# North Central Region Canola Research Program
# Application Cover Page

Project Title: Impact of Preceding Crops on Incidence and Severity of Disease in Canola

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

Co-Principal Investigator(s):

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Funds Requested for 2007: $11,000

Project Status: New _____Renewal ___X____

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.

_____ PI Signature

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

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

# Impact of Preceding Crops on Incidence and Severity of Disease in Canola

**Prinicple Investigator**:

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**Funds Requested:** $11,000

**Grant Amount Requested:**

Partial funding has been provided by grants from the Northern Canola Growers Association (2000-2006), North Dakota Oilseed Council (2000-2006), Agricultural Utilization Research Institute (2000-2001), and the CSREES Sclerotinia Initiative (2003-2004). We are seeking partial funding, $11,000, for the 2007 growing season.

I. Description of Proposed Project

Six crop rotations were initiated in spring 2000 to evaluate the influence of previous crops and cropping sequences on disease levels in canola, flax, wheat, and barley. This study will continue the same crop sequences so a true rotation may be observed. The study will consist of three 4-year rotations, one 3-year rotation, one 2-year rotation, and one 1-year rotation with different sequences of canola, flax, wheat, and barley. The study will be conducted at the North Central Research Extension Center, Minot, ND.

**Objectives:**

1. Document the influence of crop rotation on the incidence and severity of sclerotinia, blackleg, and alternaria black spot in canola.
2. Determine the impact of the previous crop on disease levels in canola.
3. Determine if fungicide applications can be eliminated or rates reduced by altering the sequence of crops in the rotation.

II. Procedures

**Crop Rotations**

Six crop rotations were established at Minot, ND in 2000. This study will continue the same crop sequences so a true rotation may be observed (Table 1). Each crop will be planted into a 30 foot by 180 foot plot, with a 30-foot border around all sides of each plot. In each year there will be 7 canola plots, 2 flax plots, 5 wheat plots, and 4 barley plots. Each treatment will be replicated four times. Every crop of the rotation must be grown in every year to help explain the effect of individual years. Therefore, we will need to establish and maintain 72 plots per year (Table 2).

Table 1. Proposed crop rotations by year and sequence.

| Rotation | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | C | C | B | W | C | C | B | W | B = barley |
| 2 | C | W | C | W | C | W | C | W | C = canola |
| 3 | F | C | B | W | F | C | B | W | F = flax |
| 4 | F | W | C | W | F | W | C | W | W = wheat |
| 5 | C | B | W | C | B | W | C | B | |
| 6 | C | C | C | C | C | C | C | C | |

Table 2. Proposed number of treatments and plots.

| | | |
|---|---|---|
| Rotation 1 | 4 treatments x 4 replications | = 16 plots |
| Rotation 2: | 2 treatments x 4 replications | = 8 plots |
| Rotation 3: | 4 treatments x 4 replications | = 16 plots |
| Rotation 4: | 4 treatments x 4 replications | = 16 plots |
| Rotation 5: | 3 treatments x 4 replications | = 12 plots |
| Rotation 6: | 1 treatment x 4 replications | = 4 plots |
| Total: | 18 treatments x 4 replications | = 72 plots |

| Rotations shown with every crop present in every year | | | | | Treatment # |
|---|---|---|---|---|---|
| 1 | C | C | B | W | 1 |
| | C | B | W | C | 2 |
| | B | W | C | C | 3 |
| | W | C | C | B | 4 |
| 2 | C | W | C | W | 5 |
| | W | C | W | C | 6 |
| 3 | F | C | B | W | 7 |
| | C | B | W | F | 8 |
| | B | W | F | C | 9 |
| | W | F | C | B | 10 |
| 4 | F | W | C | W | 11 |
| | W | C | W | F | 12 |
| | C | W | F | W | 13 |
| | W | F | W | C | 14 |
| 5 | C | B | W | C | 15 |
| | B | W | C | B | 16 |
| | W | C | B | W | 17 |
| 6 | C | C | C | C | 18 |

We will compare disease levels in canola where the preceding crop was either wheat (BWC), canola (WCC), or flax (WFC). We can also compare disease levels in canola where the crop two years previous was a small grain (BWC), canola (CWC), or flax (FWC). Another way to look at it is that we are monitoring disease levels in:

1) canola on canola
2) canola every other year
3) canola following flax, another SSR susceptible broadleaf crop
4) canola on wheat
5) canola every three years
6) canola every year

One-half of each canola plot will be sprayed with a fungicide to help determine the full impact of disease pathogens. In other words, one-half of each plot will receive a fungicide application while the other half will receive no fungicide application. Therefore, for canola, data must be collected on 56 experimental units.

