

Outdoor Heritage Fund Grant Application

The purpose of the North Dakota Outdoor Heritage Fund is to provide funding to state agencies, tribal governments, political subdivisions, and nonprofit organizations to:

Directive A. Provide access to private and public lands for sportsmen, including projects that create fish and wildlife habitat and provide access for sportsmen;

Directive B. Improve, maintain, and restore water quality, soil conditions, plant diversity, animal systems and to support other practices of stewardship to enhance farming and ranching;

Directive C. Develop, enhance, conserve, and restore wildlife and fish habitat on private and public lands; and

Directive D. Conserve natural areas for recreation through the establishment and development of parks and other recreation areas.

Exemptions

Outdoor Heritage Fund grants may not be used to finance the following:

- A. Litigation;
- B. Lobbying activities;
- C. Any activity that would interfere, disrupt, or prevent activities associated with surface coal mining operations; sand, gravel, or scoria extraction activities; oil and gas operations; or other energy facility or infrastructure development;
- D. The acquisition of land or to encumber any land for a term longer than twenty years; or
- E. Projects outside this state or projects that are beyond the scope of defined activities that fulfill the purposes of Chapter 54-17.8 of the North Dakota Century Code.

Application Deadline

Applications for the first grant round cycle are due on **December 2, 2013 at 5:00 p.m. CST.** All information, including attachments, must be submitted by that date. See instructions below for submission information.

Instructions

It is our intent to have this form available on line. However, until that on-line form is available we are asking that you submit your application as a Word document. Please download this Word document (available on the Industrial Commission/Outdoor Heritage Fund Program website at <http://www.nd.gov/ndic/outdoor-infopage.htm>) to your computer and provide the information as requested. You are not limited to the spacing provided except in those instances where there is a limit on the number of words. After completing the application, save it and attach it to an e-mail and send it to outdoorheritage@nd.gov .Then submit the Word document as noted in the following paragraph.

Attachments in support of your application may be sent by mail to North Dakota Industrial Commission, ATTN: Outdoor Heritage Fund Program, State Capitol – Fourteenth Floor, 600 East Boulevard Ave. Dept. 405, Bismarck, ND 58505 or by e-mail to outdoorheritage@nd.gov . The application and all attachments must be received or postmarked by the application deadline. You will be sent a confirmation by e-mail of receipt of your application.

You may submit your application at any time prior to the application deadline. Early submission is appreciated and encouraged to allow adequate time to review your application and ensure that all required information has been included. Incomplete applications may not be considered for funding. **Any item noted with an * is required.**

Oral Presentation. Please note that you will be given an opportunity to make a ten-minute Oral Presentation at a meeting of the Outdoor Heritage Fund Advisory Board tentatively scheduled for the week of January 13, 2014. These presentations are strongly encouraged.

Open Record. Please note that your application and any attachments will be open records as defined by law and will be posted on the Industrial Commission/Outdoor Heritage Fund website.

Name of Organization: North Dakota State University

Federal Tax ID# 45-6002439

Contact Person/Title: Amy Scott, Authorized Organizational Representative

Address: NDSU Dept. 4000, PO Box 6050

City: Fargo

State: ND

Zip Code: 58108-6050

E-mail Address: ndsuhresearch@ndsuh.edu

Web Site Address: <http://www.ndsu.edu>

Phone: 701-231-8976

Fax #: 701-231-8098

Contact Person/Title: Michael Wunsch, PhD; plant pathologist

Address: 663 Hwy. 281 N. / PO Box 219

City: Carrington

State: ND

Zip Code: 58421-0219

E-mail Address: michael.wunsch@ndsuh.edu

Web Site Address: <http://www.ag.ndsu.edu/CarringtonREC/plant-pathology>

Phone: 701-652-2951

Fax #: 701-652-2055

List names of co-applicants if this is a joint proposal:

John Rickertsen, research agronomist

North Dakota State University Hettinger Research Extension Center

102 Hwy. 12 W / PO Box 1377

Hettinger, ND 58639

701-567-4323 office / 701-567-4327 fax

MAJOR Directive:

Choose only one response.

Directive A. Provide access to private and public lands for sportsmen, including projects that create fish and wildlife habitat and provide access for sportsmen.

Directive B. Improve, maintain, and restore water quality, soil conditions, plant diversity, animal systems and to support other practices of stewardship to enhance farming and ranching;

Directive C. Develop, enhance, conserve, and restore wildlife and fish habitat on private and public lands; and

Directive D. Conserve natural areas for recreation through the establishment and development of parks and other recreation areas.

Additional Directive:

Choose all that apply.

Directive A. Provide access to private and public lands for sportsmen, including projects that create fish and wildlife habitat and provide access for sportsmen.

