NEW YORK
NON-NATIVE PLANT INVASIVENESS RANKING FORM

Scientific name:	Lotus corniculatus L.	USDA Plants Code: LOCO6
Common names:	Bird's-foot trefoil	
Native distribution:	Eurasia, northern Africa	
Date assessed:	August 5, 2009	
Assessors:	Steve Glenn, Gerry Moore	
Reviewers:	LIISMA SRC	
Date Approved:	19 Aug 2009	Form version date: 3 March 2009

New York Invasiveness Rank: Moderate (Relative Maximum Score 50.00-69.99)

Distribution and Invasiveness Rank (*Obtain from PRISM invasiveness ranking form*)			
	Status of this species in each PRISM:	Current Distribution	PRISM Invasiveness Rank
1	Adirondack Park Invasive Program	Not Assessed	Not Assessed
2	Capital/Mohawk	Not Assessed	Not Assessed
3	Catskill Regional Invasive Species Partnership	Not Assessed	Not Assessed
4	Finger Lakes	Not Assessed	Not Assessed
5	Long Island Invasive Species Management Area	Widespread	Moderate
6	Lower Hudson	Not Assessed	Not Assessed
7	Saint Lawrence/Eastern Lake Ontario	Not Assessed	Not Assessed
8	Western New York	Not Assessed	Not Assessed

Invasiveness Ranking Summary (see details under appropriate sub-section)		Total (Total Answered*) Possible	Total
1	Ecological impact	40 (40)	16
2	Biological characteristic and dispersal ability	25 (25)	19
3	Ecological amplitude and distribution	25 (25)	17
4	Difficulty of control	10 (10)	7
	Outcome score	100 (100)[b]	59[a]
	Relative maximum score †		59.00
	New York Invasiveness Rank §	Moderate (Relative Maximum Score 50.00-69.99)	

* For questions answered "unknown" do not include point value in "Total Answered Points Possible." If "Total Answered Points Possible" is less than 70.00 points, then the overall invasive rank should be listed as "Unknown."
†Calculated as 100(a/b) to two decimal places.
§Very High >80.00; High 70.00–80.00; Moderate 50.00–69.99; Low 40.00–49.99; Insignificant <40.00

A. DISTRIBUTION (KNOWN/POTENTIAL): Summarized from individual PRISM forms

A1.1. Has this species been documented to persist without cultivation in NY? (reliable source; voucher not required)	
☒	Yes – continue to A1.2
☐	No – continue to A2.1
A1.2. In which PRISMs is it known (see inset map)?	
☒	Adirondack Park Invasive Program
☒	Capital/Mohawk
☒	Catskill Regional Invasive Species Partnership
☒	Finger Lakes
☒	Long Island Invasive Species Management Area
☒	Lower Hudson
☒	Saint Lawrence/Eastern Lake Ontario
☒	Western New York

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

A2.1. What is the likelihood that this species will occur and persist outside of cultivation, given the climate in the following PRISMs? (obtain from PRISM invasiveness ranking form)

Not Assessed	Adirondack Park Invasive Program
Not Assessed	Capital/Mohawk
Not Assessed	Catskill Regional Invasive Species Partnership
Not Assessed	Finger Lakes
Very Likely	Long Island Invasive Species Management Area
Not Assessed	Lower Hudson
Not Assessed	Saint Lawrence/Eastern Lake Ontario
Not Assessed	Western New York

Documentation: Well established in PRISM.
Sources of information (e.g.: distribution models, literature, expert opinions):
Brooklyn Botanic Garden, 2009.

If the species does not occur and is not likely to occur with any of the PRISMs, then stop here as there is no need to assess the species.

A2.2. What is the current distribution of the species in each PRISM? (obtain rank *from PRISM invasiveness ranking forms*)

	Distribution
Adirondack Park Invasive Program	Not Assessed
Capital/Mohawk	Not Assessed
Catskill Regional Invasive Species Partnership	Not Assessed
Finger Lakes	Not Assessed
Long Island Invasive Species Management Area	Widespread
Lower Hudson	Not Assessed
Saint Lawrence/Eastern Lake Ontario	Not Assessed
Western New York	Not Assessed

Documentation:
Sources of information:
Brooklyn Botanic Garden, 2009.

