

**Environment and Natural Resources Trust Fund
2011-2012 Request for Proposals (RFP)**

LCCMR ID: 091-C3+4

Project Title: Developing Perennial Grain Crop for Working Agricultural Landscapes

Category: C3+4. Technical Assistance and Community-Based Planning

Total Project Budget: \$ \$674,242

Proposed Project Time Period for the Funding Requested: 3 yrs, July 2011 - June 2014

Other Non-State Funds: \$ 20,000

Summary:

Support development of four new perennial crops for Minnesota, to increase water quality, enhance wildlife habitat, and conserve natural resources while simultaneously ensuring abundant agricultural productivity from working agricultural lands.

Name: Donald Wyse

Sponsoring Organization: U of MN

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Minneapolis MN 55455

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Web Address: spaweb@umn.edu

Location

Region: Statewide

Ecological Section: Minnesota and NE Iowa Morainal (222M), Lake Agassiz, Aspen Parklands (223N), Red River Valley (251A), North Central Glaciated Plains (251B)

County Name: Itasca, Polk, Ramsey, Redwood, Roseau, Stevens, Waseca

City / Township:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ Employment	_____ TOTAL _____%

2011-2012 MAIN PROPOSAL

PROJECT TITLE: Developing Perennial Grain Crops for Working Agricultural Landscapes

I. PROJECT STATEMENT

Major agricultural regions of Minnesota are dominated by annual cropping systems that are unable to provide adequate ecological services to meet basic local and state water quality goals; protect sensitive aquifer recharge areas; manage excessive water flow at critical times; and maintain biodiversity to support wildlife. In addition, the trend for these annual crop based agricultural landscapes has been a 24% increase in corn and soybean acreage over the last two decades. This trend parallels increasing water quality impairments from sediment, nitrogen, and phosphorous from agricultural nonpoint source pollution.

There is an urgent need to develop perennial crops that when planted on environmentally sensitive areas of Minnesota’s landscape provide effective long-term solutions to agricultural nonpoint source pollution problems and at the same time provide economic benefits to the landowner, the local community and the State. These “working agricultural landscapes” will provide economic return to the farm family and environmental benefits to the state of Minnesota.

The University of Minnesota played a key role in developing annual crops like corn, soybean, and wheat that currently cover large portions of Minnesota’s agricultural landscape. The University is now well positioned to develop the next generation of crops for Minnesota’s agricultural landscapes. These new crops will have a perennial growth habit; and the landscapes planted to these perennial crops will have powerful capacities to provide ecological services and conserve resources, while also producing marketable agricultural commodities since these services will be provided without taking the land out of production. The ultimate objective is to enhance wildlife habitat and conserve natural resources while simultaneously ensuring abundant agricultural productivity from working lands. We are proposing that LCCMR funds be used to support four perennial crop development programs that focus on crops that have the capacity to provide environmental services as well as economic return for producers. These crops are Intermediate wheatgrass, perennial wheat, perennial sunflower, and perennial flax. This project will not result in the development of genetically engineered plants.

II. DESCRIPTION OF PROJECT ACTIVITIES

ACTIVITY 1: Domesticate Intermediate wheatgrass (*Thinopyrum intermedium*) for grain, forage and biofuel production. Budget: \$ 138,561

The goal of this activity is to accelerate the development of intermediate wheatgrass, a naturalized perennial grass, for use as a perennial grain, forage, and biofuel crop in Minnesota. This project will allow us to build on earlier domestication research to rapidly develop wheatgrass lines well adapted to Minnesota conditions.

