North Central Region Canola Research Program
Application Cover Page
(Must fit on one page)

Project Title: Influence of Honey Bee Pollination on Production of Canola

Lead Principal Investigator and Institution: Janet Knodel, NDSU, Fargo

Co-Principal Investigator(s):
Burton Johnson, Department of Plant Sciences, NDSU, Fargo
Bryan Hanson, Langdon REC, Langdon
Denise Markle, North Central Research Extension Center, Minot

Mailing Address of Lead PI: Department of Entomology
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Fargo, ND 58105

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Phone Number of Lead PI: 701 231-7915

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Funds Requested for 2007: $25,329

Project Status: New ___X_____ Renewal _____

Does this project involve recombinant DNA, human subjects or vertebrate animals?
____ Yes __X__ No
If yes, please complete a CSREES Assurance Statement Form 2008 or a Research & Related Other Project Information Form that is available as part of the new application kit through Grants.gov.

Does this project involve the sale of goods or services? _____ Yes __X___ No
If yes, please indicate the nature of the sale in this space:

By signing this proposal, the applicant certifies that the information contained herein is true and complete to the best of their knowledge and accepts as to any award the obligation to comply with the terms and conditions of the Cooperative State Research, Education and Extension Service in effect at the time of the award.

Janet J. Knodel
PI Signature

David A. Rider
Dept. Chair/REC Director signature
(applies only to NDSU applicants)

_____
Authorized Organizational Representative
(applies only to non-NDSU applicants)

Influence of Honey Bee Pollination on Production of Canola

PI: Janet J. Knodel, Extension Entomologist, North Dakota State University

Co PIs: Burton Johnson, Department of Plant Sciences, NDSU, Fargo
Bryan Hanson, Langdon REC, Langdon
Denise Markle, NCREC, Minot

Cooperators: Honey beekeepers (Don Nelson, Moorhead, MN; Ryan Thomas, Langdon, ND; Minot – to be determined)

Objectives.

The objectives of the proposed project are: (1) To determine the role of pollinators, honey bees (*Apis melifera* L.) in canola seed production in North Dakota. (2) To determine the impact of honey bee pollinators on the canola seed germination.

Procedures.

Objective 1: Canola (*Brassica napus* L.) genetically modified (GM) hybrid and open-pollinated varieties, *Brassica juncea* canola, and mustard (*Sinapis alba*) will be planted at NDSU Prosper's Agricultural Experimental Research Farm in Prosper, Langdon Research Extension Center in Langdon and North Central Research Extension Center in Minot, ND. Crops will be seeded in early to mid-May using 14-17 pure live seeds per sq. foot and standard agronomic practices for early season weed control. Each crop will be arranged in a RCBD with two treatment (honey bee exposure 'treated' and no honey bee exposure 'untreated') and four replicates. Experimental units will be 3.5-4.1 ft. (7 rows) x 20-22 ft. Honey bee hives (1 hive per site) will be installed at the beginning of flowering. Hives will not be moved onto the canola field until there are adequate flowers available for foraging. Free et al. (1960) reported that canola is very attractive to honey bees and has a long bloom period relative to other crops, so colonies should be moved into the field once a bloom density of 20 flowers/m^2 is reached. To exclude pollinators, the untreated plot will be grown under screen tents.

To determine the impact of native species of bees as well as commercial raised honey bees at different field sites, an observer will walk the unscreen plots for 5-minute durations and the number of honey bees and other pollinators will be identified and recorded. Morandin and Winston (2005) reported that many native species also pollinate Brassicaceae crops. The walk will be conducted two times a week during flowering. Crop phenology notes will be taken by agronomist. A small plot combine will be used to harvest plots. Yield, seed weight (gm per 1,000 seeds) and percent oil will be determined. In addition, a sub-sample of 10 randomly selected plants per plot (total of 40 plants per treatment) will be collected. The number of pods per plant will be counted and the percentage of pod set will be determined (Pod set = 100 x number of pods produced / [number of pods produced + the total number of lower abscission scars]). For each randomly selected plant, the floral potential (= number of pods produced + number of flower abscission scars) will also be determined. The number and weight of seeds per pod will be measured. Data will be tested for normality and heteroscedasticity. The statistical analysis will be conducted using ANOVA with one classification criterion (presence/absence of pollinators)