Directive B. Improve, maintain, and restore water quality, soil conditions, plant diversity, animal systems and to support other practices of stewardship to enhance farming and ranching;

Directive C. Develop, enhance, conserve, and restore wildlife and fish habitat on private and public lands;

Directive D. Conserve natural areas for recreation through the establishment and development of parks and other recreation areas.

Type of organization:

State Agency

Political Subdivision

Tribal Entity

Tax-exempt nonprofit corporation, as described in United States Internal Revenue Code (26 U.S.C. § 501 (c)).

Project Name: Optimizing crop rotation strategies to improve disease management and increase crop yields in North Dakota wheat and field pea production.

Abstract/Executive Summary.

Disease problems associated with tight cropping sequences limit the productivity of wheat and field peas in North Dakota and pose threats to crop diversity, water quality, and soil productivity. Wheat is often re-cropped to the same field for two or more sequential years, resulting in elevated disease pressure that constrains the productivity of wheat and necessitates an increased use of fungicide inputs. Field peas, which fix atmospheric nitrogen and can sharply boost the productivity of a subsequent

management solutions for root rots of field peas is a high priority among North Dakota field pea producers, principal investigator Michael Wunsch has a multi-year track record of success working with and obtaining funding from the Northern Pulse Growers Association, and co-principal investigator John Rickertsen has multiple years of research and outreach experience with field peas from his previous position in South Dakota. Shannon Berndt, executive director of the Northern Pulse Growers Association, has provided a letter of support for this proposal; this letter is provided at the end of this proposal and is also being sent separately.

Certifications

- I certify that this application has been made with the support of the governing body and chief executive of my organization.
- I certify that if awarded grant funding none of the funding will be used for any of the exemptions noted on Page 1 of this application.



Michael Wunsch; signed Nov. 20, 2013

Narrative

Organization Information –

North Dakota State University's agricultural research and extension centers conduct applied research and educational programming to enhance the productivity and competitiveness of agriculture in North Dakota. Research and outreach efforts at the NDSU Carrington and Hettinger Research Extension Centers include programs focused on both crops and livestock, with crop production research spanning the disciplines of agronomy, weed science, plant pathology, and soil science. NDSU Research Extension Centers operate under the guidance of a 12-member volunteer advisory board composed of local agricultural producers; this board is responsible for identifying priorities for research and outreach programming and for providing feedback on existing activities. The centers are staffed by a director drawn from a research or an outreach background, research scientists and regional extension professionals who lead programming in their areas of expertise, and scientific and technical support staff who aid in the execution of programming. The research centers are part of the North Dakota Agricultural Experiment Station, which is funded by legislature separately from the main NDSU campus in Fargo. Research scientists at the research extension centers report to the leadership of the ND Agricultural Experiment Station and their respective advisory boards; while they often collaborate closely with colleagues based at the main campus in Fargo, they are expected to develop independent research and outreach programming to solve production problems and enhance agricultural production in North Dakota.

North Dakota State University first opened as a public land grant institution in Fargo, North Dakota, in 1890, shortly after North Dakota officially became a state in November 1889. Initially known as the North Dakota Agricultural College, the college's name was changed to North Dakota State University in 1960. The North Dakota Agricultural Experiment Station and NDSU Extension Service are integral parts of the University. NDSU accepted its first graduate students in 1895.

NDSU has enjoyed steady growth, with enrollment now exceeding 14,500 students and over 700 faculty members. NDSU offers over 100 undergraduate and approximately 100 graduate programs in a

wide variety of fields, with degrees awarded at the doctoral, master's, professional, and baccalaureate levels. In addition to their academic studies, students have opportunities to participate in approximately 300 student organizations, leadership development, civic engagement activities, fine arts, athletics, and study abroad.

NDSU is part of the North Dakota University System (NDUS) which includes 11 campuses across the state. The State Board of Higher Education (SBHE) is the policy-setting and governing body for the NDUS. The SBHE is made up of seven citizen members appointed to four-year terms by the governor, one student appointed by the governor to serve a one-year term, a non-voting faculty advisor and a non-voting staff advisor. NDSU is headed by a President, with a Provost who provides administrative leadership for all academic activities, including eight academic colleges and the graduate school.

NDSU's mission statement: "With energy and momentum, North Dakota State University addresses the needs and aspirations of people in a changing world by building on our land-grant foundation." With its land-grant mission to provide quality education, leading-edge research and excellent service, NDSU is acknowledged as a national leader among its peers.

Purpose of Grant –

This project addresses important crop production problems of wheat and field peas in North Dakota. It is a new project to be initiated in 2014 pending the award of grant funding.

Importance of the project and project objectives:

The productivity of wheat and field peas in North Dakota is limited by disease problems associated with tight crop rotation intervals.