Outcome	Completion Date
1-1. Evaluate the performance of previously developed wheatgrass genotypes and populations at several locations in Minnesota.	Spring 2014
1-2. Determine the response of perennial-grain-type intermediate wheatgrass to planting date, fertilizer, and forage/biomass removal.	Spring 2014
1-3. Explore grain utilization options through food science research	Spring 2014

ACTIVITY 2: Develop perennial wheat through the crossing of perennial traits from perennial wheat, *Thinopyrum spp.* into annual wheat *Triticum aestivum* for use as a food crop. Budget: \$ 198,560

The goal of this activity is to introduce the perennial growth habit from wild relatives into wheat through sexual hybridization and marker-aided selection. The potential benefits of perennial wheat to soil resource conservation and wildlife habitat have long been recognized. However, the complex genetic issues involved in making hybrids between wheat and perennial grasses have until now stymied the efforts. Recently, new genetic marker systems have been developed to identify ideal plant traits and facilitate rapid variety development. We will use genetic markers to develop perennial wheat plants that have desirable agronomic traits such as yield, grain quality and persistence.

Outcome	Completion Date
2-1. Characterize the performance of previously developed perennial wheat hybrid populations in several Minnesota environments	Spring 2014
2.2 Develop a DNA marker system to identify genetic material associated with ideal perennial plant traits to speed up the development of perennial wheat varieties	Spring 2014
2-3 Cross hybrid plants to both annual and perennial species to develop genetic stocks that can be used to identify important genetic traits to aid perennial wheat variety development	Spring 2014

ACTIVITY 3: Cross perennial traits from *Helianthus tuberosus* into domesticated sunflower, *Helianthus annuus* L. to develop a perennial sunflower with high oil production potential. Budget: \$ 198,560

The goal of this activity is to cross traits for perennial habit from *Helianthus tuberosus* L. into domesticated sunflower (*Helianthus annuus* L). The combination of perennial habit from *H. tuberosus* with the marketability and agronomic characteristics of domesticated sunflower would result in a high-value, perennial crop that provides many ecosystem services to Minnesota. The new perennial oilseed sunflower could be a new source of high or mid-oleic oil that is in high demand in the food industry as well as a source of biodiesel.

Outcome	Completion Date
3-1. Develop an understanding of genetic diversity in both <i>Helianthus tuberosus</i> and <i>Helianthus annuus</i> paying particular focusing on domestication traits and perennial traits	Spring 2014
3-2. Create complex cross populations between <i>Helianthus annuus</i> and <i>H. tuberosus</i> .	Spring 2014
3-3. Develop molecular markers that can be used in the selection of superior plants for variety development	Spring 2014

ACTIVITY 4: Domesticate naturalized populations of perennial flax, *Linum perenne* and native perennial flax, *L. Lewissii* for use as oil and fiber crops. Budget: \$ 138,561

The goal of this objective is to domesticate naturalized populations of perennial flax, *Linum perenne* and native perennial flax, *L. Lewissii* for use as oil and fiber crops. These species are already well adapted to Minnesota's soil and climate and the seeds contain high quantities of oil rich in omega-3 fatty acids for use in food products. We will develop populations with a broad genetic base in order to select perennial flax lines with larger seed, high yield, and better agronomic quality and evaluate current lines under Minnesota field conditions.

Outcome	Completion Date
4-1. Evaluate the performance of existing genotypes and populations at several locations in Mn.	Spring 2014
4-2. Determine the response of perennial flax to management practices: planting date, fertility, seeding rate and time of harvest.	Spring 2014
4-3. The best individuals from within perennial flax accessions will be intercrossed to facilitate improvement within existing populations	Spring 2014

III. PROJECT STRATEGY

A. Project Team/Partners Craig Sheaffer, U of Mn,(F) germplasm evaluation, Gregg Johnson, U of MN, (F)germplasm evaluation, Jim Anderson, U of Mn,(F) wheat breeding, Lee DeHaan, Land Institute,(NF) germplasm resource, Pam Ismail, U of Mn,(F) food science, Peter Morrell, U of Mn,(F) plant domestication, Nancy Ehlike, U of Mn, (F)plant breeding, Bob Stupar, U of Mn,(F) plant genetics, Brent Hulke, USDA-ARS,(NF) sunflower genetics, Mikey Kantar, U of Mn, (F) sunflower breeding, DNR, MDA, PCA, and BSWR have contributed to the development of the project. (F)-will receive funding; (NF)-will not receive funding.

