Environment and Natural Resources Trust Fund
2009 Phase 2 Request for Proposals (RFP)

LCCMR ID: 086-C1

Project Title: Invasive Plant Management: Elimination of Invasiveness through Sterility

Total Project Budget: $ $242,015

Proposed Project Time Period for the Funding Requested: July 1, 2009 – June 31, 2012

Other Non-State Funds: $ $0.00

Priority: C1. Aquatic and Terrestrial Invasive Species

First Name: Alan **Last Name:** Smith

Sponsoring Organization: U of M

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Email: smith022@umn.edu

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Region: Statewide

County Name:

City / Township:

Summary: This project will develop, test and implement methods for the production of sterile plants, which are seedless and have reduced invasiveness, yet retain desirable characteristics.

Main Proposal: 0908-2-011-proposal-SmithTwoPageProposal.pdf

Project Budget: 0908-2-011-budget-Smith_Project Budget.pdf

Qualifications: 0908-2-011-qualifications-Smith Qualifications.pdf

Map: 0908-2-011-maps-SmithMap.pdf

Letter of Resolution:

Invasive Plant Management: Elimination of Invasiveness through Sterility

Alan Smith, University of Minnesota

I. PROJECT STATEMENT

The goal of this project is to prevent plant invasions through the application of novel technologies for producing sterile plants. This project will preserve the beneficial characteristics of target plants while eliminating invasiveness, which will improve the environmental quality of Minnesota. The invasive potential of the target plants of this proposal will be eliminated through reduced seed production. The target plants have many positive attributes that have made them popular and successful with the green industries and consumers. Some of the highly regarded attributes are ease of production, disease resistance, vigorous growth in adverse environments and cold hardiness. These popular traits also make them invasive. Additionally, each of the target plants has specific ornamental characters that make them valuable.Sterile versions of the target plants would eliminate invasiveness, maintain positive attributes and allow continued use in the industry.

The target plants for sterility are *Acer ginnala* (amur or ginnala maple), *A. platanoides*. (Norway maple), *Berberis thunbergii* (Japanese barberry), *Elaeagnus angustifolia* (Russian olive), *Euonymus alatus* (burningbush or winged euonymus), *Lonicera morrowii* (Morrow's honeysuckle), *Lonicera* × bella [*L. morrowii* × *L. tatarica* hybrid] (showy fly honeysuckle), and *Lonicera tatarica* (Tatarian honeysuckle). These plants were selected based on their importance to the horticultural industry, potential for invasiveness (each is listed on the Minnesota DNR web site on invasive species; http://www.dnr.state.mn.us/invasives/index.html), and adaptability to our strategies for sterile plant production. Please see the map page for distribution data on these target plants

II. DESCRIPTION OF PROJECT RESULTS

Result 1: Developing methods for production of sterile plants **Budget: $** 181,500

We will use two methods for production of sterile plants that lack invasiveness.
1. A biotechnology strategy that eliminates seed by introducing sterility genes into the plants' chromosomes. Please see the map page for photos of sterile flowers produced by this method. Although this method is broadly applicable to many plants, methods for gene introduction for each species must be developed. A first step in gene introduction is establishing a target plant in tissue culture. The second step is developing the protocol for gene introduction and producing sterile (seedless) varieties.
2. Mutagenesis breeding is also broadly applicable and uses a approach that creates chromosomal mutations resulting in a lack of seed production. My research program has experience in mutagenesis breeding.

Deliverable	Completion Date
1. Tissue cultures of target plants	Year 1, June, 2010
2. Experiments to optimize gene introduction	Years 2 - 3, June, 2012
3. Mutagenesis of propagules	Years 1 - 3, June, 2012
4. Selection of sterile plants	Years 2 - 3, June, 2012

Result 2: Assessment of sterile plants **Budget: $** 60,515

Male and female fertility will be determined by visual and microscopic assessments. Plants will be evaluated for other growth and horticultural characteristics. Sterile plants will be compared with normal fertile plants. It is not likely that sterility will be achieved at the end of year three for all target plants. However, those best adapted to a method may flower and allow fertility assessment.

