

Kudzu (*Pueraria lobata*): Ohio's Next Generation Invasive Plant Species?

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Purpose

To identify traits that enable kudzu, *Pueraria lobata*, to propagate at or near its current northern limit in southwest Ohio; and to eradicate a local infestation.

Background

Historical

- ◆ 1876 – Introduced to U.S. from Asia as a livestock forage crop and as an ornamental plant (Britton, 2003)
- ◆ 1933 – Seedlings distributed by US Soil Conservation Service for agricultural erosion control
- ◆ 1970 – Listed as a common weed in the South by USDA
- ◆ Current Status in Southeast: covers estimated 7 million acres
- ◆ First Reported in Ohio in the 1980's; currently, reported in Noble County and 10 counties adjacent to the Ohio River; and, in Greene County as described below and in Figure 4.

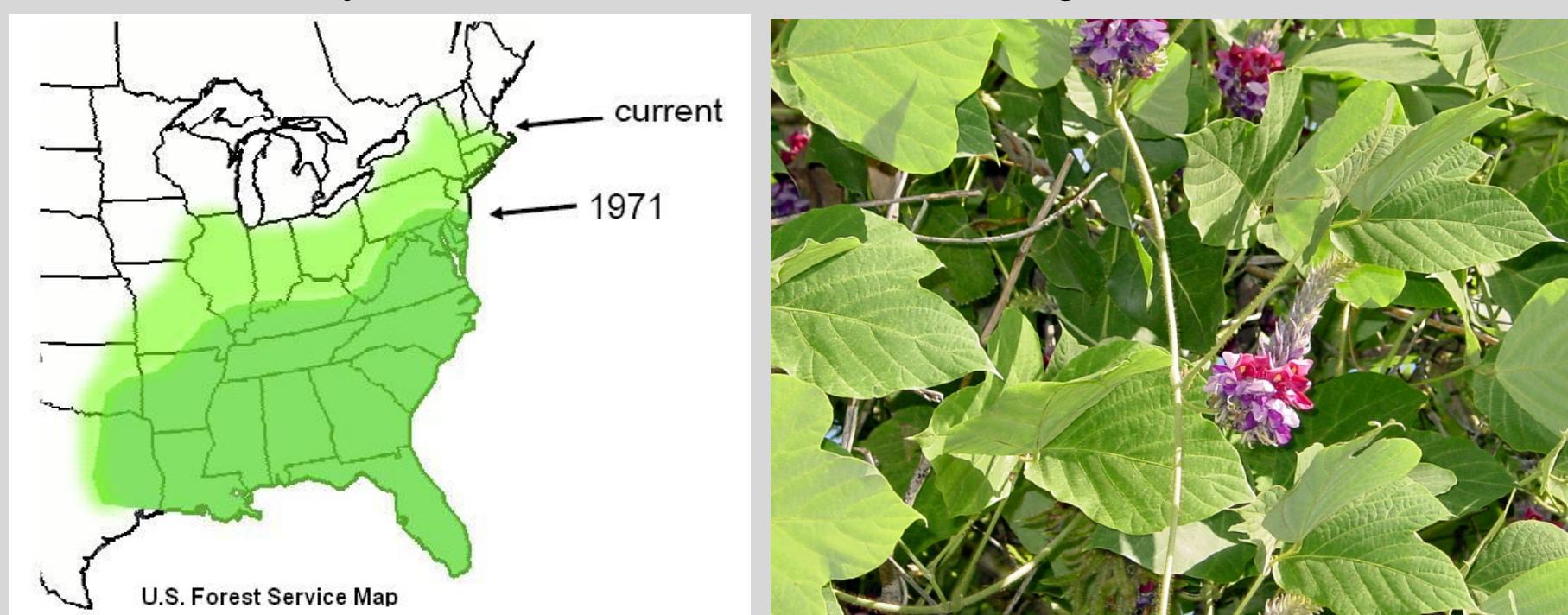


Figure 1. Distribution map of kudzu (2007) and kudzu in bloom.