by plant species and Fisher's LSD and t-test for mean separation (SAS Institute). The following variables will be analyzed: yield, seed weight, percent oil, pod set, floral potential, and weight of seeds per pod.

Objective 2: Canola (*Brassica napus* L.) GM hybrid and open-pollinated varieties, *Brassica juncea* canola, and mustard (*Sinapis alba*) will be planted at NDSU Prosper's Agricultural Experimental Research Farm in Prosper, Langdon Research Extension Center in Langdon and North Central Research Extension Center in Minot, ND. Crops will be seeded in early to mid-May using 14-17 pure live seeds per sq. foot and standard agronomic practices for early season weed control. Each crop will be arranged in a RCBD with two treatment (honey bee exposure 'treated' and no honey bee exposure 'untreated') and four replicates. Experimental units will be 3.5-4.1 ft. (7 rows) x 20-22 ft. Honey bee hives (1 hive per site) will be installed at the beginning of flowering. Hives will not be moved onto the canola field until there are adequate flowers available for foraging. Free et al. (1960) reported that canola is very attractive to honey bees and has a long bloom period relative to other crops, so colonies should be moved into the field once a bloom density of 20 flowers/m^2 is reached. To exclude pollinators, the untreated plot will be grown under screen tents. A small plot combine will be used to harvest plots. At harvest, approximately 1,000 seeds will be collected and kept in paper bags for 1 year in the laboratory to stimulate storage. Seed germination will be assessed by placing seeds in a plastic petri dish with double layers of Whatman Filter Paper #1. On the sowing date, the filter paper will be saturated with doubly distilled water and then kept moist for 5 days. Germination will be scored as successful if the two cotyledons of the seedling appear. The percentage of seed germination will be recorded for each treatment by crop.

Justification.

Canola is an oil seed plant belonging to the Cruciferae family (Brassicaceae) (Knodel and Berglund 2005). Canola has become a popular oilseed cash crop in North Dakota. North Dakota leads the United States in canola production with approximately 88 percent of the domestic production. Canola acreage has increased rapidly in North Dakota over the past ten years, with harvested acreage in North Dakota increasing from 15,000 A in 1991 to 1,040,000 A in 2005 (USDA NASS). The highest acreage planted in North Dakota was in 2002 with 1.3 million acres reported (USDA NASS). Statewide yields have averaged from 1250 to 1500 pounds per acre over the past 5 years. Canola provides an important broadleaf crop option for rotation with small grains in North Dakota. The importance of rotating different crops to reduce disease pressures, coupled with the market demand for canola, makes canola a vital crop for North Dakota agriculture.

Insect pollination is a key factor in the sexual reproduction of many agricultural crops, such as fruit tree crops, vegetable crops, forage and hay crops and seed crops. The importance of pollinators is becoming more recognized for its role in increasing yields and quality of major food and seed crops. This goal of this project is to understand the role of pollinating insects (honey bees, *Apis melifera* L.) in canola seed production and other Brassicaceae crops. This will improve our knowledge about pollination in these oil seed crops of high commercial importance. The objective of this study is to determine if pollinators are necessary for optimal canola yield and seed germination. Yield factors that will be measured include pod set, floral potential, the number of seeds per pod, and the weight of seeds per pod.

Literature Review: Previous Studies.