A2.3. Describe the potential or known suitable habitats within New York. Natural habitats include all habitats not under active human management. Managed habitats are indicated with an asterisk.

Aquatic Habitats	Wetland Habitats	Upland Habitats
☐ Salt/brackish waters	☐ Salt/brackish marshes	☒ Cultivated*
☐ Freshwater tidal	☐ Freshwater marshes	☒ Grasslands/old fields
☐ Rivers/streams	☐ Peatlands	☒ Shrublands
☐ Natural lakes and ponds	☐ Shrub swamps	☐ Forests/woodlands
☐ Vernal pools	☐ Forested wetlands/riparian	☐ Alpine
☐ Reservoirs/impoundments*	☐ Ditches*	☒ Roadsides*
	☒ Beaches and/or coastal dunes	

Other potential or known suitable habitats within New York:
Lawns,vacant lots, waste places, path edges.

Documentation:
Sources of information:
author's personal observations; Turkington & Franko, 1980; Brooklyn Botanic Garden, 2009.

B. INVASIVENESS RANKING

Questions apply to areas similar in climate and habitats to New York unless specified otherwise.

1. ECOLOGICAL IMPACT

1.1. Impact on Natural Ecosystem Processes and System-Wide Parameters (e.g. fire regime, geomorphological changes (erosion, sedimentation rates), hydrologic regime, nutrient and mineral dynamics, light availability, salinity, pH)

A.	No perceivable impact on ecosystem processes based on research studies, or the absence of impact information if a species is widespread (>10 occurrences in minimally managed areas), has been well-studied (>10 reports/publications), and has been present in the northeast for >100 years.	0
B.	Influences ecosystem processes to a minor degree (e.g., has a perceivable but mild influence on soil nutrient availability)	3
C.	Significant alteration of ecosystem processes (e.g., increases sedimentation rates along streams or coastlines, reduces open water that are important to waterfowl)	7
D.	Major, possibly irreversible, alteration or disruption of ecosystem processes (e.g., the species alters geomorphology and/or hydrology, affects fire frequency, alters soil pH, or fixes substantial levels of nitrogen in the soil making soil unlikely to support certain native plants or more likely to favor non-native species)	10
U.	Unknown	

Score: 7

Documentation:
Identify ecosystem processes impacted (or if applicable, justify choosing answer A in the absence of impact information)
One grassland study (Saj et al., 2008) found that Lotus corniculatus defoliation led to a doubling of the number of bacterial-feeding protozoa in the soil; however, this effect did not appear to lead to a significant change in the availability of soil organic N to neighbouring grasses. Another study (Brophy et al., 1987), on N transfer from Lotus corniculatus (a nitrogen fixing species) found there to be significant transfer of N from Lotus corniculatus to neighboring grasses (Phlaris arundinacea). Give this species' ability to grow in sandy, nutrient-poor open areas and its ability fix nitrogen, it seems that in these systems it could have a significant alteration of ecosystem processes.
Sources of information:
Brophy et al., 1987; Saj et al., 2008.

1.2. Impact on Natural Community Structure

A.	No perceived impact; establishes in an existing layer without influencing its structure	0
B.	Influences structure in one layer (e.g., changes the density of one layer)	3
C.	Significant impact in at least one layer (e.g., creation of a new layer or elimination of an existing layer)	7
D.	Major alteration of structure (e.g., covers canopy, eradicating most or all layers below)	10
U.	Unknown	

Score: 3

Documentation:
Identify type of impact or alteration:
Can change the density of the lower herb layer. No evidence of significant or major alteration of structure.
Sources of information:
Authors' pers. obs.