B. Timeline Requirements The proposed research has a timeline of about 9 years. Our initial request is for three years of funding which will provide the support necessary to develop a set of baseline activities required for the development of a viable plant breeding program for each of the four perennial species. However, additional support will be necessary from LCCMR for an additional 6 years to give each project enough time to develop and release perennial crop varieties adapted to Minnesota conditions.

C. Long-Term Strategy and Future Funding Needs Once the four perennial plant breeding programs are established it should be possible to access federal funding from USDA climate change, renewable fuel, water quality, and healthy foods programs to support the plant breeding efforts in the long run.

DEVELOPING PERENNIAL GRAIN CROP FOR WORKING AGRICULTURAL LANDSCAPES

Project Budget

IV. TOTAL PROJECT REQUEST BUDGET (three years: July 1, 2010 - June 30, 2014)

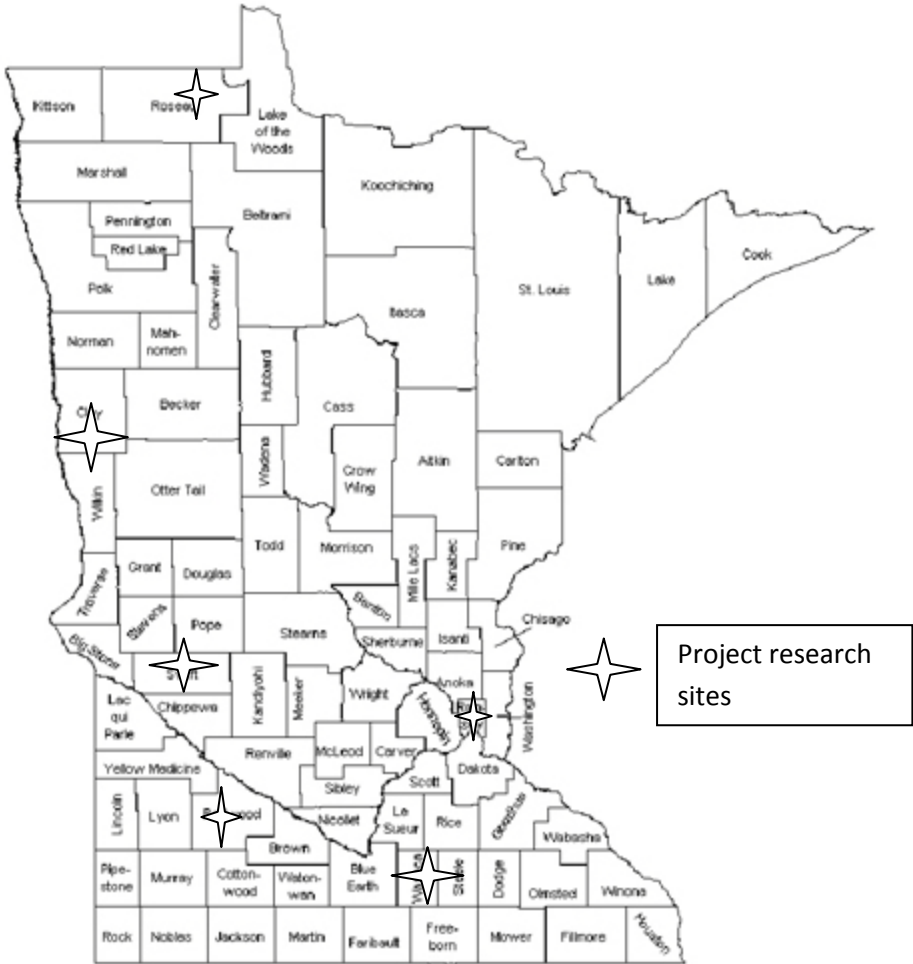
Personnel:		\$ 566,242
4 X Graduate Student stipend, 50% time, \$ fringe, \$ tuition: \$37,000/yr for 2011-2012 plus 3% increase for years 2-3.	\$469,816	
6 X Undergraduate Student Workers: 500- hrs/yr/student @ \$10/hr + 7.14% SSI for 3 yrs.	\$96,426	
Equipment/Tools/Supplies:		\$ 87,000
Supplies needed for field and greenhouse work: hormone treatments for greenhouse, tools for tuber digging, microscope materials, head bags, chemicals for pollen stain	\$12,000	
Laboratory supplies for seed composition and food science analysis	\$15,000	
Supplies needed for marker development: Primers, sequencing (different methods of genome partitioning)	\$60,000	
Travel:		\$ 21,000
To experimental plot sites, to collaborators, and state meetings : 10,000 mi/yr @ \$0.50/mi x 3 yrs, plus \$2000/yr for lodging	\$21,000	
TOTAL PROJECT BUDGET REQUEST TO LCCMR	\$ 674,242	\$ 674,242