Insect pollinators are vital to sexual reproduction of many agricultural crops, such as fruit tree crops, vegetable crops, forage and hay crops and seed crops. In fact, three-quarters of the world's flowering plant species rely on pollinators to carry pollen from the male to the female parts of flowers for reproduction (National Research Council 2006). The importance of pollinators is becoming more recognized for its role in increasing yields and quality of major food and seed crops. Cultivars of *Brassica rapa* are considered self-sterile and require insect cross-pollination to set seed, but there are conflicting views on the need for insect pollination in *B. rapa* (Canola Council of Canada, Downey et al. 1970, Fries 1983). *Brassica napus* is considered self-fertile and produces good seed yields without insect pollination (Downey et al. 1970, Free and Nuttall 1968, Kevan and Eisikowtich 1990). However, Free & Nuttall (1968) reported a 13% seed yield increase in *B. napus* plot with bee compared to those without bees. Downy et al. (1970) reported that *B. napus* is 70% self-pollinated, but this presumably leaves the remainder in need of insect- or wind-mediated cross-pollination. Canola and rapeseed have sticky pollen typical of plant requiring insect pollination (Eisikowitch 1981). In contrast, wind-pollinated species usually have smooth, dry pollen grains that are readily dispersed through the air. Eisikowitch (1981) found that *B. napus* cv. Maris Haplona pollen adhered to the flower's anthers under wind velocities as high as 5.0 m/sec. He concluded that self-pollination primarily occurs from direct contact between the long anthers and the stigma and little pollen transfers results from air movements. As a result, Eisikowitch (1981) suggested that insect pollination is important in setting seeds in this particular *B. napus* cultivar. Although most of the canola in North Dakota is GM lines, Bee World (2001) reported that honey foraging behavior on two lines of GM oilseed rape was not significantly different from bee activity on the unmodified plants of the same lines despite some difference in nectar volume and sugar content.

There is controversy over the need for insect pollination in canola species grown in Canada (Kevan and Eisikowtich 1990). Williams (1985) reports that the presence of honey bees makes little or no difference to the amount of seed produced. Others reported greater seed yield, higher seed set, high seed-meal lipid, higher numbers of seeds per pod and higher number of pods, earlier pod formation, earlier cessation of flowering, faster and more uniform seed maturation, and increase germination of seeds when honey bees were used in *B. rapa* and *B. napus* for pollination (Fries & Stark 1983, Kevan and Eisikowtich 1990, Korpela 1988, Sabbahi et al. 2005, Langridge et al. 1975, Mesquida et al. 1988). All of these factors contributed to a higher-quality crops that ripens and matures more evenly and is easier to harvest. These conflicting reports could be partially due to differences in varieties used, experimental design, ecological conditions, and also inconsistency in the use of concepts of self- and cross-pollination, open pollination, and the term yield. Regardless, canola producers may be interested in understanding the need for insect pollinators in their oilseed Brassicaceae crops of high commercial importance. Canola producers may find it beneficial to work cooperatively with beekeepers to maximize their seed yield and germination. Although it has been shown that pollination is important in the production of hybrid seed production (Pesson and Louveaux 1984), the need to introduce *A. mellifera* hives in canola fields during its flowering has not been demonstrated nor their effects on seed yield been determined in North Dakota.

Current Work.

There is no current work on the influence of honey bee pollination on seed production of canola and other Brassicaceae crops in North Dakota. In Canada, there is a controversy over the need for insect pollination in canola production (Kevan and Eisikowtich 1990). Williams (1985) reports that the presence of honey bees makes little or no difference to the amount of seed produced. Others reported greater seed yield when honey bees were used for canola seed pollination (Fries & Stark 1983, Sabbahi et al. 2005). These conflicting reports could be partially due to differences in varieties used, experimental design, ecological conditions, and also inconsistency in the use of concepts of self- and cross-pollination, open pollination, and the term yield. The purpose of this project is to examine the effect of the presence or absence of pollinators on the yield and germinability of canola and other Brassicaceae crops.

Facilities and Equipment.