1.3. Impact on Natural Community Composition

A.	No perceived impact; causes no apparent change in native populations	0
B.	Influences community composition (e.g., reduces the number of individuals in one or more native species in the community)	3

C.	Significantly alters community composition (e.g., produces a significant reduction in the population size of one or more native species in the community)	7
D.	Causes major alteration in community composition (e.g., results in the extirpation of one or several native species, reducing biodiversity or change the community composition towards species exotic to the natural community)	10
U.	Unknown	

Score 3

Documentation:
Identify type of impact or alteration:
Lotus corniculatus stands can displace native species, reducing the number of individuals.
No evidence of significant or major alterations in composition.
Sources of information:
Fellows, 2004.

1.4. Impact on other species or species groups (cumulative impact of this species on the animals, fungi, microbes, and other organisms in the community it invades. Examples include reduction in nesting/foraging sites; reduction in habitat connectivity; injurious components such as spines, thorns, burrs, toxins; suppresses soil/sediment microflora; interferes with native pollinators and/or pollination of a native species; hybridizes with a native species; hosts a non-native disease which impacts a native species)

A.	Negligible perceived impact	0
B.	Minor impact	3
C.	Moderate impact	7
D.	Severe impact on other species or species groups	10
U.	Unknown	

Score 3

Documentation:
Identify type of impact or alteration:
One grassland study found that Lotus defoliation led to a doubling of the number of bacterial-feeding protozoa in the soil. More study needed on its effects on soil microbes.
Sources of information:
Saj et al., 2008.

Total Possible 40
Section One Total 16

2. BIOLOGICAL CHARACTERISTICS AND DISPERSAL ABILITY

2.1. Mode and rate of reproduction (provisional thresholds, more investigation needed)

A.	No reproduction by seeds or vegetative propagules (i.e. plant sterile with no sexual or asexual reproduction).	0
B.	Limited reproduction (fewer than 10 viable seeds per plant AND no vegetative reproduction; if viability is not known, then maximum seed production is less than 100 seeds per plant and no vegetative reproduction)	1
C.	Moderate reproduction (fewer than 100 viable seeds per plant - if viability is not known, then maximum seed production is less than 1000 seeds per plant - OR limited successful vegetative spread documented)	2
D.	Abundant reproduction with vegetative asexual spread documented as one of the plants prime reproductive means OR more than 100 viable seeds per plant (if viability is not known, then maximum seed production reported to be greater than 1000 seeds per plant.)	4
U.	Unknown	

Score 4

Documentation:
Describe key reproductive characteristics (including seeds per plant):
Some varieties exhibit prolific seed production, under optimum conditions certain Lotus varieties may yield 675-1125 kg seed per hectare. Some varieties can also spread rhizomatously.
Sources of information:
Turkington & Franko, 1980.

2.2. Innate potential for long-distance dispersal (e.g. bird dispersal, sticks to animal hair, buoyant fruits, pappus for wind-dispersal)

A.	Does not occur (no long-distance dispersal mechanisms)	0
B.	Infrequent or inefficient long-distance dispersal (occurs occasionally despite lack of adaptations)	1
C.	Moderate opportunities for long-distance dispersal (adaptations exist for long-distance dispersal, but studies report that 95% of seeds land within 100 meters of the parent plant)	2
D.	Numerous opportunities for long-distance dispersal (adaptations exist for long-distance dispersal and evidence that many seeds disperse greater than 100 meters from the parent plant)	4
U.	Unknown	

Score 4

Documentation:
Identify dispersal mechanisms:
Enodzoochory- spread by wild and domesticated animals.
Sources of information:
Turkington & Franko, 1980.

2.3. Potential to be spread by human activities (both directly and indirectly – possible mechanisms include: commercial sales, use as forage/revegetation, spread along highways, transport on boats, contaminated compost, land and vegetation management equipment such as mowers and excavators, etc.)

A.	Does not occur	0
B.	Low (human dispersal to new areas occurs almost exclusively by direct means and is infrequent or inefficient)	1
C.	Moderate (human dispersal to new areas occurs by direct and indirect means to a moderate extent)	2
D.	High (opportunities for human dispersal to new areas by direct and indirect means are numerous, frequent, and successful)	3
U.	Unknown	

Score 3

Documentation:
Identify dispersal mechanisms:
Cultivated as a forage and silage crop with many varieties developed. Planted along roadsides to prevent soil erosion. One of the most common impurities in low-grade grass seed mixtures.
Sources of information:
Turkington & Franko, 1980; Fellows, 2004; Grant, 2004.