Traits of This Invasive Legume

- ◆ Seedlings establish in a wide variety of soils and terrains; spreads clonally by formation of vines which may grow at rates up to 30 cm per day and form new adventitious roots from the nodes (Miller, J.H. 2003).
- ◆ Vines produce trifoliate leaves and form a twisted, braided mat that can eventually overtop the crowns of shrubs and trees.
- ◆ Taproots form large, tuberous reserves that reach depths of up to 5 m.
- ◆ Energy and nutrient reserves of the taproot enables vines to enter even temporarily unfavorable microhabitats on as prelude to growing upward and overtopping trees and shrubs.
- ◆ Herbivorous predators do not function to limit this non-native species as they normally would for a native species (Sun, J., et al., 2005).
- ◆ Reproduction – Late-summer flowers are borne in dense racemes; fruits are legumes, covered with reddish-brown, villous hairs
- ◆ Seed dispersal occurs by wind, animals, and water; scarification required.

Eradicating Kudzu from Greene County, Ohio

In summer, 2007, CEMEX, Inc.- Fairborn Plant (Fairborn, OH) entered into an agreement with the authors, representing Cedarville University (Cedarville, OH) to study a kudzu infestation at their quarry site in Greene Co., OH. for the purpose of developing and implementing a successful strategy of eradication. The infestation includes a "lake patch" and 3 other patches west of the lake totaling 4.5 acres. The project affords us the opportunity to study the ecology and physiology of kudzu in possibly its northernmost site in western Ohio.



Figure 2. The kudzu infestation at the "lake site", Greene Co., Ohio.

Objectives

1. To characterize the growth, reproduction, and survival potential of kudzu in Greene County, Ohio.
2. To obtain information on kudzu ecology, physiology, and eradication through published literature and invasive plants networks.
3. To eradicate kudzu from local sites with minimal negative impact.

Methods

- ◆ Ecological Assessments – Summer, 2007
 1. Mapped boundaries of local infestations (Figures 2 and 3).
 2. Identified plant species located in affected plant communities.
 3. Noted drainage features as part of plan to contain herbicide damage.
- ◆ Develop Eradication Strategy – 2007-08:
 1. Surveyed eradication efforts, specialists, funding sources in Midwest.
 2. Networked with Ohio Invasive Plant Council (OIPC) and herbaria.
 3. Studied ecology and physiology of local infestation. (See points below.)
- ◆ Seed Development Study – Summer, 2007:
 1. Located five sample sites representing different slopes and aspects.
 2. Monitored inflorescences weekly at each site until seed maturity (Fig. 3).
 3. Obtained photographic record of floral, fruit, and seed development.
 4. Collected specimens for Cedarville University Herbarium (Figure 4).
- ◆ Seed Scarification and Viability Studies – Fall, 2007:
 1. Collected legumes in "dry rattle" stage from field study sites (Figure 5).
 2. Harvested seeds from pods; divided randomly into 4 groups of 10 seeds.
 3. Scarification: abraded seed coats with sandpaper as follows (Figure 5).
 - > Controls: No abrasion
 - > Light abrasion: Minimal abrasion of seed coats
 - > Moderate abrasion: Thorough abrasion but seed coats still intact
 - > Rigorous abrasion: Seed coats entirely removed by abrasion
 4. Seeds placed in Petri dishes in a slanted position with 5 ml distilled H₂O as moisture reserve at bottom edge to keep filter paper damp (Figure 5).
- ◆ Seedling Establishment On-Site – 2008: Monitored local 2007 field sites for evidence of kudzu seedling establishment in 2008..

Results

Ecological Assessment and Eradication Strategy (In progress or pending):

Based upon our survey of literature, landscape assessments, biotic community survey, and contact with potential eradication specialists, we selected NOVCO, Inc., Columbus, OH to conduct a summer, 2009 herbicide treatment as follows:

1. Herbicide: Transline® (clopyralid) 3,6-dichloro-2-pyridinecarboxylic acid, a systemic herbicide
2. Application Strategy:

> Phase 1: Targeted application (helicopter) leaving an unsprayed buffer zone along lake shore
Aim: To minimize collateral damage; buffer zone will limit runoff into lake (Figure 2).

