prevention practices [85] for specific guidelines in preventing the spread of weed seeds and propagules under different management conditions.

Cultural control: No information is available on this topic.

Physical or mechanical control: Heavy and repeated cutting or grazing have been reported to decrease bicolor lespedeza cover [62]; however, timing and duration of these treatments were not described.

Biological control: As of 2010, there were no reports of bicolor lespedeza biocontrols being studied or released. Biological control of invasive species has a long history that indicates many factors must be considered before using biological controls. Refer to these sources: [87,90] and the Weed control methods handbook [83] for background information and important considerations for developing and implementing biological control programs.

Chemical control: Several studies have compared the effectiveness of different herbicides to control bicolor lespedeza. In one report, mowing 1 to 3 months prior to treating with herbicides increased effectiveness [57]. Herbicide treatments and application methods were compared or reported in the following sources: [8,28,57,58]. Some herbicide tolerances are reported by Morisawa [62].

While herbicides can be effective in gaining initial control of a new invasion or a severe infestation, rarely are they a complete or long-term solution to weed management [13]. See the Weed control methods handbook [83] for considerations on the use of herbicides in natural areas and detailed information on specific chemicals.

Integrated management: No information is available on this topic.

APPENDIX: FIRE REGIME TABLE

SPECIES: Lespedeza bicolor

The following table provides fire regime information that may be relevant to bicolor lespedeza habitats. Follow the links in the table to documents that provide more detailed information on these fire regimes.

Fire regime information on vegetation communities in which bicolor lespedeza may occur. This information is taken from the LANDFIRE Rapid Assessment Vegetation Models [51], which were developed by local experts using available literature, local data, and/or expert opinion. This table summarizes fire regime characteristics for each plant community listed. The PDF file linked from each plant community name describes the model and synthesizes the knowledge available on vegetation composition, structure, and dynamics in that community. Cells are blank where information is not available in the Rapid Assessment Vegetation Model.

Great Lakes Northeast South-central US Southern Appalachians Southeast

Great Lakes

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Great Lakes Grassland					
Mosaic of bluestem prairie and oak-hickory	Replacement	79%	5	1	8
	Mixed	2%	260		
	Surface or low	20%	2		33

Northeast

- Northeast Woodland
- Northeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Northeast Woodland					
Eastern woodland mosaic	Replacement	2%	200	100	300
	Mixed	9%	40	20	60
	Surface or low	89%	4	1	7
	Replacement	16%	128		
	Mixed	32%	65		

Rocky outcrop pine (Northeast)					
	Surface or low	52%	40		
Pine barrens	Replacement	10%	78		
	Mixed	25%	32		
	Surface or low	65%	12		
Oak-pine (eastern dry-xeric)	Replacement	4%	185		
	Mixed	7%	110		
	Surface or low	90%	8		
Northeast Forested					
Northern hardwoods (Northeast)	Replacement	39%	≥1,000		
	Mixed	61%	650		
Eastern white pine-northern hardwoods	Replacement	72%	475		
	Surface or low	28%	>1,000		
Northern hardwoods-eastern hemlock	Replacement	50%	≥1,000		
	Surface or low	50%	≥1,000		
Northern hardwoods-spruce	Replacement	100%	≥1,000	400	>1,000
Appalachian oak forest (dry-mesic)	Replacement	2%	625	500	≥1,000
	Mixed	6%	250	200	500
	Surface or low	92%	15	7	26
Beech-maple	Replacement	100%	>1,000		
Northeast spruce-fir forest	Replacement	100%	265	150	300
Southeastern red spruce-Fraser fir	Replacement	100%	500	300	≥1,000
South-central US • South-central US Grassland • South-central US Shrubland • South-central US Woodland • South-central US Forested					
		Fire regime characteristics			