2.4. Characteristics that increase competitive advantage, such as shade tolerance, ability to grow on infertile soils, perennial habit, fast growth, nitrogen fixation, allelopathy, etc.

A.	Possesses no characteristics that increase competitive advantage	0
B.	Possesses one characteristic that increases competitive advantage	3
C.	Possesses two or more characteristics that increase competitive advantage	6
U.	Unknown	

Score 6

Documentation:
Evidence of competitive ability:
Perennial, root nodules fix nitrogen via a symbionic bacteria (Rhizobium japonicum) which allows it to colonize poor soils. Some varieties thrive on a wide range of soil moisture, ph, salinity, and texture. Some varieties demonstrate extreme cold weather hardiness. Has a deep taproot enhancing drought resistance. Some varieties can also spread rhizomatously. Very variable (morphological and physiological) species, which may enhance ecological amplitude in some varieties.
Hypothesised to have arisen as a hybrid of L. tenuis and L. uliginosus (Grant & Small, 1996).
Sources of information:
Turkington & Franko, 1980; Grant & Small, 1996; Voigt & Mosjidis, 2002; Banuelos & Beuselinck, 2003; Fellows, 2004; Teakle et al., 2006.

2.5. Growth vigor

A. Does not form thickets or have a climbing or smothering growth habit 0
B. Has climbing or smothering growth habit, forms a dense layer above shorter vegetation, forms dense thickets, or forms a dense floating mat in aquatic systems where it smothers other vegetation or organisms 2
U. Unknown

Score 0

Documentation:
Describe growth form:
While reported to cover "large areas" in the literature, no dense or smothering habit observed in New York.
Sources of information:
Turkington & Franko, 1980; authors' pers. obs. .

2.6. Germination/Regeneration

A. Requires open soil or water and disturbance for seed germination, or regeneration from vegetative propagules. 0
B. Can germinate/regenerate in vegetated areas but in a narrow range or in special conditions 2
C. Can germinate/regenerate in existing vegetation in a wide range of conditions 3
U. Unknown (No studies have been completed)

Score 2

Documentation:
Describe germination requirements:
In some varieties viability recorded as high as 80-98%; 9 year old seed still had a viability of 10%. Germination is increased by fire. In the field seedlings noted only in open or nearly open soils conditions.
Sources of information:
Turkington & Franko, 1980; Li & Hill,1989; Fellows, 2004.

2.7. Other species in the genus invasive in New York or elsewhere

A. No 0
B. Yes 3
U. Unknown

Score 0

Documentation:
Species:
Lotus tenuis (syn. L. glaber) and L. unifoliatus reported from New York but none reported a sinvasive here or elsewhere. U.S.D.A., 2009; Weldy & Werier, 2009.

Total Possible 25

Section Two Total 19

3. ECOLOGICAL AMPLITUDE AND DISTRIBUTION

3.1. Density of stands in natural areas in the northeastern USA and eastern Canada (use same definition as Gleason & Cronquist which is: "The part of the United States covered extends from the Atlantic Ocean west to the western boundaries of Minnesota, Iowa, northern Missouri, and southern Illinois, south to the southern boundaries of Virginia, Kentucky, and Illinois, and south to the Missouri River in Missouri. In Canada the area covered includes Nova Scotia, Prince Edward Island, New Brunswick, and parts of Quebec and Ontario lying south of the 47th parallel of latitude")

A.	No large stands (no areas greater than 1/4 acre or 1000 square meters)	0
B.	Large dense stands present in areas with numerous invasive species already present or disturbed landscapes	2
C.	Large dense stands present in areas with few other invasive species present (i.e. ability to invade relatively pristine natural areas)	4
U.	Unknown	

Score 0

Documentation:
Identify reason for selection, or evidence of weedy history:
While reported to cover "large areas" in the literature, no large, contiguous stands (not deliberately planted) over 0.25 acre observed in New York (although certainly ubiquitous).
Sources of information:
Authors' personal observations; Turkington & Franko, 1980.