**Disease Sampling**

Each half (fungicide-treated and untreated) of every canola plot will be sampled for incidence and severity of Sclerotinia, blackleg, and alternaria black spot.

**Sclerotinia**

*Sclerotinia ascospore counts*. Ascospore sampling will be done within the canopy of each canola plot. Sampling for spores will be done at 20% bloom and again 1 week later. Petri plates with Steadman's (Steadman *et al*) semi-selective medium will be placed on the soil surface at four locations in each canola subplots to sample for spores in the plot. The plates will be exposed with the covers removed for 2 ½ hours. After exposure, the plates will be covered and incubated for 3 days at 70-75° F in the dark.

Colonies of Sclerotinia will be identified 3 days after exposure by a color change in the blue medium surrounding the colonies, resulting in a yellow halo. Presence of a thin, prostrate shiny growth will also be used to confirm that the colonies in the halos are Sclerotinia. The number of Sclerotinia colonies will be counted on each plate and the total number of colonies per plot and sampling date will be calculated.

Canola petals will also be tested for the presence of ascospores. Petals will be collected from four areas within each canola subplot on the same ascospore sampling dates previously mentioned. Four petals from each sampling area will be placed on a petri dish with the same semi-selective media previously mentioned. The petri plates will be incubated, and the presence or absence of sclerotinia ascospores will be observed the same way. Sclerotinia disease risk will be reported on the scale of 0 to 45% incidence being low risk, 45-90% incidence being high risk, and 90 to 100% incidence being high risk (Morrall and Thomson 1991).

*Sclerotinia Incidence and Severity*. Sampling will be conducted when the crop is in the swath. The sampling locations will be paced off, and 10 consecutive stems at each location, beginning where the pace ends, will be removed and inspected for SSR. This will assure a sample size of 100 plants per subplot. Sclerotinia will be identified by stems that are bleached white. Diseased stems may also be spongy or shredded and have sclerotia (hard black bodies) inside the stems. In order to assure accurate assessment of bleached stems, the sampling should be done within one week of swathing before the healthy stems lose their green color and become straw colored. Sclerotinia incidence (percent of infected plants) and severity on a scale of 0 to 5 (0 being healthy, 5 being dead) will be calculated for each plot.

Flax will also be evaluated for sclerotinia incidence and severity. A total of 100 plants per plot will be evaluated in a similar fashion as canola.

**Blackleg**

Sampling will be done twice during the growing season (4-leaf stage and pre-harvest). Canola leaves on 10 plants at 10 random locations per subplot will be evaluated for blackleg lesions. Incidence of lesions on leaves will be recorded.

The second evaluation will be conducted when the crop is in the swath. The plants sampled for SSR will be sampled for blackleg as well. Blackleg will be identified by blackened lower stems, or lesions on the lower stem that are dark gray with a black border and with black fruiting bodies (pycnidia), or by plant crowns that are black, or gray or streaked with gray (determined by cutting the stem off at the crown). Blackleg incidence (percent infected plants) and severity on a scale of 0 to 5 (0 being healthy, 5 being dead) will be calculated for each plot will be calculated for each plot.

**Alternaria Black Spot**

Sampling will be done at 10 locations in each canola plot. The locations and timing of sampling will correspond to those for blackleg and Sclerotinia. A sample of 5 pods will be collected at random from several different stems at each of 10 locations. The percent of pod area infected (severity) will be estimated using the severity scale of Conn *et al*. Average severity and incidence for each plot will be calculated.

**Expected Results**

Possible results of the study would be the increase of incidence and severity of diseases with the increase of the occurrence of canola in the rotation. Further research needs to be conducted as to the economic impact of the increased disease levels.

**Data Analysis**

The results will be analyzed as a split plot at the end of each year. Once the rotation cycle has been completed the entire rotation will be analyzed over time.

**Pitfalls and Limitations**

Possible pitfalls of the study would be environmental conditions that are not favorable to disease in canola. Other limitations include the presence or absence of naturally occurring disease inoculum for SSR, blackleg, or alternaria black spot.

III. Justification

Low crop prices and severe disease problems in spring wheat have forced many producers in the northern plains to turn to alternative crops. Wheat production in North Dakota was down over two million acres in 2005 compared to 1997. In contrast, canola, sunflower, dry bean, flax, and pea production have been increasing in recent years. Canola acres have increased in North Dakota from 18,000 acres in 1991 to over 1 million acres in 2005.

