

**North Central Region Canola Research Program
Application Cover Page**

Project Title: Effect of saflufenacil and flumioxazin applied preharvest on canola yield and seed quality

Lead Principal Investigator and Institution: Brian Jenks, North Dakota State University

Co-Principal Investigator(s): Ed Davis, Montana State University-Bozeman

Mailing Address of Lead PI: North Central Research Extension Center
5400 Highway 83 South
Minot, ND 58701

Email Address of Lead PI: brian.jenks@ndsu.edu

Phone Number of Lead PI: 701-857-7677

Fax Number of Lead PI: 701-857-7676

Funds Requested for 2010: \$8,000

Project Status: New ☒ Renewal ☐

Does this project involve recombinant DNA, human subjects or vertebrate animals?
☐ Yes ☒ 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 ☒ 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.

PI Signature

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

Effect of saflufenacil and flumioxazin applied preharvest on canola yield and seed quality

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Research Proposal

February 11, 2010

Statement of the problem:

Current canola production practices include swathing, which helps the crop mature and dry down more uniformly across the field. Swathing at the optimum stage of ripening reduces green seed content as well as yield losses due to premature shattering. Swathing may present financial challenges if a grower has to purchase a swather or pay to have his fields custom swathed. In addition, growers and custom swathers are not always able to get to every field in a timely manner. Swathing late can lead to fluffy windrows that are susceptible to blowing and increased shattering. The canola swath should be allowed to cure and ripen for 10 to 21 days, during which a strong wind may blow the swaths out of the windrow making combining very difficult and often resulting in yield losses due to shattering. Cool, wet conditions like which occurred in the 2004 growing season in the northern plains can extend the ripening and drying period to 28 days resulting in an increased risk of yield losses due to severe weather.

When it comes to swathing canola, one of the biggest challenges for canola growers is time. Swathing canola is slow and time consuming, which forces growers to begin swathing before optimum maturity in order to finish before the last of the crop is overripe. Swathing canola can also overlap with the need to swath other crops like barley. A grower who has the capacity to swath 200 acres of barley per day may only be able to swath 80 acres of canola in the same time frame.

Canola growers are interested in the concept of straight combining canola. Straight combining canola has not been a recommended practice due to the lack of uniform maturity across fields. The risk with straight combining canola is that individual areas in a field or even on an individual plant can be ripe, but other areas are still green. Uneven maturation usually forces a grower to delay harvest, which can increase the risk of seed loss due to shattering. If straight combining canola is to become a viable practice, the grower may need a desiccant to aid in uniformly ripening the crop for harvest. Currently, there are no desiccants labeled for preharvest use in canola.

Justification:

In 2004, a replicated large-scale trial was conducted in Rugby, ND to compare straight combining canola versus the traditional method of swathing. Straight combining had 235 pounds per acre higher yield than swathing with similar seed and oil quality. This trial indicates that straight combining canola can be done successfully. However, the seed moisture and dockage was considerably higher with straight combining due to the fact that the stems were still green. The use of a desiccant prior to straight combining would have resulted in a drier crop at harvest.

In 2005 and 2006, NDSU conducted more field-scale trials and demonstrated that timely straight combining can achieve similar or better canola yields compared to swathing. Straight-combined canola tended to have lower harvest moisture, darker seed color, lower green seed, and higher test weight. Under optimal conditions and management, it appears that straight combining is a feasible option for many growers.

In 2008, late-season rains just before swathing resulted in canola regrowth. This regrowth caused higher seed moisture in the bin with potential quality loss and discounts.

Growers that planned to straight-cut needed a desiccant to effectively kill the plants and reduce plant and seed moisture.

Saflufenacil (Sharpen) is a new herbicide that is labeled for sunflower desiccation only. NDSU research showed that desiccation with saflufenacil alone or with glyphosate was comparable to paraquat (Gramoxone Inteon) after 10-14 days. Flumioxazin (Valor) is labeled for preharvest desiccation in dry bean. Paraquat is a desiccant that is labeled for preharvest use in many crops including soybean, dry bean, field pea, chickpea, lentil, and sunflower. If saflufenacil or flumioxazin can be shown to desiccate canola similar to paraquat, then these herbicides could facilitate direct combining by drying down slow-maturing areas of the field and allow growers to combine canola fields earlier.