3.2. Number of habitats the species may invade

A.	Not known to invade any natural habitats given at A2.3	0
B.	Known to occur in two or more of the habitats given at A2.3, with at least one a natural habitat.	1
C.	Known to occur in three or more of the habitats given at A2.3, with at least two a natural habitat.	2
D.	Known to occur in four or more of the habitats given at A2.3, with at least three a natural habitat.	4
E.	Known to occur in more than four of the habitats given at A2.3, with at least four a natural habitat.	6
U.	Unknown	

Score 4

Documentation:
Identify type of habitats where it occurs and degree/type of impacts:
See A2.3.
Sources of information:
author's personal observations; Turkington & Franko, 1980; Brooklyn Botanic Garden, 2009.

3.3. Role of disturbance in establishment

A.	Requires anthropogenic disturbances to establish.	0
B.	May occasionally establish in undisturbed areas but can readily establish in areas with natural or anthropogenic disturbances.	2
C.	Can establish independent of any known natural or anthropogenic disturbances.	4
U.	Unknown	

Score 2

Documentation:

Identify type of disturbance:
Usually established in disturbed, cultivated, or ecotonal sites, especially along roadways; rarely observed in pristine habitats in New York. Not known to require anthropogenic disturbance to establish.
Sources of information:
Authors' personal observations.

3.4. Climate in native range

A. Native range does not include climates similar to New York 0
B. Native range possibly includes climates similar to at least part of New York. 1
C. Native range includes climates similar to those in New York 3
U. Unknown

Score 3

Documentation:
Describe what part of the native range is similar in climate to New York:
Eurasia- as far north as Siberia
Sources of information:
Turkington & Franko, 1980.

3.5. Current introduced distribution in the northeastern USA and eastern Canada (see question 3.1 for definition of geographic scope)

A. Not known from the northeastern US and adjacent Canada 0
B. Present as a non-native in one northeastern USA state and/or eastern Canadian province. 1
C. Present as a non-native in 2 or 3 northeastern USA states and/or eastern Canadian provinces. 2
D. Present as a non-native in 4–8 northeastern USA states and/or eastern Canadian provinces, and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 1 northeastern state or eastern Canadian province. 3
E. Present as a non-native in >8 northeastern USA states and/or eastern Canadian provinces. and/or categorized as a problem weed (e.g., “Noxious” or “Invasive”) in 2 northeastern states or eastern Canadian provinces. 4
U. Unknown

Score 4

Documentation:
Identify states and provinces invaded:
Reported from all Northeast states and provinces.
Sources of information: See known introduced range in plants.usda.gov, and update with information from states and Canadian provinces.
U.S.D.A., 2009.

3.6. Current introduced distribution of the species in natural areas in the eight New York State PRISMs (Partnerships for Regional Invasive Species Management)

A. Present in none of the PRISMs 0
B. Present in 1 PRISM 1
C. Present in 2 PRISMs 2
D. Present in 3 PRISMs 3
E. Present in more than 3 PRISMs or on the Federal noxious weed lists 4
U. Unknown

Score 4

Documentation:
Describe distribution:

See A1.1.
Sources of information:
Brooklyn Botanic Garden, 2009; Weldy & Werier, 2009.

Total Possible	25
Section Three Total	17

4. DIFFICULTY OF CONTROL

4.1. Seed banks

A.	Seeds (or vegetative propagules) remain viable in soil for less than 1 year, or does not make viable seeds or persistent propagules.	0
B.	Seeds (or vegetative propagules) remain viable in soil for at least 1 to 10 years	2
C.	Seeds (or vegetative propagules) remain viable in soil for more than 10 years	3
U.	Unknown	

Score 2

Documentation:
Identify longevity of seed bank:
Some varieties exhibit prolific seed-banking- one study calculated a seed bank of 13.3 million viable seeds per hectare. Some viability reported to remain for seeds nine years old. Evidence lacking for longer than ten years.
Sources of information:
Turkington & Franko, 1980; Leishman et al., 2000.