North Dakota leads the nation in canola production. Canola has been planted in nearly every county since 1999, producing 90% of the nation's canola.

With low prices for many crops currently grown in the northern plains, producers are asking whether rotations involving more profitable broadleaf crops can be shortened. Current agronomic recommendations are to plant a broadleaf crop like canola or sunflower no more than once every four years to avoid buildup of disease pathogens. However, some producers have planted a broadleaf crop like canola for two consecutive years on the same field in an attempt to increase overall profit potential. For many producers it is a matter of selecting crops that will provide them enough profit to stay in business another season. Additional information on the impact of crop rotation on disease will help producers optimize their limited resources.

## IV. Literature Review

Crop rotation with pathogen non-hosts is considered to be a very important cultural factor for reducing disease in crops. This practice is primarily directed toward the reduction of pathogen inoculum by eliminating susceptible hosts. The success of crop rotation as a cultural control measure is related to the longevity of pathogen inoculum, the wide host range of certain pathogens and the proximity of fields of susceptible host crops grown next to rotated fields. Rotations alone will not always reduce disease as spore inoculum can also come from neighboring fields (Williams 1981).

Three to four-year rotations between susceptible crops have been suggested to reduce Sclerotinia stem rot caused by *Sclerotinia sclerotiorum*. This may not be sufficient and Williams and Stelfox (1980) found that the number of viable sclerotia of this organism in soil was unchanged after 3 consecutive years of barley following canola. This study also revealed that 2 consecutive years of canola led to higher numbers of viable sclerotia than one year of canola.

Three-year rotations usually reduce the severity of blackleg caused by *Leptosphaeria maculans* (Petrie 1986). The fungus has been found to survive in stubble for more years with the most damaging infections arising from inoculation produced by 2-3 year old stubble. Over 90% of the canola stubble harboring black leg disappears in 2 years; however, the more decay-resistant crowns and taproots released ascospores of *Leptosphaeria maculans* for an additional 3-5 years following an infected crop of canola (Petrie 1995).

McLaren et al. evaluated the prevalence and incidences of blackleg and sclerotinia stem rot in 1997 and 1998 in 173 and 278 fields, respectively. Fields were categorized into 2(one year out of canola)-5 year rotations. As the canola rotations increased from 2 to 5 years the incidence of blackleg decreased during both field seasons. The effectiveness of canola rotations in reducing this disease depends on the presence of inoculant in adjacent fields. In Canada, ascospores of *Leptosphaeria maculans* can be dispersed for up to 2 km (Petrie 1978). Crop rotation and field placement needs to be considered for disease avoidance.

Tillage may also reduce blackleg incidence and severity compared with a no-till system. Blackleg stem severity in canola preceded by 3-years of canola in a no-till system was 3, compared to only 1.5 in canola in the same rotation but with conventional tillage (Fernando 2004, Guo et al. 2005). This is likely due to decomposition and microbial degradation of the blackleg fungus on the canola residue as it is incorporated into the soil profile. A four year study (1999 – 2002) in Manitoba, Canada showed both rotation and tillage to significantly

reduce the number of infected plants, the number of blackleg lesions per leaf, and the number of infected leaves per plant (Guo et al. 2006).

Rotation effect on the prevalence and incidence of Sclerotinia stem rot was less consistent (McLaren et al). In one region surveyed, disease incidence was reduced from 42 to 7 % when rotation was increased from 2-3 years. However disease incidence in the 4-5 year rotations was 14 and 37 % respectively. The disease incidence was less in the 5-year rotation than in the 2-year rotations in 1998, but disease levels varied considerably in the 3 and 4 year rotations.

Seedling blight and root rot of canola can be reduced with the use of rotation. In Alberta, a higher incidence of root rot caused by *Rhizoctonia solani* was reported when canola was preceded by fescue (Evans 1994). Growing barley for 2-3 years after canola significantly reduced the population of *R. solani* under zero-tillage (Yang et al. 1995). Alternaria blight of canola, caused by *Alternaria brassicae,* can be minimized by having 3 non-host crops between canola crops (Thomas 1985).

V. Results from 2000 to 2006

Please see progress report.

VI. Facilities and Equipment

The study will be conducted at the North Central Research Extension Center, Minot, ND. Equipment owned by the research center will be used such as drills, sprayers, combines, etc. The field will be surveyed by Ackerman Surveying using GPS and staked to insure plots are in the same location from year to year. Disease risk testing medium will be purchased from the Plant Pathology Department, North Dakota State University, Fargo, ND.