> Phase 2: Ground-based application to surviving kudzu and remaining buffer along lakeshore (2010)

3. Funding: Collaboration between USFWS, Dow Chemical, CEMEX, Inc., and NOVCO, Inc.

Other Considerations:

> Long-Term Success requires that the extensive root system be completely destroyed
> Mechanical methods including use of grazing livestock usually offer only a short-term, often costly option; must be persistent to prevent re-growth, thus preventing carbohydrate supply to the roots.

Seed Development and Seedling Establishment:

1. Despite a shorter Ohio growing season, kudzu flowered in late summer and set seeds (Figures 1 & 5).
2. We verified that scarification was essential to germination of kudzu seeds. See Table →
3. We also verified that kudzu seeds germinated and produced viable seedlings on-site without human intervention (Figure 7). We were unable to determine the time requirement or the mechanism that promotes scarification in nature.

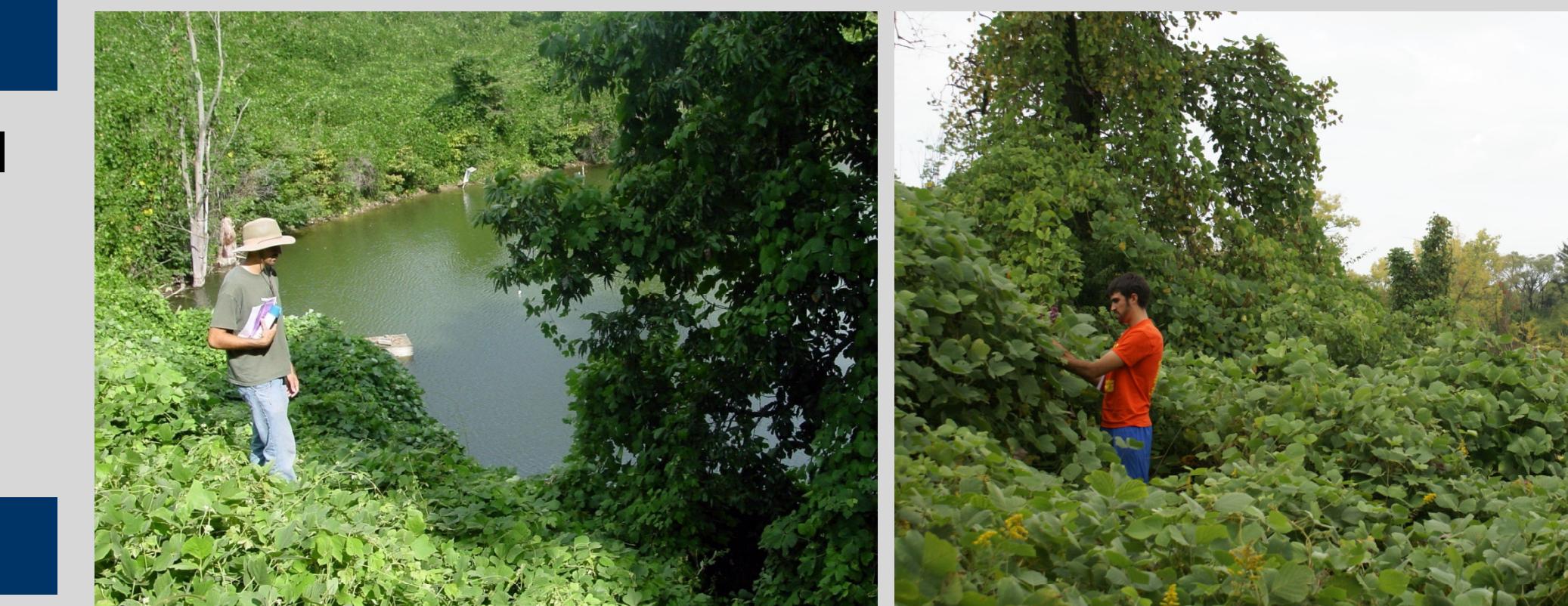


Figure 3 Field study at 'lake site' (left) and monitoring seed development (right)