The research facilities and farm equipment located at the North Dakota State University Agricultural Experiment Stations - Prosper Agricultural Experiment Research Farm, North Central Research Extension Center, and Langdon Research Extension Center will be used for the research plots. Local honey bee keepers have been identified as potential cooperators in each area and will be contacted. Vehicles will be rented from the North Dakota state fleet for travel to and from field sites. Existing office and computer facilities will be used and are adequate,

Personnel.

The time commitment for the PI and Co-PIs will be 5% FTE.

Project Timetable.

The 2007 growing season will represent the first year of data collection. At least two site-years of data are needed to fully understand the interactions between honey bees and canola seed yield and germinability.

Outreach. An annual progress report will be prepared each year and a final report after project completion. A detailed final report of results will be prepared and will be filed in January. Results will be presented at scientific and grower meetings, cited in regional and statewide extension and canola industry newsletters and published in scientific journals when applicable.

References

Bee World. 2001. Pollinator activity on canola. Bee World 82(3).

Canola Council of Canada. 2006. The canola connection. http://www.canola-council.org/.

Downey, R.K., S.H. Pawlowski, J. McAnsh. 1970. Rapeseed – Canada's Cinderella crop. Rapeseed Assoc. of Canada; Pub. No. 32.

Eisikowitch, D. 1981. Some aspects of pollination of oil-seed rape (*Brassica napus* L.). J. Agric. Sci., Cambridge 96: 321-326.

Free, J.B., N.W. Free and S.C. Jay. 1960. The effect on foraging behavior of moving honey bee colonies to crops before or after flowering has begun. J. Econ. Entomol. 53:564-566.

Free, J.B. and P.M. Nuttall. 1968. The pollination of oilseed rape (*Brassica napus*) and the behavior of bees on the crop. J. Agric. Sci., Cambridge 71: 91-94.

Fries, I. and J. Stark. 1983. Measuring the importance of honey bee in rape seed production. J. Apicultural Res. 22: 272-276.

Kevan, P.G. and D. Eisikowitch. 1990. The effects of insect pollination on canola (*Brassica napus* L. cv. O.A.C. Triton) seed germination. Euphytica 45: 39-41.

Knodel, J. and D. Berglund (editors). 2005. Canola Production Field Guide, NDSU Ext. Serv. A1280, Feb. 2005.

Korpela, S. 1988. The influence of honey bee pollination on turnip rape (*Brassica campestris*) yield and yield components. Annales Agriculturae Fenniae 27: 295-303.

Langridge, D.F., R.D. Goodman. 1975. A study on pollination of oilseed rape (*Brassica campestris*). Australian J. Exper. Agric. And Animal Husbandry 15: 285-288.

Mesquida, J., M. Renard, J.S. Pierre. 1988. Rapeseed (*Brassica napus* L.) productivity: The effect of honey bee (*Apis mellifera* L.) and different pollination condition in cage and field tests. Apidologie 19: 51-72.

Morandin, L.A. and M.L. Winston. 2005. Wild bee abundance and seed productions in conventional, organic, and genetically modified canola. Ecological Applications 15:571-881.

National Research Council of the National Academies. 2006. Status of pollinators in North America. The National Academies Press, Washington, D.C. 303 pp.

Pesson, P. and J. Louveaux. 1984. Pollinisation et productions végétales. INRA. Paris, France.

Sabbahi, R., D. de Olivereira, and J. Marceau. 2005. Influence of honey bee (Hymenoptera: Apidae) density on the production of canola (Crucifera: Brassicacae). J. Econ. Entomol. 98: 267-372.

SAS Institute. 1991. SAS/STAT user's guide, Version 6, 1st ed. Vol. 2. SAS Institute, Cary NC.

USDA National Agricultural Statistics Service (NASS). 2006. Acreage reports. http://usda.mannlib.cornell.edu/.

Williams, I.H. 1985. The pollination of swede rape (*Brassica napus* L.) Bee World 66: 16-22.