Deliverable	Completion Date
1. Description of plant growth and horticultural characteristics	Years 2 - 3, June, 2012
2. Assessment of male and female fertility	Years 2 - 3, June, 2012

III. PROJECT STRATEGY AND TIMELINE

A. Project Partners

We will leverage a partnership with Bailey Nurseries (Contact: Terri McEnaney, President Bailey Nurseries; 651-768-3318) in this research. The in-kind support from Bailey Nurseries will include field space, plant care and expertise for selecting plants acceptable to the horticultural industry of Minnesota. Bailey Nurseries of Minnesota is one of the nation's largest growers of ornamental trees, shrubs, evergreens, perennials and annuals has the skill and resources that are synergistic with those of my research program that can make this project successful.

B. Project Impact

The horticulture industry has been a significant contributor of invasive woody perennial plants and some of these plants are still being sold. Continued sales are largely due to the utility of these plants in the green industry. These plants have not been regulated in Minnesota because they are popular with growers and consumers, they are economically important to the green industry and there is a lack of efficient measures for their control. This project will preserve the beneficial characteristics of target plants while eliminating invasiveness, which will improve the environmental quality of Minnesota. The invasive potential of the target plants will be eliminated through reduced seed production while maintaining other favorable characteristics.

Specifically, the production of sterile varieties prevents the continued introduction of invasive plants and therefore decreases their spread and environmental impact. Regulation of these plants is an alternative to this project, however it would come at a cost. Therefore, production of sterile varieties without invasiveness is a novel and effective strategy to prevent further introduction and spread.

C. Time

The target plants for sterility are long-lived perennials. Although the manipulation of the plants for sterility can be accomplished in three years, the assessment and selection of specific plants for each target species is likely to continue for several years beyond three years. Funding for three years allows a population of plants to be produced, from which sterile varieties can be selected.

D. Long-Term Strategy (if applicable)

This project is not part of a larger project, however my research program has used support from the horticulture industry to develop these management strategies in partnership with Bailey Nurseries.

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Alan Smith, University of Minnesota, Department of Horticultural Science

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET

BUDGET ITEM *(See list of Eligible & Non-Eligible Costs, p. 17)*	**AMOUNT**	**% FTE**
Personnel: 50% time gradute student in APS graduate program - 3 years with salary and fringe (health insurance = ; tuition =	$ 116,932	50%
Research associate: Nicole Gardner, 50% time plus fringe	$ 72,543	50%
Undergradute student hourly salary and fringe for routine laboratory help ($2,000/yr)	$ 6,000	9%
Contracts: No contracts	$ -	
	$ -	
Equipment/Tools: Tissue culture incubator dedicated for sterile plant production	$ 12,000	
Project-dedicated field computer for data collection and analysis	$ 2,000	
Digital camera for recording plant characteristics (fertility and growth)	$ 500	
Acquisition (Including Easements): No acquisitions	$ -	
Restoration: No restoration	$ -	
Other: Laboratory supplies and reagents ($9,000/year for three years)	$ 27,000	
Greenhouse user fee @ $140/month for 36 months ($1,680/ year; $5,040/ 3 years)	$ 5,040	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	$ -	
	$ 242,015	

V. OTHER FUNDS

SOURCE OF FUNDS		
Remaining $ From Previous Trust Fund Appropriation (if applicable): Not applicable	**AMOUNT**	**Status**
Other Non-State $ Being Leveraged During Project Period: Bailey Nurseries in kind support for plant selection and growth.	$ -	*Unspent or Not Legally Obligated*
Other State $ Being Spent During Project Period: *Not applicable*	$ -	*Secured or Pending*
In-kind Services During Project Period:	$ -	*Secured or Pending*
Past Spending: *Not applicable*	$ -	
	$ -	