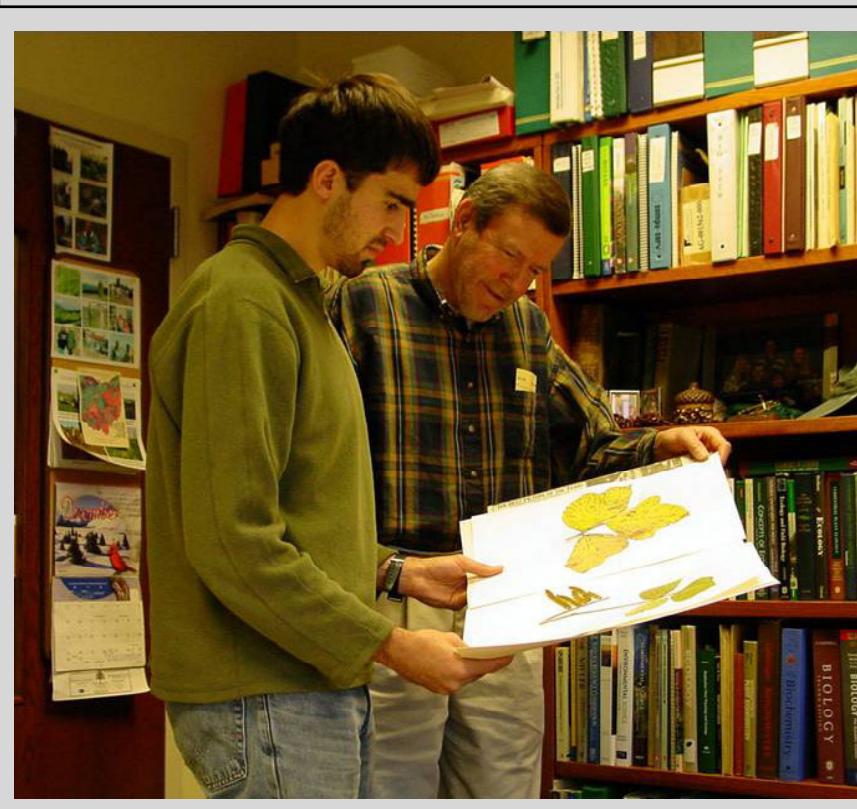


Figure 4. Herbarium records (above); reported kudzu sites by Ohio Invasive Plants Council ,2008 (right).