Tight crop rotations have long been practiced by wheat producers in North Dakota, and re-cropping wheat to the same field for two or more years remains a common practice in parts of the state. Re-cropping of wheat causes a buildup of disease pressure (Kirkegaard et al. 2008), and the recent increase in frequency of high-rainfall growing seasons in North Dakota has exacerbated wheat disease problems, especially where re-cropping is practiced. The increased disease pressure is reflected in a dramatic rise in foliar fungicide usage: The percent of North Dakota wheat acreage receiving at least one foliar fungicide application increased from 2% in 1996 to 7% in 2000, 22% in 2004, and 41% in 2008, the most recent year for which data are available (Zollinger 1998, Glogoza 2002, Zollinger 2006, Zollinger 2009). In other wheat producing regions, crop rotation out of wheat has been shown to reduce foliar diseases of wheat (eg, Bailey et al. 2001) and root diseases of wheat (eg, Angus et al. 2001, Cook 1990), with the effect of crop rotation on disease suppression more pronounced when conditions are wet than when they are dry (Kirkegaard et al. 2008).

Field peas, which fix atmospheric nitrogen and can sharply boost the productivity of a subsequent wheat crop while reducing fertilizer inputs, have been widely adopted as a rotational crop with wheat in some regions of North Dakota, but their frequent cultivation in these regions has caused a buildup of field pea root disease problems that threaten the continued viability of peas as a rotational crop. Field peas are a valuable rotation crop due to their ability to break the disease cycle in wheat (Bailey et al. 2001), to yield well under both low- and high-rainfall conditions (Angadi et al. 2008), and to reduce nitrogen fertilization requirements in successive wheat and oilseed crops (Soon and Clayton 2002). The primary root disease of peas in North Dakota and neighboring Saskatchewan is *Fusarium* root rot (Chittem 2009, Fernandez 2007); seed treatments do not provide satisfactory control of this disease (Goswami 2010-2012, *unpublished*), resistant varieties are not available (Goswami

2010-2011, *unpublished*; Grünwald et al. 2003), and the crop rotation interval required to manage the disease is unknown. Crop rotation has been shown to help reduce Fusarium root rot; in an 11-year experiment conducted in southwestern Saskatchewan, a pea/wheat rotation resulted in a significant reduction in Fusarium root rot and field pea yields relative to continuous peas (Nayyar et al. 2009), but the one-year rotation out of peas was still too short to confer satisfactory suppression of this disease. Unable to manage the disease, some producers have begun abandoning field peas in favor of soybeans, canola, or more intensive wheat production, all of which present undesirable risks – for intensive wheat production, increased disease pressure; for soybeans and canola, crop failure or poor yields (Angadi et al. 2008) during the low-rainfall years often experienced in western North Dakota.

The objective of this proposal is to identify (1) the minimum crop rotation interval out of peas needed for satisfactory management of root rots in field peas and (2) the maximum cropping intensity of wheat under which optimal yields can be achieved without fungicide inputs and under which disease levels are kept below an economically damaging threshold.

Directives of the Outdoor Heritage Fund addressed by this project:

The proposed project addresses Directives B and C of the Outdoor Heritage Fund.

Directive B of the Outdoor Heritage Fund: The proposed project will strengthen farming and ranching in North Dakota by promoting crop diversity, improving crop stewardship, improving water quality, and enhancing soil productivity in regions of the state where wheat is the dominant crop.

- **Crop diversity and crop stewardship:** The project is expected to result in improved crop diversity and crop stewardship that will benefit both crop and livestock producers. The identification of crop rotation practices that break disease cycles in wheat and field peas will protect the viability of field peas as a rotational crop grown with wheat, reduce fungicide input requirements in wheat, and improve yields of wheat and field pea crops. By facilitating sustained production of field peas, the project will also benefit livestock producers by ensuring a local supply of field peas and field pea screenings, which are highly valuable feedstocks for beef cattle (Anderson et al. 2007).
- **Water quality:** The project is expected to result in improved water quality. The identification of crop rotation practices that keep diseases below the thresholds that adversely affect crop yields will reduce fungicide input requirements, resulting in reduced groundwater and surface water pollution caused by runoff and leaching of pesticides. The inclusion of field peas as a rotational crop with wheat reduces nitrogen fertilizer input requirements, resulting in reduced groundwater and surface water pollution caused by leaching and runoff of nitrates from nitrogen fertilizers. Research from Saskatchewan indicates that the inclusion of field peas in wheat cropping systems once every four years can reduce required nitrogen fertilizer inputs by 13 to 19% in subsequent wheat crops and by nearly 29% across a four-year rotation (Soon and Clayton 2002).
- **Soil conditions:** The project is also expected to improve soil conditions. High populations of soil-borne pathogens are a major constraint to soil productivity, and the identification of crop rotation practices that prevent the buildup of root diseases will provide producers with a tool for preventing the accumulation of soil-borne pathogens that adversely affect soil productivity.