Budget. (Please see next page.)

Budget Narrative.

Salary and Fringe. Items listed as wages will be used for one full-time M.S. Graduate Student ($13,000 plus $260 in fringed benefits @ 2%) in the Department of Entomology, and three partial supported pre-baccalaureate summer worker for each of the co-PIs at $1,250 each (@ 10% fringed benefits for $125). The PI and graduate student will be responsible for conducting research, overseeing field data collection (e.g., plant collections, seed counts, counting and pinning pollinators), computer data entry, statistical analyses, and report generation. Co-PIs will be responsible for planting and harvesting plots, crop phenology notes and routine agronomic practices, such as weed control. Time slip funds for the pre-baccalaureate summer workers will be maintained at their respective NDSU RECs or Department.

Materials and Supplies. Trap netting and stakes to prevent honey bee pollination in the 'untreated' plots will cost an estimate $5,000 (quote from Jim Hansel, Great Lakes IPM, Vestaburg, MI). Other monies for materials and supplies will used for purchasing insect collecting bags & equipment, flags, plot stakes, labels, seed and other miscellaneous supplies. There is also a small rental charge to have the bee hives placed in canola plots during flowering. It is estimated to be $150 per hive at three sites for a total of $450 (source: P. Gregoire, bee keeper).

Travel. Travel funds for the MS. Graduate Student will be used to collect field data on yield factors and to conduct bee walks at the three different locations - Prosper, Minot, and Langdon. It is estimated that a minimum of six visits to each field sites is necessary and this would be about 6,000 miles total @ $0.38/mile or $2,280. Each Co-PI will receive a small amount of travel funds ($38) to cover routine field visits to plot for agronomic practices.

Budget for 2007 - Itemized by Location

Item	Cost/unit	Unit	Quantity	Total Cost
Department of Entomology, Fargo - Knodel				
MS Graduate Student				$13,000
Fringed Benefits 2%				$260
Netting, screens, poles and labor (Quote from "Great Lakes IPM")				$5,000
Miscellaneous supplies (field stakes, seeds, baggies,…)				$100
Honey bee hive rental	$150.00	per hive	3	$450
Travel (Minimum of 6 visits to Minot, Langdon, Prosper)	$0.38	per mile	6000	$2,280
Subtotal				**$21,090**
NCREC, Minot - D. Markle				
Prebaccacaureate student	$10.00	per hour	125	$1,250
Fringed Benefits 10%				$125
Travel	$0.38	per mile	100	$38
Subtotal				**$1,413**
Langdon REC - B. Hanson				
Prebaccacaureate student	$10.00	per hour	125	$1,250
Fringed Benefits 10%				$125
Travel	$0.38	per mile	100	$38
Subtotal				**$1,413**
Prosper Ag Exp Stn. - B. Johnson, Dept. of Plant Sciences, Fargo				
Prebaccacaureate student	$10.00	per hour	125	$1,250
Fringed Benefits 10%				$125
Travel	$0.38	per mile	100	$38
Subtotal				**$1,413**
Total Salaries				**$16,750**
Total Fringed Benefits				**$635**
Total Salaries & Fringed Benefits				**$17,385**
Total Materials & Supplies				**$5,550**
Total Travel				**$2,394**
Grand Total				**$25,329**

JANET J. KNODEL

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FAX (701) 231-8557

EDUCATION:

2005 **PhD,** Entomology, North Dakota State University
1983 **M.S.**, Entomology, Virginia Polytechnic Institute and State University
1980 **B.S.**, Zoology, North Dakota State University

PROFESSIONAL EXPERIENCE:

•Department of Entomology, NDSU — Nov 2005-present
Assistant Professor – Extension Entomologist
•North Central Research Extension Center, NDSU — January 1998-Nov 2005
Extension Crop Protection Specialist
Adjunct faculty status in the Department of Entomology, NDSU, Fargo
•IPM Support Group, Cornell University, NYSAES — September 1985-January 1998
Senior Extension Associate, Biological Monitoring Coordinator
•Finger Lakes Community College, Canandaigua, New York — January-May 1991
Adjunct Assistant Professor
•Florist and Nursery Crops Laboratory, USDA-ARS, and Department of Entomology, University of Maryland — January 1984-August 1985
Faculty Research Assistant

FIELD OF SPECIALIZATION:

•Leadership in extension entomology programming relevant to the Upper Great Plains and in disseminating extension/research results in both professional and lay publications.

•Develop and promote the Integrated Pest Management (IPM) Program of North Dakota with Dr. Marcia McMullen, ND IPM Coordinator.

•Over 20 years experience in conducting applied research in pest management of field and horticultural crops. Research projects include: insecticide-fungicide testing (including seed treatments and foliar sprays), evaluating different monitoring systems, using pheromone trapping systems for forecasting pest populations and infestation risks in the field, and evaluating alternative pest management tactics (cultural, biological control).

HONORS:

2006 "State Early Career" Award from Epsilon Sigma Phi, Cooperative Extension Professionals' Organization.
2003 Scholarship from Epsilon Sigma Phi, Cooperative Extension Professionals' Organization.
2003 Mary and Mark Andrews Scholarship, College of Agriculture, Food Systems, and Natural Resources, NDSU, Fargo, ND.
2003 The Honor Society of Phi Kappa Phi, NDSU, Fargo, ND.
2002 Scholarship from Epsilon Sigma Phi, Cooperative Extension Professionals' Organization.
2001 Nominee for the Myron and Muriel Johnsrud Excellence in Extension Award, NDSU, Fargo.

PROFESSIONAL LICENSES:

- Pesticide Training Certificate - Commercial, Ag Pest Control

- IR-4 Good Laboratory Practices Field Training Certification

PROFESSIONAL SOCIETIES:

- Entomological Society of America, Entomological Society of Canada, Entomological Society of Manitoba, International Organization for Biological Control, North Dakota Pea and Lentil Association, Manitoba-ND Zero Tillage Farmers Association, National Sunflower Association, Epsilon Sigma Phi, Phi Kappa Phi

SELECTED & RECENT PUBLICATIONS AT NDSU:

Web-Related:

Extension website for Department of Entomology: http://www.ndsu.nodak.edu/entomology/ext.htm

Computer CDs:

Developed insect matrix and insect information on **"Crop Sequence Calculator"** in cooperation with the Northern Great Plains Research Laboratory, USDA ARS. It is an interactive program for viewing crop sequencing information and calculating returns.

Peer-reviewed publications:

Bradley, C. A., S. Halley, J. Lukach, M. McMullen, **J. Knodel**, G. Endres, and T. Gregoire. 2004. Distribution and severity of pasmo on flax in North Dakota and evaluation of fungicides and cultivars for management. Plant Dis. 88: 1123-1126.

Charlet, L.D. and **J.J. Knodel**. 2003. Impact of planting date on sunflower beetle (Coleoptera: Chrysomelidae) infestation, damage, and parasitism in cultivated sunflower. J. Econ. Entomol. 96(3): 706-13.

Extension Reports:

J. Knodel, M. Boetel, D. Olson, and D. Markle. 2007. 2007 North Dakota Field Crop Insect Management Guide. NDSU Ext. Serv., E-1143.

Mundal, K.D., G.J. Brewer, L.D. Charlet and **J.J. Knodel.** 2006. Banded Sunflower Moth. NDSU Ext. Serv. E-823 (revised), November 2006.

Olson, D.L. and **J.J. Knodel.** 2005. Are All the Flea Beetles the Same? NDSU Ext. Serv. E-1274, July 2005.