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
South-central US Grassland					
Bluestem-sacahuista	Replacement	70%	3.6	1	
	Mixed	30%	7.7	2	
Desert grassland	Replacement	82%	8		
	Mixed	18%	37		
Blackland prairie	Replacement	96%	4		
	Surface or low	4%	100		
Southern shortgrass or mixed-grass prairie	Replacement	100%	8	1	10
Southern tallgrass prairie	Replacement	91%	5		
	Mixed	9%	50		
Oak savanna	Replacement	3%	100	5	110
	Mixed	5%	60	5	250
	Surface or low	93%	3	1	4
South-central US Shrubland					
Southwestern shrub steppe	Replacement	76%	12		
	Mixed	24%	37		
Shinnery oak-mixed grass	Replacement	96%	7		
	Mixed	4%	150		
Shinnery oak-tallgrass	Replacement	93%	7		
	Mixed	7%	100		
South-central US Woodland					
Mesquite savanna	Replacement	5%	100		
	Mixed	4%	150		
	Surface or low	91%	6		
Oak-hickory savanna	Replacement	1%	227		
	Surface or low	99%	3.2		
	Replacement	16%	25	10	100

Interior Highlands dry oak/bluestem woodland and glade	Mixed	4%	100	10	
	Surface or low	80%	5	2	7
Oak woodland-shrubland-grassland mosaic	Replacement	11%	50		
	Mixed	56%	10		
	Surface or low	33%	17		
Interior Highlands oak-hickory-pine	Replacement	3%	150	100	300
	Surface or low	97%	4	2	10
Pine bluestem	Replacement	4%	100		
	Surface or low	96%	4		
South-central US Forested					
Interior Highlands dry-mesic forest and woodland	Replacement	7%	250	50	300
	Mixed	18%	90	20	150
	Surface or low	75%	22	5	35
Gulf Coastal Plain pine flatwoods	Replacement	2%	190		
	Mixed	3%	170		
	Surface or low	95%	5		
West Gulf Coastal plain pine (uplands and flatwoods)	Replacement	4%	100	50	200
	Mixed	4%	100	50	
	Surface or low	93%	4	4	10
West Gulf Coastal Plain pine-hardwood woodland or forest upland	Replacement	3%	100	20	200
	Mixed	3%	100	25	
	Surface or low	94%	3	3	5
Southern floodplain	Replacement	42%	140		
	Surface or low	58%	100		
Southern floodplain (rare fire)	Replacement	42%	≥1,000		
	Surface or low	58%	714		
Cross Timbers	Replacement	3%	170		
	Mixed	2%	250		
	Surface or low	94%	6		
Southern Appalachians					

- Southern Appalachians Grassland
- Southern Appalachians Woodland
- Southern Appalachians Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southern Appalachians Grassland					
Bluestem-oak barrens	Replacement	46%	15		
	Mixed	10%	69		
	Surface or low	44%	16		
Eastern prairie-woodland mosaic	Replacement	50%	10		
	Mixed	1%	900		
	Surface or low	50%	10		
Southern Appalachians Woodland					
Appalachian shortleaf pine	Replacement	4%	125		
	Mixed	4%	155		
	Surface or low	92%	6		
Table Mountain-pitch pine	Replacement	5%	100		
	Mixed	3%	160		
	Surface or low	92%	5		
Oak-ash woodland	Replacement	23%	119		
	Mixed	28%	95		
	Surface or low	49%	55		
Southern Appalachians Forested					
Bottomland hardwood forest	Replacement	25%	435	200	≥1,000
	Mixed	24%	455	150	500
	Surface or low	51%	210	50	250
Mixed mesophytic hardwood	Replacement	11%	665		
	Mixed	10%	715		
	Surface or low	79%	90		
Appalachian oak-hickory-pine	Replacement	3%	180	30	500
	Mixed	8%	65	15	150