Directive C of the Outdoor Heritage Fund: The project will identify crop rotation practices that reduce nitrogen fertilizer and fungicide input requirements, resulting in reduced leaching and runoff of nitrates and pesticides and improved water quality. These improvements in water quality will result in healthier aquatic environments for fish and wildlife and enhanced fish and wildlife habitat.

Project methods:

Six crop rotation sequences will be evaluated under no-till production systems at the NDSU Carrington and Hettinger Research Extension Centers:

- (1) field pea / spring wheat
- (2) field pea / spring wheat / corn
- (3) field pea / spring wheat / spring wheat
- (4) field pea / spring wheat / canola / spring wheat (Hettinger)
field pea / spring wheat / soybean / corn (Carrington)
- (5) field pea / spring wheat / spring wheat / spring wheat
- (6) field pea / spring wheat / corn or barley / broadleaf crop / spring wheat / corn

A completely randomized experimental block design with a minimum of five replicates will be employed. Plot sizes will be 30 ft x 60 ft, with 10 ft x 60 ft in the interior of each plot harvested for seed yield and quality. Fertility and weed management will be conducted to optimize crop productivity.

Pre- and post-emergence damping off will be quantified with plant population assessments conducted early in crop development. On wheat, assessments will be conducted when the second leaf is at least 50% emerged and prior to tillering; on peas, assessments will be conducted at 1 to 2 true nodes. Root and crown rots will be quantified by digging 50 plants selected randomly across a consistent zig-zag pattern in each plot, washing roots and crowns, and visually identifying root and crown diseases and their severity. The incidence of Fusarium root rot will be confirmed by isolating the causal pathogen on pathogen-specific media (Schmale et al. 2006). To confirm visual disease diagnoses for all other root diseases, appropriate laboratory analyses (Singleton et al. 1992) will be conducted on a minimum of 20 representative roots. On field pea roots, separate laboratory protocols will be conducted targeting *Aphanomyces* spp., *Pythium* spp., and *Rhizoctonia* spp., in addition to *Fusarium* spp.; on wheat roots, separate laboratory protocols will be conducted targeting *Bipolaris sorokinianai*, cause of common root rot, *Gaeumannomyces graminis*, cause of take-all, *Pythium* spp., and *Rhizoctonia* spp. in addition to *Fusarium* spp. On wheat, assessments will be conducted during inflorescence emergence; on peas, assessments will be conducted prior to bloom at the 8- to 10-node stage. To capture the impact of Fusarium root rot, which often does not cause significant plant mortality on peas until the mid- to late vegetative stages, a second plant population assessment will also be conducted on peas at this growth stage. The severity of leaf and head diseases in wheat will be evaluated between the soft- to hard-dough growth stages. The severity of foliar diseases in peas will be assessed during mid- to late pod development. For both wheat and peas, separate disease ratings will be conducted for each major disease present.

Seed yield and quality (test weight, kernel weight, and protein) will be assessed at harvest. Soil fertility will be assessed annually in each plot; soil samples will be collected in the late fall shortly before the ground freezes and evaluated for nitrogen (at both 0 to 6 inch and 6 to 24 inch depths), phosphorous, potassium, pH, salts, sulfur, chloride, copper, and organic matter. Soil analyses will be conducted by Agvise (Northwood, ND).

Data will be evaluated with analysis of variance in PROC GLM or PROC MIXED of SAS (version 9.3; SAS Institute, Cary, NC). The assumption of constant variance will be assessed by plotting residuals against predicted values, and the assumption of normality will be assessed with a normal probability plot; appropriate systematic transformations will be applied as needed to ensure that data meet model assumptions. Single-degree-of-freedom contrasts will be conducting utilizing Fisher's protected least significant difference to control the Type I error rate at the level of the experiment. Analyses will be conducted controlling for the effect of experimental replicate.

Timetable for project implementation, 2014:

- March 2014 – seed and Rhizobium inoculant will be procured
- April 2014 – site selection will be finalized
- April/May 2014 – planting, weed control, initial plant population assessments
- June 2014 – root rot assessments (and associated laboratory analyses) completed; second plant population assessment conducted.
- July 2014 – foliar disease assessments completed
- August 2014 – harvest
- November 2014 – evaluation of seed yield and quality
- December 2014 – data analysis and reporting