Paraquat and diquat (Reglone) are not labeled for canola. However, USDA-IR-4 initiated residue trials in 2009 to establish a tolerance for diquat. Previous NDSU and MSU studies have shown that paraquat and diquat can adequately desiccate canola in 7-14 days. This study will be conducted to compare saflufenacil and flumioxazin to paraquat and diquat. If saflufenacil or flumioxazin are found to perform equally, they may be the desiccant of choice since they are much less expensive and are safer to use than diquat. In this study, we will also compare these desiccants to the normal practice of swathing.

Research objectives:

1. Determine the effect of saflufenacil and flumioxazin applied preharvest on canola yield, seed moisture, and seed quality compared to paraquat and diquat.
2. Compare yield, seed moisture, and seed quality of swathed canola to desiccant-treated canola.

Research procedures:

The study will be conducted at two locations: 1) North Central Research Extension Center, Minot, ND and 2) Montana State University, Bozeman, MT.

Saflufenacil, flumioxazin, paraquat and diquat will be applied preharvest as outlined in Table 1. A tractor-mounted sprayer with the boom raised approximately 18" above the canola canopy will be used to apply the desiccants. A Liberty Link canola variety will be used for the trial. Saflufenacil and flumioxazin will be applied at 10 gpa. Paraquat and diquat will be applied at 20 gpa. Saflufenacil (Sharpen) will be applied at 2 oz alone and at 1 oz in a tank mix with glyphosate at 0.75 lb ae. Saflufenacil treatments will include MSO and AMS (1% v/v and 17 lb/100 gal). Flumioxazin (Valor) will be applied with MSO (1% v/v). Paraquat (Gramoxone Inteon) will be applied at 2 pt/A with NIS (0.25% v/v). Diquat (Reglone) will be applied at 1.5 pt/A with NIS (0.25% v/v). One treatment will be swathed with a plot swather to compare current grower practices to the chemical desiccants. We will also include one treatment that will be straight cut with no desiccant applied. All treatments will be harvested at 7 days after application.

Table 1. Target canola stages for preharvest desiccant applications.

| Canola seed color | Application |
|--------------------------|---|
| Top 1/3 | Green to light green |
| Middle 1/3 | Seeds starting to turn light brown or reddish brown |
| Bottom 1/3 | Many seeds brown, reddish brown to purple |

Individual plots will be 10 by 30 ft arranged in a randomized complete block design with four replications. Data to be collected include canola yield, test weight, seed moisture content at harvest, % oil content, green count, heat damage, total damage, grade, and seed loss due to shattering prior to harvest. Four sticky cards will be placed on the ground under the canopy just prior to or following the desiccant treatment. Sticky cards will be collected just prior to harvest and seeds will be counted to estimate yield loss per acre. We will also document seed and pod color at all swath and harvest dates. All data will be subjected to analysis of variance with SAS and mean separation using Fisher's Protected LSD test at $\alpha = 0.05$.

Expected benefits:

1. Provide a comparison of saflufenacil and flumioxazin desiccation compared to standard desiccants, paraquat and diquat.
2. Generate important research comparing canola yield, seed moisture, seed quality, and oil content.
3. Provide important information to aid producers in successfully straight combining canola and quantify the risks of straight combining versus swathing canola.
4. Could result in straight combining canola becoming a more viable practice.

Duration:

This study will be initiated in April 2010. A report containing results, conclusions, and recommendations will be completed by February 1, 2011.

Budget narrative for Minot and Bozeman:

Project budget details per location:

| <u>Salary</u> | <u>Cost</u> |
|-------------------------|--------------------|
| Research Associate | \$2,000 |
| Benefits | <u>\$700</u> |
| | \$ 2,700 |
| <u>Operating</u> | |
| Seed | \$100 |
| Fertilizer | \$100 |
| Fuel | \$100 |
| Repairs | \$200 |
| Research supplies | <u>\$150</u> |
| | \$650 |
| <u>Travel</u> | \$300 |
| <u>Total</u> | \$3,650 |

Seed quality testing* \$700

* (Grade, damages kernels, dockage, moisture, green count: Analyze seeds at \$12.50 x 28 samples x 2 locations)

Each location will receive \$3,650 to conduct the study. All samples will be sent to Minot for analysis. Minot will need \$700 to pay for the seed quality testing.