Knodel, J.J. and D.L. Olson. 2005. Insect Management and Control. In *Canola Production Field Guide*, J. Knodel and D. Berglund (editors), NDSU Ext. Serv. A1280, Feb. 2005.

Knodel, J.J., G.M. Fauske, and R.C. Smith. 2004. Butterfly Gardening in North Dakota. NDSU Ext. Serv., Ext Bull. E-1266.

Bradley, C.A., **J. Knodel**, G. Endres, T. Gregoire, and M. McMullen. 2004. 2003 Flax Disease Survey in North Dakota. NDSU Ext. Serv., PP-1261.

Bradley, C.A., **J. Knodel**, G. Endres, and M. McMullen. 2003. 2002 Flax Disease Survey in North Dakota. NDSU Ext. Serv., ER-82.

Knodel, J.J. and D. Olson. 2002. Crucifer Flea Beetle Biology and Pest Management in Canola. NDSU Ext. Serv., E-1234.

Knodel, J.J., and L.D. Charlet. 2002. Biology and Integrated Pest Management of the Sunflower Stew Weevils in the Great Plains. NDSU Ext. Serv., E-821 (revised).

Knodel, J.J. and M. McMullen. 2002. Integrated Pest Management in North Dakota Agriculture. NDSU Ext. Serv., PP-863 (revised).

Lamey, A., **J. Knodel**, G. Endres, K. Andol, R. Ashley, D. Barondeau, B. Craig, V. Crary, Z. Fore, N. Johnson, S. Knoke, M. Liane, T. Lykken, R. Melaas, M. Miller, C. Nyegaard, H. Person, N. Peterson and R. Severson. 2002. 2001 Canola Disease Survey in Minnesota and North Dakota. NDSU Ext. Rep. 71, 8 p.

Lamey, A. **J. Knodel**, G. Endres, T. Gregoire, and R. Ashley. 2001. 2000 Sunflower Disease and Midge Survey. NDSU Ext. Serv. Rep. 68, 7 pp.

Knodel, J.J., L.D. Charlet, and P.A. Glogoza. 2000. Biology and Pest Management of the Sunflower Beetle. NDSU Ext. Serv., E-824, 8 pp.

Bryan K. Hanson
Langdon Research Extension Center
Box 310, Hwy 5E
Langdon, ND 58249

Education

Master of Science in Agronomy, June 1983- Oklahoma State University
Bachelor of Science in Agronomy, February 1981 - North Dakota State University

Employment

Agronomist, North Dakota State University, Langdon Research Extension Center.
September 1, 1983 to present

Job Function – Evaluate crop cultivars and experimental lines of small grain, row, oil, and alternative crops for northeast North Dakota. Conduct crop production research to determine inputs and management needs to improve producer profitability. Disseminate research results for the benefit of the state.

Graduate Assistant – Oklahoma State University. June 1981 to July 1983.
Crop Scout, North Dakota State University. Summers of 1979 and 1980
Born and raised on small grain farm in south central North Dakota.

Publications

Johnson, B.L., and B.K. Hanson. 2003. Row-spacing interactions on spring canola performance in the Northern Great Plains. Agron. J. 95:703-708

Hanson, B.K., 2003. Evaluation of foliar fungicides on canola for control of sclerotinia stem rot, 2002. Fungicide and Nematicide Tests (online). Report 58:FC034. DOI:10:1094/FN58. The American Phytopathological Society,
St. Paul, MN.

Endres, G., B. Hanson, M. Halverson, B. Schatz, and B. Henson. 2002. Flax response to nitrogen and seeding rates. Proceedings of the 59th Flax Institute of the United States. p. 196-198.

Hanson, B.K. and H.A. Lamey, 2001. Evaluation of foliar fungicides on canola for control of sclerotinia stem rot, 2002. Fungicide and Nematicide Tests (online). Report 56:FC1. DOI:10:1094/FN56. The American Phytopathological Society, St. Paul, MN.