Literature cited

- Anderson, V., Lardy, G., and Ilse, B. 2007. Field Pea Grain for Beef Cattle. North Dakota Extension Service, Extension Publication AS-1301.
- Angadi, S. V., McConkey, B. G., Cutforth, H. W., Miller, P. R., Ulrich, D., Selles, F., Volkmar, K. M., Entz, M. H. and Brandt, S. A. 2008. Adaptation of alternative pulse and oilseed crops to the semiarid Canadian Prairie: Seed yield and water use efficiency. *Canadian Journal of Plant Science* 88: 425-438.
- Bailey, K.L., Gossen, B.D., Lafond, G.P., Watson, P.R., and Derksen, D.A. 2001. Effect of tillage and crop rotation on root and foliar diseases of wheat and pea in Saskatchewan from 1991 to 1998: Univariate and multivariate analyses. *Canadian Journal of Plant Science* 81:789-803.
- Chittam, K. 2009. PhD Thesis, Chapter One: Identification and characterization of *Fusarium* spp. associated with root rots of field pea in North Dakota. North Dakota State University.
- Cook, R.J. 1990. Diseases caused by root-infecting pathogens in dryland agriculture. *Advances in Soil Science* 13:214-239.
- Fernandez, M.R. 2007. *Fusarium* populations in roots of oilseed and pulse crops grown in eastern Saskatchewan. *Can. J. Plant Sci.* 87:945-952.
- Gardner, P.A., Angus, J.F., Pitson, G.D., Wong, P.T.W. 1998. A comparison of six methods to control take-all in wheat. *Australian Journal of Agricultural Research* 49:1225-1240.
- Glogoza, P., McMullen, M., Zollinger, R., Thostenson, A., DeJong, T., Meyer, W., Schaer, N., and Olson, J. 2002. Pesticide Use and Pest Management Practices for Major Crops in North Dakota - 2000. North Dakota State University Extension Publication ER-79; North Dakota State University, North Dakota Agricultural Statistics Service, and North Dakota Department of Agriculture.
- Grünwald, N.J., Coffman, V.A., and Kraft, J.M. 2003. Sources of partial resistance to *Fusarium* root rot in the *Pisum* Core Collection. *Plant Disease* 87:1197-1200.
- Kirkegaard, J., Christen, O., Krupinsky, J., and Layzell, D. 2008. Break crop benefits in temperate wheat production. *Field Crops Research* 107:185-195.
- Nayyar, A., Hamel, C., Lafond, G., Gossen, B.D., Hanson, K., and Germida, J. 2009. Soil microbial quality associated with yield reduction in continuous-pea. *Applied Soil Ecology* 43:115-121.
- Schmale, D.G., Leslie, J.F., Saleh, A.A., Shields, E.J., and Bergstrom, G.C. 2006. Genetic structure of atmospheric populations of *Gibberella zeae*. *Phytopathology* 96:1021-1026.
- Singleton, L.L., Mihail, J.D., and Rush, C.M., eds. 1992. *Methods for Research on Soilborne Phytopathogenic Fungi*. American Phytopathological Society Press, St. Paul, MN.
- Zollinger, R., Dexter, A.G., Dahl, G.K., Fitterer, S.A., McMullen, M.P., Waldhaus, G.E., Glogoza, P., Ignaszewski, K. 1998. Pesticide Use and Pest Management Practices for Major Crops in North Dakota 1996. North Dakota State University and North Dakota Agricultural Statistics Service.
- Zollinger, R., Glogoza, P., McMullen, M., Bradley, C.A., Dexter, A.G., Knopf, D., Wilson, E., DeJong, T., and Meyer, W. 2006. Pesticide Use and Pest Management Practices in North Dakota 2004. North Dakota State University Extension Publication W-1308; North Dakota State University, North Dakota Department of Agriculture, and USDA NASS North Dakota Field Office.
- Zollinger, R., McMullen, M., Knodel, K., Gray, J., Jantzi, D., Kimmit, G., Hagemeister, K., Schmitt, C. 2009. Pesticide Use and Pest Management Practices in North Dakota 2008. North Dakota State University Extension Publication W-1446; North Dakota State University, North Dakota Department of Agriculture, and USDA NASS North Dakota Field Office.

Management of Project –

The project will be managed in accordance with the methods and timeline detailed in the previous section.

The agronomic components of this project will be managed in Carrington by Michael Wunsch, plant pathologist at the NDSU Carrington Research Extension Center, and in Hettinger by John Rickersten, agronomist at the NDSU Hettinger Research Extension Center. At both locations, disease diagnoses and associated laboratory analyses will be conducted by M. Wunsch and his team.

M. Wunsch received his PhD in plant pathology from Cornell University in Ithaca, New York in May 2010, where he studied with Gary Bergstrom, the extension field crops specialist. He has served with the NDSU Carrington Research Extension Center since June 2010 and holds a 70% research and 30% extension appointment. He conducts applied disease management studies on a

broad range of crops grown in North Dakota, including field peas, other cool-season pulse crops, and wheat. Major emphases of his research program include improving disease management in the cool-season pulse crops, including field peas; developing improved management recommendations for Sclerotinia diseases of soybeans, sunflowers, and dry beans; and evaluating seed treatments for the management of root diseases of wheat and soybeans.