Total funding at each location:

| | |
|---------|--|
| Minot | \$4,350 (includes seed quality testing for both locations) |
| Bozeman | \$3,650 |

Total funding requested:

\$8,000

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

TOTAL BUDGET

| | | | | | | | | |
|--|--|----------------------------------|----------|---|--|---|--|--|
| ORGANIZATION AND ADDRESS North Dakota State University Fargo, ND 58105 | | | | USDA AWARD NO. | | | | |
| PROJECT DIRECTOR(S) Dr. Brian M. Jenks, NDSU Ed Davis, Montana State University | | | | DURATION PROPOSED MONTHS: _12_ Funds Requested by Proposer | DURATION PROPOSED MONTHS: _____ Funds Approved by CSREES (If different) | Non-Federal Proposed Cost-Sharing/Matching Funds (If required) | Non-federal Cost-Sharing/Matching Funds Approved by CSREES (If Different) | |
| A. Salaries and Wages..... | | CSREES-FUNDED WORK MONTHS | | | | | | |
| | | Calendar | Academic | Summer | | | | |
| 1. No. Of Senior Personnel | | | | | | | | |
| a. ____ (Co)-PD(s)..... | | | | | | | | |
| b. ____ Senior Associates..... | | | | | | | | |
| 2. No. of Other Personnel (Non-Faculty) | | | | | | | | |
| a. _2_ Research Associates/Postdoctorates..... | | 2 | | | 4000 | | | |
| b. ____ Other Professionals..... | | | | | | | | |
| c. ____ Paraprofessionals..... | | | | | | | | |
| d. ____ Graduate Students..... | | | | | | | | |
| e. ____ Prebaccalaureate Students..... | | | | | | | | |
| f. ____ Secretarial-Clerical | | | | | | | | |
| g. ____ Technical, Shop and Other..... | | | | | | | | |
| Total Salaries and Wages..... → | | | | | 4000 | | | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | 1400 | | | | |
| C. Total Salaries, Wages, and Fringe Benefits (A plus B) → | | | | 5400 | | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | | |
| E. Materials and Supplies | | | | 1300 | | | | |
| F. Travel | | | | 600 | | | | |
| G. Publication Costs/Page Charges | | | | | | | | |
| H. Computer (ADPE) Costs | | | | | | | | |
| I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.) | | | | | | | | |
| J. All Other Direct Costs (In budget narrative, list items and dollar amounts, and provide supporting data for each item.) | | | | 700 | | | | |
| K. Total Direct Costs (C through J) → | | | | 8000 | | | | |
| L. F&A/Indirect Costs (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs included in on/off campus bases.) | | | | | | | | |
| M. Total Direct and F&A/Indirect Costs (K plus L) → | | | | 8000 | | | | |
| N. Other..... → | | | | | | | | |
| O. Total Amount of This Request..... → | | | | 8000 | | | | |
| P. Carryover -- (If Applicable)Federal Funds: \$ Non-Federal funds: \$ Total \$ | | | | | | | | |
| Q. Cost-Sharing/Matching (Breakdown of total amounts shown on line O) Cash (both Applicant and Third Party) → - Non Cash Contributions (both Applicant and Third Party) | | | | | | | | |
| AME AND TITLE (Type or print) | | | | SIGNATURE (required for revised budget only) | | DATE | | |
| Project Director | | | | | | | | |
| Authorized Organizational Representative | | | | | | | | |
| Signature (for optional use) | | | | | | | | |