VII. Project Timetable

The study was initiated in 2000. The first year of the second rotation cycle was 2004. In 2007, we will enter the fourth year of the second rotation cycle. During each field season, disease risk, incidence, and severity will be evaluated, as well as yield for each of the crops.

## Literature Cited


Conn, K. L., J. P. Tewari and R. P. Awasthi. 1990. A disease assessment key for Alternaria black spot in rapeseed and mustard. Can. Plant Dis. Sur. 70(1):19-22.

Evens, I. R. 1994. Diseases of oilseeds. Pages 144-157 in M. J. Dorrance, ed., Practical Crop Protection. Alberta Agriculture, Food and Rural Development. Edmonton, Canada.

Fernando, D. 2004. Personal Communication

Fernando, D. 2005. Personal Communication and Lab Visit.

Guo, X. W., W.G.D. Fernando, and M. Entz. 2005. Effects of crop rotation and tillage on blackleg disease of canola. Can. J. Plant Pathology. Vol. 27. p. 53.

Guo, X.W., W.G.D. Fernando, and M. Entz. 2006. Dynamics of infection by *Leptosphaeria maculans* on canola (*Brassica napus*) as influenced by crop rotation and tillage. Archives of Phytopathology and Plant Protection. 00(0):1 – 10.

Kurle, J. E. 2000. Personal Communication

McLaren, D. L., R. G. Platford, and J. L. Lamb. 1999. Impact of the frequency of canola in the rotation on blackleg and sclerotinia stem rot. Can. J. Plant Pathology. Vol. 21. P 316.

Morrall, R. A. A. and J. R. Thomson. 1991. Petal test manual for Sclerotinia in canola. University of Saskatchewan, Saskatoon, SK 25pp.

Peel, M. 1998. Crop rotations for increased productivity. Extension Bulletin. EB-48. North Dakota State University, Fargo, ND.

Petrie, G. A. 1986. Consequences of survival of *Leptosphaeria maculans* (blackleg) in canola stubble residue through an entire crop rotation sequence. Can. J. Plant Pathol. 8:353 (Abstract)

Petrie, G. A. 1978. M Occurrence of highly virulent strain of blackleg (*Leptosphaeria maculans*) on rape in Saskatchewan (1975-77). Can. Plant Dis Surv. 58:21-25.

Petrie, G. A. 1995. Long term survival and sporulation of Leptosphaeria maculans (blackleg) on naturally-infected rapeseed/canola stubble in Suskatchewan. Can Plant Dis Survey. 75:1.

Steadman, J. R., J. Marcinkowska and S. Rutledge. 1994. A semi-selective medium for isolation of *Sclerotinia sclerotiorum*. Can. J. Plant Pathology 16:68-70.

Thomas. P. 1985. Canola Growers Manual. Canola Council of Canada, Winnipeg, Canada, 1424 pp.

Williams, J. R. and D. Stelfox. 1980. Influence of farming practices in Alberta on germination and apothecium production of sclerotia of *Sclerotinia sclerotiorum*. Can. J. Plant Pathol. 2:169-

172.

Williams, J. R. 1981. Sclerotinia stem rot of rapeseed. Agric. For. Bull., Univ. Alberta 4:26-27

Yang, J., P. D. Kharbanda, and D. W. McAndrew. 1995. Anastomosis groups and pathogenicity of Rizoctonia sp. From a canola and barley rotation under reduced tillage in Alberta. Can. J. Plant Pathol. 17:364 (Abstract)

**Key Individuals**

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

OMB Approved 0524-0039
Expires 03/31/2004

# CURRENT AND PENDING SUPPORT

**Instructions:**

1. Record information for active and pending projects, including this proposal. (Concurrent submission of a proposal to other organizations will not prejudice its review by CSREES.)
2. All current efforts to which project director(s) and other senior personnel have committed a portion of their time must be listed, whether or not salary for the person involved is included in the budgets of the various projects.
3. Provide analogous information for all proposed work which is being considered by, or which will be submitted in the near future to, other possible sponsors including other USDA programs.