J. Rickertsen received his MS in agronomy from the University of Nebraska, Lincoln in 1989 and, after working with commercial corn breeding programs for several years, served as a research associate/agronomist at South Dakota State University West River Ag Center from 1994 to 2012. At SDSU, he conducted variety trials and production research on wheat, field peas, chickpeas, sunflowers and other minor crops grown in western South Dakota, and he managed a long-term crop rotation study at Wall, SD with nine rotations ranging from two to six years in length. These rotations included winter wheat in rotation with various combinations of proso millet, safflower, sunflower, corn, barley and field pea. J. Rickertsen has served as the Research Agronomist at the NDSU Hettinger Research Extension Center since January 2013, where he conducts variety trials, conducts research to improve production practices and weed control, and works with 15 different crops.

Evaluation –

The success of this project will be evaluated with the following metrics and timeline:

- **May 2014 – *evaluation of whether the crop was planted in a timely manner.*** Planting will be considered timely if it is completed by the dates that producers must meet in order to be eligible for crop insurance. Because the first year of this study (2014) will involve planting the entire study area to peas, planting will be considered to have been conducted in a timely manner if the study is planted by May 10 in Hettinger and May 20 in Carrington, the dates corresponding to the final planting dates under which commercial producers are eligible for crop insurance for peas.
- **Late May / early June – *evaluation of successful crop establishment.*** Crop establishment will be considered successful if plant populations, as assessed at the 1- to 2-node stage on peas, are estimated to not be reduced more than 30 percent relative to the seeding rate (on a pure live seeds basis) due to abiotic stress.
- **Late June and mid-July – *evaluation of successful weed management.*** Weed management will be considered successful if (1) there is no herbicide injury at bloom initiation and (2) there is less than one weed in excess of 3 inches tall per 10 square feet at canopy closure.
- **July – *evaluation of successful insect pest management.*** The most common insect pest found on peas is the pea aphid. Aphid populations will be assessed weekly in the month of July counting the number of aphids on at least five 8-inch plant tips from four different locations in each trial. Aphid management will be considered successful if populations are below the threshold of 2 to 3 aphids per 8-inch plant tip.
- **August – *evaluation of whether seed yield and seed quality assessments are representative.*** The yield and quality assessment will be considered unbiased if harvesting is conducted when the crop has reached full maturity (no green pods) and when less than 1 percent of the pods have dehisced and released their grain naturally.
- **November and December – *assessment of whether the research results are unbiased.*** The first year of this study (2014) will involve planting the entire study area to field peas, and the second year of this study (2015) will involve planting the entire study area to spring wheat; crop rotation sequences will not diverge across treatments until the third year of this study. Consequently, no treatment differences are expected the first two years of this study unless

previous cropping history or other non-target factors are influencing disease and yield outcomes. The results across treatments will be considered unbiased (not appreciably influenced by factors other than the crop rotation treatments) if (1) the plant population, root disease, foliar disease, seed yield, and seed quality results do not differ significantly across treatments in the first two years of this study and (2) the variability in results across treatments is sufficiently low that the coefficient of variation is below 20 for plant population, seed yield, and seed quality assessments, below 50 for root disease assessments, and below 30 for foliar disease assessments. A significant difference will be defined as one that has less than a 5% chance of occurring by random chance.

Financial Information

ATTACHMENT: Project Budget – Using the standard project budget format that is available on the website at <http://www.nd.gov/ndic/outdoor-infopage.htm> , please include a detailed total project budget that specifically outlines all the funds you are requesting.*

The project budget should identify all matching funds, funding sources and indicate whether the matching funds are in the form of cash or in-kind services. As noted on the standard project budget format, certain values have been identified for in-kind services. Please utilize these values in identifying your matching funds. **NOTE: No indirect costs will be funded.**

Budget Standard Form

Project Expense	OHF Request	Applicant's Match Share (Cash)	Applicant's Match Share (In-Kind)	Applicant's Match Share (Indirect)	Other Project Sponsor's Share	Project Expense
Personnel	\$6,933.00	-	-	-	\$6,933.00	\$13,866.00
Principal Investigator	-	\$3,400.00	-	-	-	\$3,400.00
Services	\$648.00	-	-	-	\$648.00	\$1,296.00
Supplies	\$2,700.00	-	-	-	\$2,700.00	\$5,400.00
Travel	\$456.00	-	-	-	\$456.00	\$912.00
Indirect costs	-	-	-	\$2,792.00	-	\$2,792.00
Total project costs	\$10,737.00	\$3,400.00	-	\$2,792.00	\$10,737.00	\$27,666.00

Half of the funding (beyond the applicant's match) is requested from the Outdoor Heritage Fund; the other half is being requested from the Northern Pulse Growers Association. The timing of grant deadlines relative to the growing season precludes obtaining a funding decision from the Northern Pulse Growers prior to applying to the Outdoor Heritage Fund. Funding from the Northern Pulse Growers is highly likely; identifying management solutions for root rots of field peas is a high priority among North Dakota field pea producers, principal investigator Michael Wunsch has a multi-year track record of success working with and obtaining funding from the Northern Pulse Growers Association, and co-principal investigator John Rickertsen has multiple years of research and outreach experience with field peas from his previous position in South Dakota. Shannon Berndt, executive director of the Northern Pulse Growers Association, has provided a letter of support for this proposal; this letter is provided at the end of this proposal and is also being sent separately.