4.2. Vegetative regeneration

A.	No regrowth following removal of aboveground growth	0
B.	Regrowth from ground-level meristems	1
C.	Regrowth from extensive underground system	2
D.	Any plant part is a viable propagule	3
U.	Unknown	

Score 2

Documentation:
Describe vegetative response:
Adventitious buds and shoots can arise from the root.
Sources of information:
Turkington & Franko, 1980.

4.3. Level of effort required

A.	Management is not required: e.g., species does not persist without repeated anthropogenic disturbance.	0
B.	Management is relatively easy and inexpensive: e.g. 10 or fewer person-hours of manual effort (pulling, cutting and/or digging) can eradicate a 1 acre infestation in 1 year (infestation averages 50% cover or 1 plant/100 ft^2).	2
C.	Management requires a major short-term investment: e.g. 100 or fewer person-hours/year of manual effort, or up to 10 person-hours/year using mechanical equipment (chain saws, mowers, etc.) for 2-5 years to suppress a 1 acre infestation. Eradication is difficult, but possible (infestation as above).	3
D.	Management requires a major investment: e.g. more than 100 person-hours/year of manual effort, or more than 10 person hours/year using mechanical equipment, or the use of herbicide, grazing animals, fire, etc. for more than 5 years to suppress a 1 acre infestation. Eradication may be impossible (infestation as above).	4
U.	Unknown	

Score 3

Documentation:

Identify types of control methods and time-term required:
Management of this plant may not be required since it is not known to form large populations outside of cultivation or away from deliberate plantings.

Chemical: Bromocil, Isocil, Atrazine, Simazine, Duuron, Cyanazine, Paraquat, Glyphosate, Napropamide, and 2,4-D with MCPA have shown effect control with some varieties, although some varieties have developed a tolerance to certain herbicides (Turkington & Franko, 1980; Shawa, 1982; Davis & Linscott, 1986; Boerboom et al., 1990).

Mechanical: Cutting or grazing can help keep some varities in check, but other varieties (especially semiprostrate-growth varieties) are better able to tolerate grazing pressure (Turkington & Franko, 1980).

Biocontrol: One study found evidence that few insects or diseases were found to seriously affect Lotus (Turkington & Franko, 1980). A later study in Wisconsin identified a few potential insect pests (Wipfli et al., 1989), but further research is lacking. Another study (Kimpinski et al., 1999) found the root-lesion nematode (Pratylenchus penetrans) infecting some varieties, but cultivars and lines tested exhibited wide genetic variability for invasion.

Sources of information:
Turkington & Franko, 1980; Shawa, 1982: Davis & Linscott, 1986; Wipfli et al., 1989; Boerboom et al., 1990; Kimpinski et al., 1999; Grant, 2004.

Total Possible	10
Section Four Total	7
Total for 4 sections Possible	100
Total for 4 sections	59

C. STATUS OF CULTIVARS AND HYBRIDS:

At the present time (May 2008) there is no protocol or criteria for assessing the invasiveness of cultivars independent of the species to which they belong. Such a protocol is needed, and individuals with the appropriate expertise should address this issue in the future. Such a protocol will likely require data on cultivar fertility and identification in both experimental and natural settings.

Hybrids (crosses between different parent species) should be assessed individually and separately from the parent species wherever taxonomically possible, since their invasiveness may differ from that of the parent species. An exception should be made if the taxonomy of the species and hybrids are uncertain, and species and hybrids can not be clearly distinguished in the field. In such cases it is not feasible to distinguish species and hybrids, and they can only be assessed as a single unit.

Some cultivars of the species known to be available: NOTE: A perusal of the Lotus corniculatus literature finds a large number of cultivars, "genotypes", "ecotypes", "races", and "lines" developed over the years ('Empire', the first cultivar developed in North America, was actually developed in NY State and "selected for persistence") (Grant, 2004); and is considered the most variable of all Lotus spp. (Turkington & Franko, 1980). There is a concomitant report of great morphological, physiological, and ecological variation , making invasive assessment probelmatic.