V. OTHER FUNDS

V. SOURCE OF OTHER FUNDS	AMOUNT	Status
Other Non-State \$ Being Applied to Project During Project Period:		
National Sunflower Association Development of a Perennial Sunflower for Use in an Integrated Blackbird Management System	\$ 15,000	<i>Approved</i>
Land Institute to further perennial breeding research	\$ 5,000	<i>Approved</i>

PROJECT TITLE: Developing Perennial Grain Crops for Working Agricultural Landscapes PI Donald Wyse

County Map of Minnesota



Map created by Lucinda M. Hall
Automated Cartographic Information Center (ACIC)
John R. Boehart Map Library
University of Minnesota - Twin Cities
August 1999

BIOGRAPHICAL SKETCH

DONALD L. WYSE

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EDUCATIONAL HISTORY

The Ohio State University, 1970, B.S., Agronomy
Michigan State University, 1972, M.S., Crop Science (Weed Science)
Michigan State University, 1974, Ph.D., Crop Science (Weed Science)

PROFESSIONAL POSITIONS

Founding Director, Minnesota Institute for Sustainable Agriculture, Univ. of Minnesota, 1992-2000
Co-director, Center for Integrated Natural Resources and Agricultural Management, 1995-present
Professor, Dept. of Agronomy and Plant Genetics, University of Minnesota, 1986-present
Associate Professor, Dept. of Agronomy/Plant Genetics, University of Minnesota, 1980-1986
Assistant Professor, Dept. of Agronomy and Plant Genetics, University of Minnesota, 1974-1980

RESEARCH AND MANAGEMENT EXPERIENCE

Donald Wyse is a Professor in the Department of Agronomy and Plant Genetics at the University of Minnesota, St. Paul, where he teaches and conducts research in weed management, cropping system development, and plant breeding and selection. His research concentrates on biological weed management, development of multifunctional agricultural systems, perennial crop breeding, and legume and grass seed production systems. He has focused his research efforts on the development of perennial cropping systems, cover crop systems, biomass prairie polycultures, and has studied their impact on soil and water quality. He has lead several multi-disciplinary research teams composed of university faculty and scientists from both state and federal agencies. He has experience in managing large multi year grants. Dr. Wyse was the founding Director of the Minnesota Institute for Sustainable Agriculture and currently serves as Co-director of the Center for Integrated Natural Resources and Agricultural Management at the University of Minnesota. Recent activities of the Center have led to the development of the Mississippi River—Green Land, Blue Water Initiative that includes universities, state and federal agencies, and NGO's that have organized to deal with the landscape issues that impact water quality in the Mississippi River and Great Lakes Basin. He was one of the founding organizers of the Midwest Cover Crops Council and is an active member of the Executive Committee.