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE
NDSU BUDGET

OMB Approved 0524-0039
Expires 03/31/2004

| | | | | | | | |
|---|--|----------|--|---|---------------------------------------|--|---|
| ORGANIZATION AND ADDRESS North Dakota State University | | | | USDA AWARD NO. | | | |
| PROJECT DIRECTOR(S) Brian Jenks, North Dakota State University | | | | DURATION PROPOSED MONTHS: _12__ | DURATION PROPOSED MONTHS: _____ | Non-Federal Proposed Cost- Sharing/ Matching Funds (If required) | Non-federal Cost- Sharing/Matching Funds Approved by CSREES (If Different) |
| A. Salaries and Wages | | | | CSREES-FUNDED WORK MONTHS | | | |
| 1. No. Of Senior Personnel | | Calendar | | Academic | | Summer | |
| a. ____ (Co)-PD(s)..... | | | | | | | |
| b. ____ Senior Associates..... | | | | | | | |
| 2. No. of Other Personnel (Non-Faculty) | | | | | | | |
| a. _1_ Research Associates/Postdoctorates..... | | 1 | | | | 2000 | |
| b. ____ Other Professionals..... | | | | | | | |
| c. ____ Paraprofessionals..... | | | | | | | |
| d. ____ Graduate Students..... | | | | | | | |
| e. ____ Prebaccalaureate Students..... | | | | | | | |
| f. ____ Secretarial-Clerical | | | | | | | |
| g. ____ Technical, Shop and Other..... | | | | | | | |
| Total Salaries and Wages → | | | | | | 2000 | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | | | 700 | |
| C. Total Salaries, Wages, and Fringe Benefits (A plus B) → | | | | | | 2700 | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | | | 650 | |
| F. Travel | | | | | | 300 | |
| G. Publication Costs/Page Charges | | | | | | | |
| H. Computer (ADPE) Costs | | | | | | | |
| I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.) | | | | | | | |
| J. All Other Direct Costs (In budget narrative, list items and dollar amounts, and provide supporting data for each item.) | | | | | | 700 | |
| K. Total Direct Costs (C through J) → | | | | | | 4350 | |
| L. F&A/Indirect Costs (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs included in on/off campus bases.) | | | | | | | |
| M. Total Direct and F&A/Indirect Costs (K plus L) → | | | | | | 4350 | |
| N. Other → | | | | | | | |
| O. Total Amount of This Request → | | | | | | 4350 | |
| P. Carryover -- (If Applicable) Federal Funds: \$ | | | | Non-Federal funds: \$ | | Total \$ | |
| Q. Cost-Sharing/Matching (Breakdown of total amounts shown on line O) | | | | | | | |
| Cash (both Applicant and Third Party) → | | | | | | | |
| - Non Cash Contributions (both Applicant and Third Party) | | | | | | | |
| AME AND TITLE (Type or print) | | | | SIGNATURE (required for revised budget only) | | | DATE |
| Project Director | | | | | | | |
| Authorized Organizational Representative | | | | | | | |
| Signature (for optional use) | | | | | | | |

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0524-0039. The time required to complete this information collection is estimated to average 1.00 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