References for species assessment:

Banuelos, G. S. & P. R. Beuselinck. 2003. Growth of three forage species in saline conditions. Arid Land Research & Management. 17(1):13-22.

Boerboom, C. M., D. L. Wyse, and D. A. Somers. 1990. Mechanism of Glyphosate tolerance in birdsfoot-trefoil (Lotus corniculatus). Weed Science. 38(6):463-467.

Brophy, L. S., G. H. Heichel, and M. P. Russelle. 1987. Nitrogen transfer from forage legumes to grass in a systematic planting desing. Crop Science 27: 753-758.

Brooklyn Botanic Garden. 2009. AILANTHUS database. [Accessed on August 5, 2009].

Davis C. and D. L. Linscott. 1986. Tolerance of birdsfoot-trefoil (Lotus corniculatus) to 2,4-D. Weed Science. 34(3):373-376.

Fellows, M. 2004. Lotus corniculatus. U.S. Invasive Species Impact Rank (I-Rank). NatureServe Explorer. <www.natureserve.org>. [Accessed on August 5, 2009].

Grant, W. F. 2004. List of Lotus corniculatus (birdsfoot trefoil), L. uliginosus/L.pedunculatus (big trefoil), L. glaber (narrowleaf trefoil), and L. subbiflorus cultivars. Part 1. Cultivars with known or tentative country of origin. Lotus Newsletter. 34:12-26.

Grant, W. F. & E. Small. 1996. The origin of the Lotus corniculatus (Fabaceae) complex: A synthesis of diverse evidence. Canadian Journal of Botany. 74(7):975-989.

Kimpinski, J., Y. A.Papadopoulos, B. R. Christie, K. B. McRae, & C. E. Gallant. 1999. Invasion and reproduction of Pratylenchus penetrans in birdsfoot trefoil cultivars. Phytoprotection. 80(3):179-184.

Leishman, M. R., G. J. Masters, I. P. Clarke, & V. K. Brown. 2000. Seed bank dynamics: The role of fungal pathogens and climate change. Functional Ecology. 14(3):293-299.

Li, Q. & M. J.Hill.1989. Seed development and dormancy characteristics in Lotus corniculatus L. New Zealand J. Agric. Res. 32(3):333-336.

Saj, S., J. Mikola, & F. Ekelund. 2008. Legume defoliation affects rhizosphere decomposers, but not the uptake of organic matter N by a neighbouring grass. Plant & Soil. 311(1-2):141-149.

Shawa, A. Y. 1982. Control of Aster (Aster subspicatus) and birdsfoot-trefoil (Lotus corniculatus) in cranberries (Vaccinium macrocarpon) cultivar McFarlin with Napropamide. Weed Science. 30(4):369-371.

Teakle, N. L., D. Real, & T. D. Colmer. 2006. Growth and ion relations in response to combined salinity and waterlogging in the perennial forage legumes Lotus corniculatus and Lotus tenuis. Plant & Soil. 289(1-2):369-383.

Turkington R. & G. D. Franko. 1980. The biology of Canadian weeds. 41. Lotus corniculatus L. Canad. J. Pl. Sci. 60:965-979.

United States Department of Agriculture, National Resources Conservation Service. 2009. The PLANTS Database. National Plant Data Center, Baton Rouge, Louisiana [Accessed on August 5, 2009].

Voigt, P. W., & J. A. Mosjidis. 2002. Acid-soil resistance of forage legumes as assessed by a soil-on-agar method. Crop Science. 42(5):1631-1639.

Weldy, T. & D. Werier. 2009. New York Flora Atlas. [S. M. Landry and K. N. Campbell (original application development), Florida Center for Community Design and Research. University of South Florida]. New York Flora Association, Albany, New York. [Accessed on August 5, 2009].

Wiefi M. S., J. L.Wedberg, D. B. Hogg, & T. D. Syverud. 1989. Insect pests associated with birdsfoot-trefoil (Lotus corniculatus) in Wisconsin, USA.Great Lakes Entomologist. 22(1):25-34.

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References for ranking form:

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