Macintosh HD:Users:alansmith:Proposals:LCCMR2008:2009_Project Budget.xls

Invasive Plant Management: Elimination of Invasiveness through Sterility

Alan Smith, University of Minnesota, Department of Horticultural Science

Alan G. Smith: Project Manager Qualifications and Organization Description

Education:

University of Florida, Ph.D.,	1985, Plant Pathology
Iowa State University, M.S.,	1981, Microbiology
University of Nebraska, B.S.	1978, Microbiology and Chemistry

Professional Positions:

Associate Professor, University of Minnesota Dept. of Horticultural Science, 1994 - present
Director of Graduate Studies for the Plant Biological Sciences Graduate Program
University of Minnesota, 1997 - 1999
Assistant Professor, Univ. of Minnesota Dept. of Horticultural Science, 1988 - 1994
Post-Doctoral Associate, Monsanto Co., 1985 - 1988.
Research Assistant, Department of Plant Pathology, University of Florida, 1981 - 1985.

Research:

A goal of my research is to understand the processes of flower development. I have focused on the function and regulation of genes with expression specific to the reproductive organs of higher plants, stamens and carpals. Results from these experiments are used in applied projects for the improvement of horticultural crops. The applied research develops strategies to manipulate growth and size of plants and for the control of reproduction. Genetic and plant breeding strategies are tested for controlling male and female fertility. The production of sterile plants is beneficial for increasing flower longevity and eliminating invasiveness and allergenic pollen. Dr. Smith is a graduate faculty member of the Plant Biological Sciences and the Applied Plant Sciences graduate programs and is a member of Plant Molecular Genetics Institute.

Selected Publications:

Smith, A.G. and N.O. Anderson. 2006. Engineered Sterility for Non-native Plant Invaders. IN: *Floriculture, Ornamental and Plant Biotechnology: Advances and Topical Issues* (1st Edition). J.A. Teixeira da Silva, ed. Global Science Books, London, UK.

Smith, A.G., N. Gardner and E.S. Zimmermann. 2005. Engineering sterility for horticultural crops. HortScience 40: 1020-1021.

Smith, A.G., and E. Zimmermann. 2005. Adventitious shoot production and transformation of *Euonymus alata.* HortScience 40: 1081.

Smith, A.G., and E. Zimmermann. 2004. Increased Flower Longevity in *Petunia* with Male Sterility. HortScience 39: 822.

University of Minnesota, Department of Horticultural Science:

Internationally known for research in environmental issues, plant breeding and the development of new plant varieties, the Department of Horticultural Science at the University of Minnesota is home to a highly respected faculty with diverse areas of expertise in plant science. Public outreach and education through the Master Gardener Program and The Minnesota Landscape Arboretum is complemented by strong service to the horticultural industries. Our research facilities are among the best in the nation. In Alderman Hall, modern laboratories are available with equipment for research and teaching. My research program has strong collaborations with other researchers in academics and industry.

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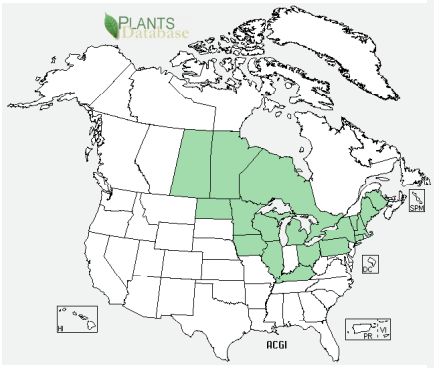
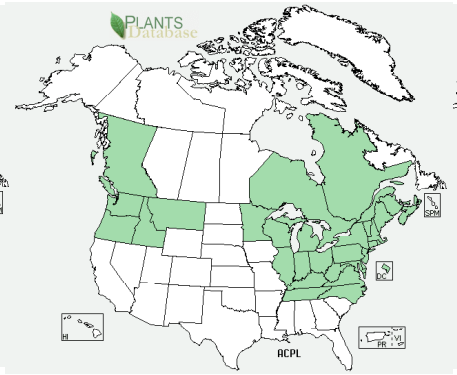
Shaded states or provinces show the distribution of each of the eight invasive plants that are targeted for elimination of invasiveness. Maps are from the USDA, National Plant Data Center (http://plants.usda.gov/).