UNITED STATES DEPARTMENT OF AGRICULTURE
COOPERATIVE STATE RESEARCH, EDUCATION, AND EXTENSION SERVICE

OMB Approved 0524-0039
Expires 03/31/2004

MSU BUDGET

| | | | | | | | | | | |
|--|------------------------------|----------------------------------|----------|---|---|--|---|--------------------------|------------------------------|-----------------|
| ORGANIZATION AND ADDRESS Montana State University (subcontract with North Dakota State University) Bozeman, MT | | | | USDA AWARD NO. | | | | | | |
| PROJECT DIRECTOR(S) Ed Davis, Montana State University | | | | DURATION PROPOSED MONTHS: <u>12</u> Funds Requested by Proposer | DURATION PROPOSED MONTHS: _____ Funds Approved by CSREES (If different) | Non-Federal Proposed Cost-Sharing/Matching Funds (If required) | Non-federal Cost-Sharing/Matching Funds Approved by CSREES (If Different) | | | |
| A. Salaries and Wages..... | | CSREES-FUNDED WORK MONTHS | | | | | | | | |
| | | Calendar | Academic | | | | | Summer | | |
| 1. No. Of Senior Personnel | | | | | | | | | | |
| a. ____ (Co)-PD(s)..... | | | | | | | | | | |
| b. ____ Senior Associates..... | | | | | | | | | | |
| 2. No. of Other Personnel (Non-Faculty) | | | | | | | | | | |
| a. <u>1</u> Research Associates/Postdoctorates..... | | 1 | | | 2000 | | | | | |
| b. ____ Other Professionals..... | | | | | | | | | | |
| c. ____ Paraprofessionals..... | | | | | | | | | | |
| d. ____ Graduate Students..... | | | | | | | | | | |
| e. ____ Prebaccalaureate Students..... | | | | | | | | | | |
| f. ____ Secretarial-Clerical..... | | | | | | | | | | |
| g. ____ Technical, Shop and Other..... | | | | | | | | | | |
| Total Salaries and Wages..... → | | | | | 2000 | | | | | |
| B. Fringe Benefits (If charged as Direct Costs) | | | | 700 | | | | | | |
| C. Total Salaries, Wages, and Fringe Benefits (A plus B) → | | | | 2700 | | | | | | |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | | | | |
| E. Materials and Supplies | | | | 650 | | | | | | |
| F. Travel | | | | 300 | | | | | | |
| G. Publication Costs/Page Charges | | | | | | | | | | |
| H. Computer (ADPE) Costs | | | | | | | | | | |
| I. Student Assistance/Support (Scholarships/fellowships, stipends/tuition, cost of education, etc. Attach list of items and dollar amounts for each item.) | | | | | | | | | | |
| J. All Other Direct Costs (In budget narrative, list items and dollar amounts, and provide supporting data for each item.) | | | | | | | | | | |
| K. Total Direct Costs (C through J) → | | | | 3650 | | | | | | |
| L. F&A/Indirect Costs (If applicable, specify rate(s) and base(s) for on/off campus activity. Where both are involved, identify itemized costs included in on/off campus bases.) | | | | | | | | | | |
| M. Total Direct and F&A/Indirect Costs (K plus L) → | | | | 3650 | | | | | | |
| N. Other..... → | | | | | | | | | | |
| O. Total Amount of This Request..... → | | | | 3650 | | | | | | |
| P. Carryover -- (If Applicable) <table style="width: 100%; border: none;"> <tr> <td style="width: 33%; border: none;">Federal Funds: \$</td> <td style="width: 33%; border: none;">Non-Federal funds: \$</td> <td style="width: 33%; border: none;">Total \$</td> </tr> </table> | | | | | | | | Federal Funds: \$ | Non-Federal funds: \$ | Total \$ |
| Federal Funds: \$ | Non-Federal funds: \$ | Total \$ | | | | | | | | |
| Q. Cost-Sharing/Matching (Breakdown of total amounts shown on line O) Cash (both Applicant and Third Party) → - Non Cash Contributions (both Applicant and Third Party) | | | | | | | | | | |
| AME AND TITLE (Type or print) | | | | SIGNATURE (required for revised budget only) | | DATE | | | | |
| Project Director | | | | | | | | | | |
| Authorized Organizational Representative | | | | | | | | | | |
| Signature (for optional use) | | | | | | | | | | |

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Fax: (701) 857-7676
E-mail: Brian.Jenks@ndsu.edu

Education:

Ph.D., Weed Science, Department of Agronomy, University of Nebraska, Lincoln, Nebraska. May 1996.

Dissertation title: Movement, Degradation, and Detection of Atrazine Following Long-term Use in a Continuous Corn Cropping System

M.S., Agronomy, Department of Plants, Soils, and Biometeorology, Utah State University, Logan Utah. December 1990.

Thesis Title: Efficacy and Environmental Evaluation of DPX-79406 and DPX-V9360 for Wild Proso Millet Control

B.S., Agronomy, Department of Plants, Soils, and Biometeorology, Utah State University, Logan, Utah. June 1988.

Professional Experience:

Dec 97-Present Weed Scientist, North Dakota State University, North Central Research Extension Center, Minot, North Dakota

Joint research (85%) and extension (15%) appointment. Responsible for developing and implementing an integrated weed management program in north central North Dakota that focuses on solving key weed management problems in chickpea, lentil, dry pea, sunflower, safflower, dry bean, soybean, corn, canola, juncea, flax, and small grains. Answer lawn weed control questions from local community.

Aug 95-Nov 97 Extension Coordinator, National Jointed Goatgrass Research Initiative, University of Nebraska, Scottsbluff, Nebraska

Central resource person to collect and disseminate information and to coordinate technology transfer activities for the National Jointed Goatgrass Research Initiative.