Hanson, B.K., B.L. Johnson, R.A. Henson, N.R. Riveland, E.D. Eriksomoen, P. Carr, and M. Zarnstorff. 2001. Seeding rate response to various management factors in canola production. C03-hanson111418-P. ASA Abstr. (CD-ROM), ASA, Madison, WI.

Hanson, Bryan. 2001. Planting rate influence on yield and agronomic traits of hard red spring wheat in northeastern North Dakota. NDSU Ag Report 1.

Johnson, B.L., R.K. Zollinger, B.K. Hanson, R.A. Henson, E.D. Eriksmoen, and N.R. Riveland. 2000. Herbicide tolerant and traditional canola production systems comparisons. p. 143. In Agronomy Abstracts, ASA, Madison, WI.

Berglund, D.R., B.K. Hanson, and M.R. Zarnstorff. 1999. Swathing and harvesting canola. North Dakota State University Ext. Service. North Dakota State University. Bulletin A-1171.

Hanson, B. K., B.G. Schatz, M. Zarnstorff, and E. Oelke. 1998. Swathing and harvest date effects on canola.

p. 103. In Agronomy Abstracts, ASA, Madison, WI.

Johnson, B.L., K. R. McKay, A.A. Schneiter, B.K. Hanson, and B.G. Schatz. 1995. Influence of planting date on canola and crambe production. J.Prod. Agric. 8:594-599.

Annual Farmer Report of Small Grain and Flax, and Row, Oil and Specialty Crops are mailed to approximately 6500 farmers in NE North Dakota.

Committees and Administration Activities

-NDSU Variety Release Committee
-Research Representative for Canola SBARE Funding

Burton L. Johnson, Ph.D.	**Education**
Associate Professor, Department of Plant Sciences North Dakota State University, Fargo 701-231-7971 e-mail <burton.johnson@ndsu.edu>	Ph.D. in Plant Sciences. 1993. North Dakota State University, Fargo M.S. in Plant Sciences. 1982. North Dakota State University, Fargo B.S. in Biology. 1974. Minnesota State University Moorhead

Professional Experience

Associate Professor, Dept. of Plant Sciences, North Dakota State Univ., Fargo, from July 1, 2004 to present. Assistant Professor, Dept. of Plant Sciences, North Dakota State Univ., Fargo, from April 1998 to June 30, 2004. Appointment is 90% research and 10% teaching. Leadership is provided in conducting crop production research in sunflower, alternative, and potential new crops in North Dakota. Teaching responsibilities include instructing an undergraduate course in crop production, and advising undergraduate and graduate students.

Interim Project Leader, Dept. of Plant Sciences, North Dakota State Univ., Fargo, from January 1993 to April 1998. Appointment was 100% research and associated with crop production research in sunflower, alternative, and potential new crops in North Dakota.

Research Specialist II, Dept. of Plant Sciences, North Dakota State Univ., Fargo, from April 1976 to April 1998. Appointment was to provide support to the project leader in conducting crop production research in sunflower, alternative, and potential new crops in North Dakota.

Peer-Reviewed Journal Publications 2006 to 2002

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Area Extension Specialist – Crop Protection, North Central Research Extension Center, North Dakota State University, Minot, ND
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Soil Conservationist/Agronomist, NRCS, Towner, ND.
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Graduate Research Assistant, North Dakota State University, Fargo, ND.
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Product Development Intern, DuPont, Fargo, ND.
January - August 1996.

Field Disease Surveyor, North Dakota State University, Fargo, ND.
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AWARDS

2004 IR-4 Technical Service Award, North Central Region

PUBLICATIONS

Markle, D. M. 2001. Leafy Spurge (*Euphorbia esula*) control and herbage production with imazapic. Weed Technol. 15:474-480.

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Co-authored several publications for NCREC Annual Report, ND Weed Control Res. Report, and Western Society of Weed Sci. Res. Progress Report. 2000-2005.