	Surface or low	89%	6	3	10
Eastern hemlock-eastern white pine-hardwood	Replacement	17%	≥1,000	500	>1,000
	Surface or low	83%	210	100	>1,000
Oak (eastern dry-xeric)	Replacement	6%	128	50	100
	Mixed	16%	50	20	30
	Surface or low	78%	10	1	10
Appalachian Virginia pine	Replacement	20%	110	25	125
	Mixed	15%	145		
	Surface or low	64%	35	10	40
Appalachian oak forest (dry-mesic)	Replacement	6%	220		
	Mixed	15%	90		
	Surface or low	79%	17		
Southern Appalachian high-elevation forest	Replacement	59%	525		
	Mixed	41%	770		

Southeast

- Southeast Grassland
- Southeast Shrubland
- Southeast Woodland
- Southeast Forested

Vegetation Community (Potential Natural Vegetation Group)	Fire severity*	Fire regime characteristics			
		Percent of fires	Mean interval (years)	Minimum interval (years)	Maximum interval (years)
Southeast Grassland					
Southeast Gulf Coastal Plain Blackland prairie and woodland	Replacement	22%	7		
	Mixed	78%	2.2		
Everglades sawgrass	Replacement	96%	3	2	15
	Surface or low	4%	70		
Floodplain marsh	Replacement	100%	4	3	30
Everglades (marl prairie)	Replacement	45%	16	10	20
	Mixed	55%	13	10	

Palmetto prairie	Replacement	87%	2	1	4
	Mixed	4%	40		
	Surface or low	9%	20		
Pond cypress savanna	Replacement	17%	120		
	Mixed	27%	75		
	Surface or low	57%	35		
Southern tidal brackish to freshwater marsh	Replacement	100%	5		
Gulf Coast wet pine savanna	Replacement	2%	165	10	500
	Mixed	1%	500		
	Surface or low	98%	3	1	10
Southeast Shrubland					
Pocosin	Replacement	1%	>1,000	30	>1,000
	Mixed	99%	12	3	20
Southeast Woodland					
Longleaf pine/bluestem	Replacement	3%	130		
	Surface or low	97%	4	1	5
Longleaf pine (mesic uplands)	Replacement	3%	110	40	200
	Surface or low	97%	3	1	5
Longleaf pine-Sandhills prairie	Replacement	3%	130	25	500
	Surface or low	97%	4	1	10
Pine rocklands	Mixed	1%	330		
	Surface or low	99%	3	1	5
Pond pine	Replacement	64%	7	5	500
	Mixed	25%	18	8	150
	Surface or low	10%	43	2	50
South Florida slash pine flatwoods	Replacement	6%	50	50	90
	Surface or low	94%	3	1	6
Atlantic wet pine savanna	Replacement	4%	100		
	Mixed	2%	175		
	Surface or				

	low	94%	4		
Southeast Forested					
Sand pine scrub	Replacement	90%	45	10	100
	Mixed	10%	400	60	
Coastal Plain pine-oak-hickory	Replacement	4%	200		
	Mixed	7%	100		
	Surface or low	89%	8		
Atlantic white-cedar forest	Replacement	34%	200	25	350
	Mixed	8%	900	20	900
	Surface or low	59%	115	10	500
Maritime forest	Replacement	18%	40		500
	Mixed	2%	310	100	500
	Surface or low	80%	9	3	50
Mesic-dry flatwoods	Replacement	3%	65	5	150
	Surface or low	97%	2	1	8
Loess bluff and plain forest	Replacement	7%	476		
	Mixed	9%	385		
	Surface or low	85%	39		
South Florida coastal prairie-mangrove swamp	Replacement	76%	25		
	Mixed	24%	80		
Southern floodplain	Replacement	7%	900		
	Surface or low	93%	63		

*Fire Severities—
Replacement: Any fire that causes greater than 75% top removal of a vegetation-fuel type, resulting in general replacement of existing vegetation; may or may not cause a lethal effect on the plants.
Mixed: Any fire burning more than 5% of an area that does not qualify as a replacement, surface, or low-severity fire; includes mosaic and other fires that are intermediate in effects.
Surface or low: Any fire that causes less than 25% upper layer replacement and/or removal in a vegetation-fuel class but burns 5% or more of the area [37,50].

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