1991-95 Research Assistant, Weed Science, University of Nebraska, Lincoln, Nebraska.

Dissertation research focused on the fate of atrazine in continuous corn. Research objectives were to:

- 1) Compare an enzyme immunoassay with gas chromatography for atrazine detection in soil and water.
- 2) Determine the influence of surface and subsurface soil properties on atrazine sorption and degradation.
- 3) Evaluate the ability of the LEACHM model to adequately predict atrazine fate in surface and subsurface soils.

1988-91

Research Assistant, Weed Science, Utah State University, Logan, Utah.

Thesis research focused on wild proso millet control in corn. Research objectives were to:

- 1) Determine optimum application time and efficacy of DPX-V9360 and DPX-79406 for wild proso millet control.
- 2) Evaluate sensitivity of wheat, oats, alfalfa, corn, dry beans, and safflower to DPX-V9360 and DPX-79406 carryover.

Membership in Professional Organizations:

Weed Science Society of America
Western Society of Weed Science
North Central Weed Science Society
North Dakota Dry Pea & Lentil Assoc.
Northern Canola Growers Assoc.

Extension Publications

McKay, K, P. Miller, B. Jenks, J. Riesselman, K. Neill, D. Buschena, and AJ Bussan. Growing chickpea in the northern Great Plains. Extension publication A-1236, North Dakota State University, Fargo, ND, 58105.

Refereed Manuscripts (Published)

Jenks, B. M., F. W. Roeth, A. R. Martin, and D. L. McCallister. 1998. The influence of surface and subsurface soil properties on atrazine sorption and degradation. Weed Sci. 46:132-138.

Jenks, B. M., F. W. Roeth, and A. R. Martin. 1997. Comparison of an enzyme immunoassay with gas chromatography for atrazine determination in water and soil. Bull. Environ. Contam. Toxicol. 58:696-703.

Abstract and Proceedings Papers - 65

Research Reports - Western Society of Weed Science, 41 reports
North Central Weed Science Society, 8 reports
North Dakota Weed Control Research Reports

Edward S. Davis

Montana State University
Land Resource and Environmental Science
334 Leon Johnson Hall
Bozeman, MT 59717

Phone: (701) 857-7677
Fax: (406) 994-3933
E-mail: edavis@montana.edu

Education:

M.S. Physical Therapy, Department of Health Care Professionals, Northern Arizona University, Flagstaff, Arizona. June 1998.

Clinical Internships: Outpatient Pediatric Physical Therapy, Primary Children's Hospital, Salt Lake City, Utah.

Home Health Physical Therapy, Powell Valley Health Care, Powell, Wyoming.

Outpatient Orthopedic Physical Therapy, S.P.O.R.T. Physical Therapy, Lewiston, Idaho.

Inpatient Physical Therapy, Bozeman Deaconess Hospital, Bozeman, Montana.

M.S., Agronomy, Plant and Soil Science Department, Montana State University, Bozeman, Montana. June 1991.

Thesis Title: Spotted Knapweed Control, Biology and Seed Longevity.

B.S., Agronomy, Plants and Soil Science Department, Montana State University, Bozeman, Montana. December, 1980.

Professional Experience:

Apr 01-Present Weed Scientist, Montana State University, Bozeman, Montana

100% research appointment. Responsible for developing and implementing an integrated weed management program in Montana with primary focus on dry land cropping systems. Conduct herbicide screening trials in cereal grains, pulse crops, forage crops, and non-crop land.

Aug 98-Mar 01 Physical Therapist, S.P.O.R.T Physical Therapy, Lewiston, Idaho.

Provide physical therapy services in outpatient, inpatient and home health settings.

1991-93 Assistant Professor, Weed Science, Central Agricultural Research Center, Montana State University, Moccasin, Montana.

Establish and conduct applied weed research program addressing regional weed control issues in central Montana agricultural crop land, range land, and public lands.

1984-91

Research Assistant, Weed Science, Montana State University, Bozeman, Montana.

Conduct field and greenhouse weed research trials, Oversee temporary seasonal workers, assist graduate students with research projects, Operate and maintain project equipment and machinery. Compile and report annual research results.

Membership in Professional Organizations:

Weed Science Society of America
Western Society of Weed Science
Montana Weed Control Association