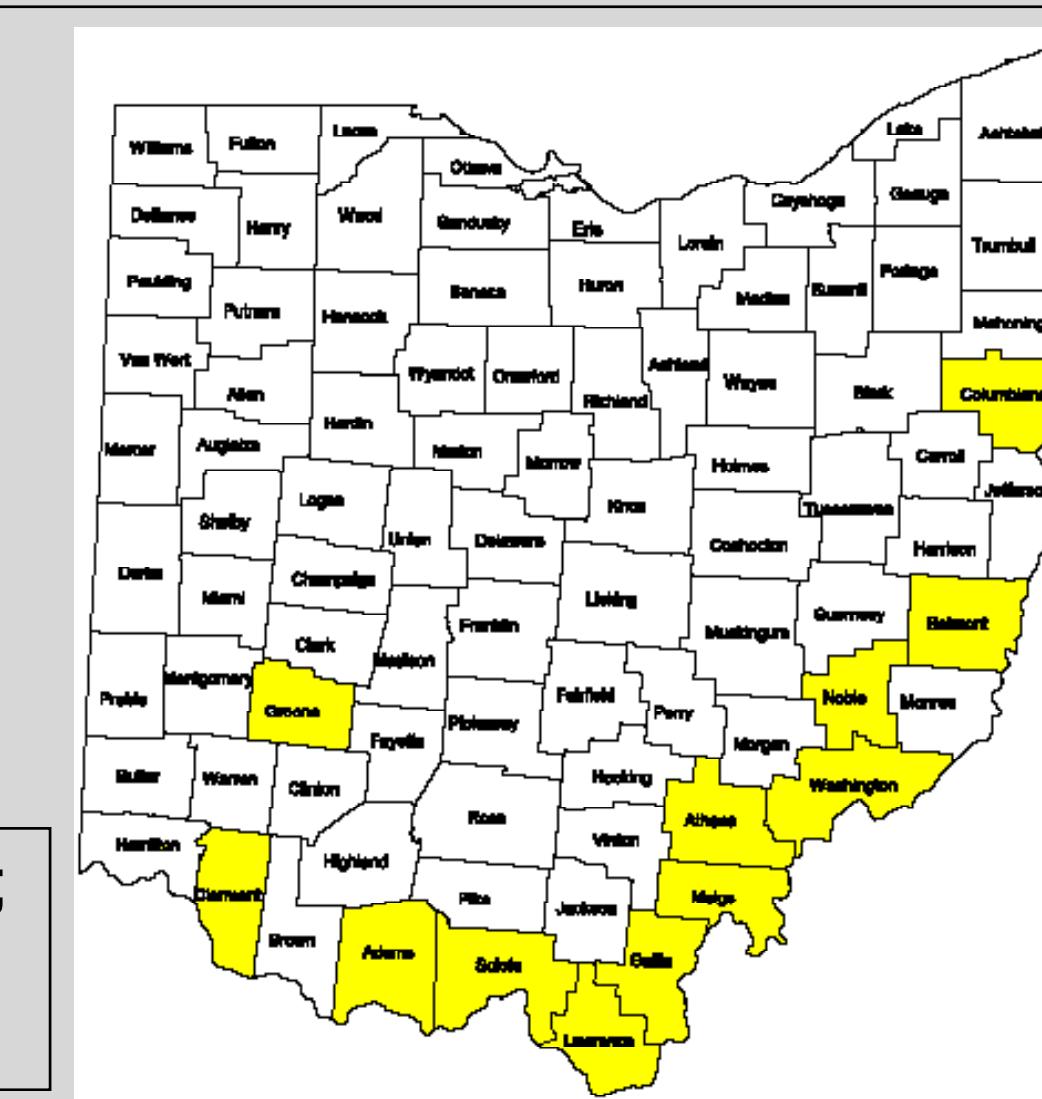


Fig.5 Kudzu legumes (left); seed scarification experiment with varying abrasion..



Figure 6 Kudzu site in Clermont County,Ohio

Scarification	% Germination
None	0
Light Abrasion	30
Moderate Abrasion	100
Rigorous Abrasion	70