Personnel: Partial salary support is requested for technical support to assist in site preparation, planting, weed and insect pest management, harvest, seed cleaning, seed yield and quality assessment, data entry, and equipment maintenance and repairs associated with this project. Estimated costs are \$5,832 (120 hours in Carrington at \$15.00/hour plus 35% fringe benefits; 140 hours in Hettinger at \$18.00/hour plus 35% fringe benefits). Partial salary support is requested for the research specialist who will assist with fertility management, planting, weed and insect pest management, harvesting, laboratory assays, and student supervision; estimated cost is \$2,268 (approximately 4% of a \$42,000 annual salary plus 35% fringe benefits). Partial salary support is requested for the seasonal workers who will conduct plant population assessments, dig and wash roots for root disease evaluations, prepare roots for laboratory assays, assist in the execution of laboratory assays, and conduct manual weed removal as needed. Estimated costs are \$5,280 (400 hours in Carrington at \$10.00/hour plus 10% fringe benefits; 80 hours in Hettinger at \$10/hour plus 10% fringe benefits).

Principal Investigator: The research leader in Carrington will dedicate approximately 2% of his time (contributed as cash match including fringe benefits) coordinating this project, supervising staff, conducting disease assessments and pathogen diagnoses, assisting in the execution of agronomic tasks, analyzing data, and summarizing results. The research leader in Hettinger will dedicate approximately 2% of his time (contributed as cash match including fringe benefits) coordinating this project at that location, supervising staff, assisting in the execution of agronomic tasks, and summarizing and analyzing results.

Services: Funding is requested to conduct soil analyses in each treatment plot after harvest (\$1,296; 72 samples at \$18.00 per sample; testing conducted by Agvise in Northwood, ND).

Supplies: Funding is requested for supplies to conduct laboratory confirmation of visual disease diagnoses (\$1,400; see itemized list below). An additional \$4,000 is requested for other supplies required to conduct the work, including seed, Rhizobium inoculant, herbicides, insecticides, diesel and gasoline fuel, stakes, harvest bags, and replacement parts required for equipment maintenance and repairs associated with this project.

Travel: Funding is requested for two trips from Carrington to Hettinger to collect root samples and assess foliar diseases (\$512 for 1,280 miles of travel; rental rates for a sedan from the state fleet are \$0.40/mile). Additional funding is requested for off-station travel to purchase supplies and on-station travel to conduct plot maintenance (\$400 for 540 miles of travel; rental rates for a full-sized pickup truck from the state fleet are \$0.74/mile).

Indirect costs: The standard 26% overhead rate associated with conducting projects at NDSU research centers is contributed as indirect match. This overhead rate encompasses utilities, ancillary support (including office support), depreciation and replacement of research and office equipment, upkeep of facilities required to conduct research activities, land rents, and other operating costs.

Itemized list of laboratory supplies:

- benomyl (Methyl 1-(butylcarbamoyl)-2-benzimidazolecarbamate), 95%, 25 grams (Sigma-Aldrich catalog number 381586-25G): \$186.50
- metalaxyl (N-(2,6-dimethylphenyl)-N-(methoxyacetyl)-DL-alanine methyl ester, 100 mg (Sigma-Aldrich catalog number 32012-100MG): \$43.30
- amphotericin B, solubilized, suitable for culturing; 50 mg (Sigma-Aldrich catalog number A9528-50MG): \$34.40
- vancomycin, vancomycin hydrochloride from *Streptomyces orientalis*, BioReagent suitable for culturing; 1 gram (Sigma-Aldrich catalog number V1130-1G): \$248.50

- pimaricin from *Streptomyces chattanoogensis* >95% (Sigma-Aldrich catalog number P9703-25MG): \$204.50
- tannic acid, 50 grams (Sigma-Aldrich catalog number 403040-50G): \$20.30
- casein hydrochloride (Sigma-Aldrich catalog number 22090-100G): \$15.70
- Sterile Petri dishes, 100 x 15 mm, 3 cases (VWR catalog number 25384-342): \$194.73
- Corn meal agar, Hi Media, 500 g (VWR catalog number 61000-028): \$175.62
- Miscellaneous laboratory costs (price increases to the above-mentioned products, toothpicks, scalpels, sodium hypochlorite, laboratory ethanol, paper towels, tubes for processing samples, etc.): \$276.45

- I certify that a project budget will be sent to the Commission*



Michael Wunsch, signed Nov. 20, 2013

Sustainability – Indicate how the project will be funded or sustained in future years. *

Include information on the sustainability of this project after all the funding from the Outdoor Heritage Fund has been expended and whether the sustainability will be in the form of ongoing management or additional funding from a different source.