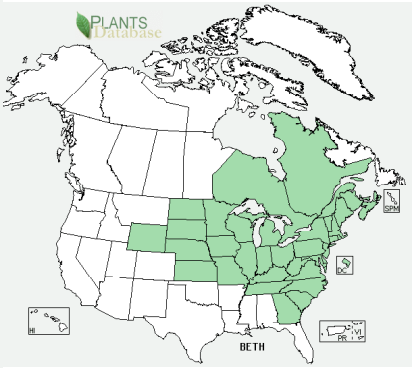
The lower right photo shows a sterile flower of *Nicotiana tabacum* that preserves ornamental characteristics, yet eliminates seed set.



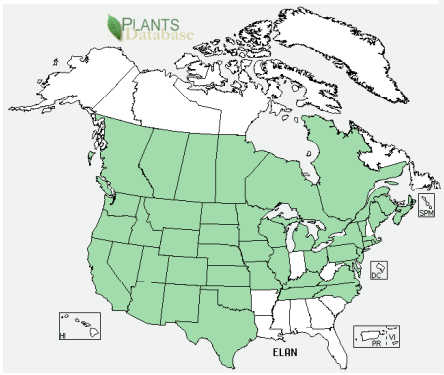
Acer ginnala
(amur or ginnala maple)



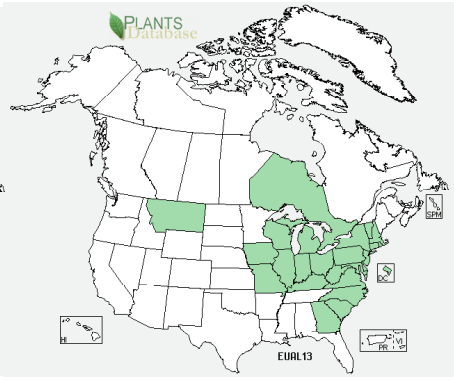
A. platanoides
(Norway maple)



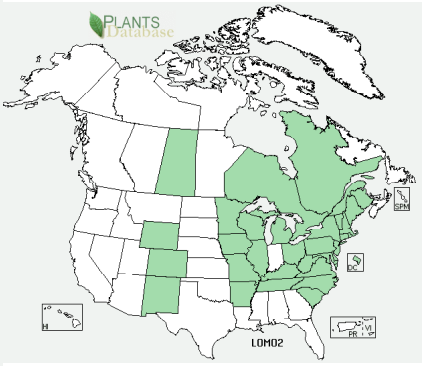
Berberis thunbergii
(Japanese barberry)



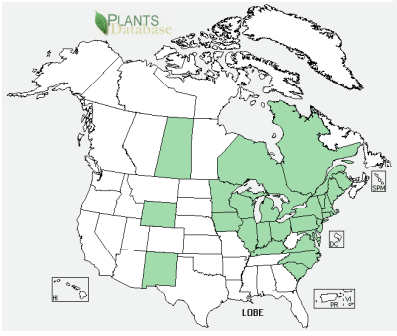
Elaeagnus angustifolia
(Russian olive)



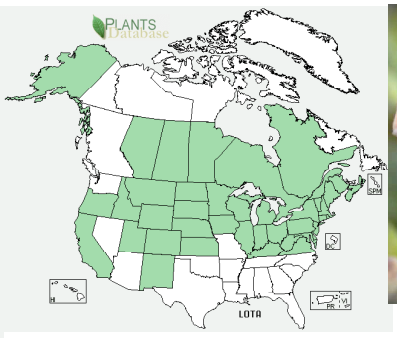
Euonymus alatus
(burningbush)



Lonicera morrowii
(Morrow's honeysuckle)



Lonicera × bella
(showy fly honeysuckle)



Lonicera tatarica
(Tatarian honeysuckle)

Sterile flower (left) is very similar to the fertile flower (right), but sets no seed.