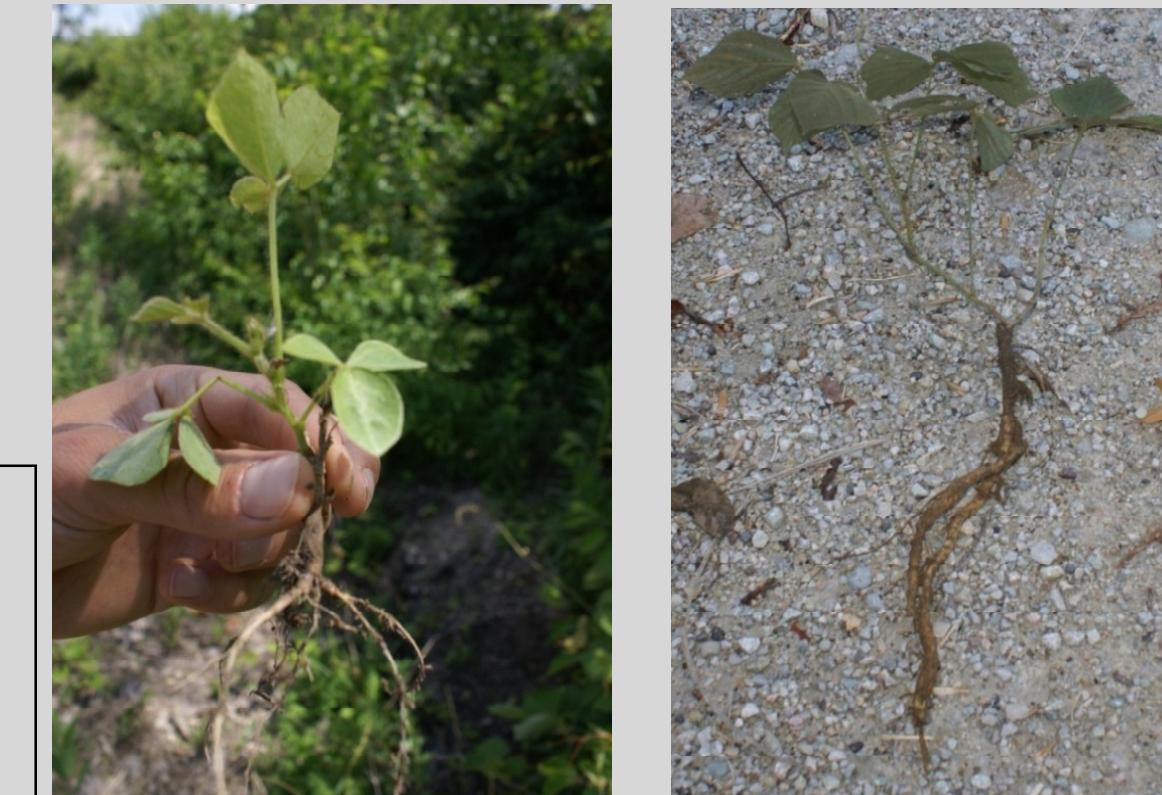


Figure 7. Kudzu seedling with its distinct root system (May 31, 2008) (near-right photo). Far-right photo was obtained on October 25, 2008.

Discussion and Recommendations

Ecological Threat

Reduction in barriers to long-distance dispersal, combined with disruption of natural landscapes, has allowed kudzu to threaten the composition and stability of biotic communities (Sage, 2008). With the help of climate warming, the limiting cold temperature has been receding northward, allowing kudzu to survive in increasingly more northern latitudes including the Great Lakes Region. In addition, the elevated atmospheric CO₂ concentrations strongly favor kudzu growth (Dukes and Mooney, 1999). Together, these forces have led to increased distribution and expansion of kudzu occurrences in Ohio (Figures 1 and 4).

Recommendation

This potential "super invader" of Ohio must be eradicated at all locations in the state to counter its tendency to spread. Early detection and eradication is essential because of the devastating nature of kudzu and the difficulty of eradicating older infestations.

Implementation

Educate and motivate the public to identify and report kudzu sites

Link Existing Networks with government agencies, NGO's and land stewards to verify and report kudzu

Link Program to Wise Land Stewardship that seeks to restore and reclaim disturbed landscapes and restore native species.

Result: Early detection and eradication of young infestations

Eradication at present sites to prevent further spread

Restoration of degraded landscapes that invite kudzu.

References

- Britton, K., D. Orr, J. Sun. 2003. Biological Control of Invasive Plants in the Eastern United States." <http://www.invasive.org/eastern/biocontrol/25Kudzu.html>
- Dukes, Jeffery; Harold Mooney. 1999. "Does global change increase the success of biological invaders?" *Tree* vol. 14 no. 4, 135-138
- Invasive and Noxious Weeds. USDA Natural Resources Conservation Service. <http://plants.usda.gov/java/noxiousDriver>
- Miller, James H. 2003. "Nonnative invasive plants of southern forests: a field guide for identification and control." <http://ctap.inhs.uiuc.edu/newinvaders/srs/K.html>
- Ohio Invasive Plants Council (OIPC), Kirtland, OH. <http://www.oipc.info/>
- Sage, Rowan. 2008. Threats to Biodiversity: Looking Ahead. <http://www.oforest.on.ca/Presentations/2008/Threats%20to%20Biodiversity-Looking%20Ahead.pdf> Univ. of Toronto, and Ontario Forestry Assn.
- Sun, Jianghua; Zhu-Dong Liu; Kerry Britton; Ping Cai; David Orr; Judith Hough-Goldstein. 2005 "Survey of phytophagous insects and foliar pathogens in China for a biocontrol perspective on kudzu, *Pueraria montana* var. *lobata* (Willd.)" http://ag.udel.edu/enwc/research/biocontrol/pdf/Sun_et_al2006.pdf

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