In the proposed budget for 2014, half of the funding (beyond the applicant’s match) is requested from the Outdoor Heritage Fund, and the other half is being requested from the Northern Pulse Growers Association. In 2015 and beyond, funding requests will be split among the Outdoor Heritage Fund, the Northern Pulse Growers Association, and the Wheat Commission. If funding from the Outdoor Heritage Fund is no longer available in a future year, funding requests to the commodity groups will be increased.

Partial Funding – Indicate how the project will be affected if less funding is available than that requested. *

If the project is only partially funded, the scope and detail of disease evaluations and related laboratory work will be reduced.

Scoring of Grants

All applications will be scored by the Outdoor Heritage Fund Advisory Board after your ten-minute oral presentation. The ranking sheet(s) that will be used by the Board is available on the website at <http://www.nd.gov/ndic/outdoor-infopage.htm> .

Awarding of Grants

All decisions on requests will be reported to applicants no later than 30 days after Industrial Commission consideration. Applicants whose proposals have been approved will receive a contract outlining the terms and conditions of the grant. Please note the appropriate sample contract for your organization on the website at <http://www.nd.gov/ndic/outdoor-infopage.htm>

that set forth the general provisions that will be included in any contract issued by the North Dakota Industrial Commission. Please indicate if you can meet all the provisions of the sample contract. If there are provisions in that contract that your organization is unable to meet, please indicate below what those provisions would be.

Should this project be selected for funding and a contract is issued to NDSU, we request the sample language in article 11 and 20 be deleted and the following replacement language be inserted in articles 11 and 20 of the sample contract for a state entity.

11. Ownership of Work Product, Equipment and Materials

Title to all inventions and discoveries made solely by Contractor inventors resulting from the Agreement shall reside in Contractor; title to all inventions and discoveries made solely by Commission inventors resulting from the Agreement shall reside in Commission; title to all inventions and discoveries made jointly by Contractor and Commission inventors resulting from the Agreement shall reside jointly in Contractor and Commission. Inventorship shall be determined in accordance with U.S. Patent Law.

20. Compliance with Public Records Law

Contractor understands that, except for disclosures prohibited in this Agreement, the Commission must disclose to the public upon request any records it receives from the Contractor. Contractor further understands that any records that are obtained or generated by the Contractor under this Agreement, except for records that are confidential under this Agreement, may, under certain circumstances, be open to the public upon request under the North Dakota open records law. Contractor agrees to contact the Commission immediately upon receiving a request for information under the open records law and to comply with the Commission's instructions on how to respond to the request.

Responsibility of Recipient

The recipient of any grant from the Industrial Commission must use the funds awarded for the specific purpose described in the grant application and in accordance with the contract. The recipient cannot use any of the funds for the purposes stated under Exemptions on the first page of this application.

If you have any questions about the application or have trouble submitting the application, please contact Karlene Fine at 701-328-3722 or kfine@nd.gov



Northern
Pulse Growers
Association

November 21, 2013

Outdoor Heritage Fund
State Capitol, 14th Floor
600 E. Boulevard Ave. Dept. 405
Bismarck, ND 58505-0840
701-328-3722 (office), 701-328-2820 (fax)

Dear Outdoor Heritage Fund Advisory Board,

The Northern Pulse Growers Association would like to indicate its support for the proposal "Optimizing crop rotation strategies to improve disease management and increase crop yields in North Dakota wheat and field pea production".

Fusarium root rot has become a critical limiting factor for field pea production in North Dakota, and the development of crop rotation recommendations to prevent the buildup of this disease and other diseases in field peas would be of high value to producers. No management recommendations currently exist for Fusarium root rot; resistant field pea varieties are not available, and, due to the relatively late crop growth stages at which the disease develops, seed treatments are not effective.

I encourage the Outdoor Heritage Fund Advisory Board to consider this proposal when it meets in January. Peas are often planted in April in North Dakota, and the second Outdoor Heritage Fund grant deadline of April 1 is too late to finalize research plans for the 2014 growing season. The Northern Pulse Growers Association, which awarded \$325,000 in research funding in 2013, invests heavily in research to address production problems in field peas, lentils, and chickpeas. Our research committee will award funding for the 2014 growing season this March, and research proposals addressing Fusarium root rot in peas have been received very favorably by our research committee in recent years, as have proposals submitted by Dr. Michael Wunsch, the lead investigator of this project.

Sincerely,

Shannon Berndt,
Executive director

Northern Pulse Growers Association
1710 Burnt Boat Drive
Bismarck, ND 58503
701-222-0128 (office), 701-222-6340 (fax)
berndt@northernpulse.com