| NAME (List/PD #1 first) | SUPPORTING AGENCY AND AGENCY ACTIVE AWARD/PENDING PROPOSAL NUMBER | TOTAL $ AMOUNT | EFFECTIVE AND EXPIRATION DATES | % OF TIME COMMITTED | TITLE OF PROJECT |
|---|---|---|---|---|---|
| | Active: | | | | |
| B. Jenks | NCGA, NDOC, CSREES National Canola Research Program | 33,150 | 2006-2007 | 5 | Impact of preceding crops on diseases in canola |
| B. Jenks and E. Eriksmoen | Cool Season Food Legume | 25,114 | 2006-2007 | 10 | Effect of seeding date, seeding rate, and fall- or spring-applied herbicides for weed management in lentil. |
| R. Lym et al. | CSREES special grant – Invasive weeds | 20,213 | 2005-2008 | 3 | Yellow toadflax control |
| B. Jenks and J. Lukach | CSREES – National Canola Research Program | 20,700 | 2006-2007 | 5 | Effect of paraquat and diquat applied preharvest on canola yield and seed quality |
| B. Jenks et al. | ND Oilseed Council | 11,000 | 2006-2007 | 3 | Safflower tolerance to sulfentrazone in conventional and no-till systems |
| B. Jenks | NDDPLA | 11,800 | 2006-2007 | 5 | Evaluation of dry pea tolerance to experimental herbicides and control of prickly lettuce and false chamomile. |
| | Pending: | | | | |
| B. Jenks and E. Eriksmoen | CSREES - Cool Season Food Legume | 22,220 | 2007-2008 | 5 | Prickly lettuce/chamomile control and pulse crop tolerance to new herbicides |



Form CSREES-2005 (12/2000)

# Brian M. Jenks

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## Education:

Ph.D., Weed Science, Department of Agronomy, University of Nebraska, Lincoln, Nebraska. December 1995.

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, dry bean, canola, crambe, flax, and small grains.

**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:

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 or in preparation)

Kegode, G. and B. M. Jenks. Biennial wormwood (*Artemisia biennis*) control in dry bean (*Phaseolus vulgaris*) (In preparation – Paper to be submitted to Weed Tech.)

Jenks, B. M., K. R. McKay, D. M. Markle, and G. P. Willoughby. Long-term Canada thistle control using crop rotations, cultural practices, and herbicide combinations. (In preparation - Paper to be submitted to Weed Sci.)

Jenks, B. M., K. R. McKay, D. M. Markle, and G. P. Willoughby. Effect of application rate and timing on weed control in Roundup Ready, Liberty Link, and Clearfield canola. (In preparation - Paper to be submitted to Weed Tech.)

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 - 48

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

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

OMB Approved 0524-0039
Expires 03/31/2004

# BUDGET

| ORGANIZATION AND ADDRESS<br>North Dakota State University<br>Fargo, ND 58105<br><br>PROJECT DIRECTOR(S)<br>Dr. Brian M. Jenks | | | | USDA AWARD NO.<br><br>DURATION PROPOSED MONTHS: __12___<br><br>**Funds Requested by Proposer** | DURATION PROPOSED MONTHS: _____<br><br>**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** | | | | | | |
| 1. No. Of Senior Personnel | Calendar | Academic | Summer | | | | |
| a. ____ (Co)-PD(s)..... | | | | | | | |
| b. ____ Senior Associates ..... | | | | | | | |
| 2. No. of Other Personnel (Non-Faculty)<br>a. __1__ Research Associates/Postdoctorates ..... | 3 | | | 7407 | | | |
| b. ____ Other Professionals..... | | | | | | | |
| c. ____ Paraprofessionals | | | | | | | |
| d. ____ Graduate Students..... | | | | | | | |
| e. ____ Prebaccalaureate Students..... | | | | | | | |
| f. ____ Secretarial-Clerical..... | | | | | | | |
| g. ____ Technical, Shop and Other ..... | | | | | | | |
| **Total Salaries and Wages** .....→ | | | | 7407 | 0 | 0 | 0 |
| B. Fringe Benefits (If charged as Direct Costs) | | | | 2593 | | | |
| **C. Total Salaries, Wages, and Fringe Benefits (A plus B)** → | | | | 10000 | 0 | 0 | 0 |
| D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.) | | | | | | | |
| E. Materials and Supplies | | | | 1000 | | | |
| F. Travel | | | | | | | |
| 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 I)**.....→ | | | | 11000 | 0 | 0 | 0 |
| **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** (J plus K) → | | | | 11000 | 0 | 0 | 0 |
| **N. Other**.....→ | | | | | | | |
| **O. Total Amount of This Request** .....→ | | | | 11000 | 0 | 0 | 0 |
| **P. Carryover -- (If Applicable)Federal Funds: $** | | | | **Non-Federal funds: $** | | **Total $** | |
| **Q. Cost-Sharing/Matching (Breakdown of total amounts shown on line O)**<br>**Cash (both Applicant and Third Party)** →<br>**Non-Cash Contributions (both Applicant and Third Party)** → | | | | | | | |

| **NAME AND TITLE** (Type or print) | **SIGNATURE** (required for revised budget only) | **DATE** |
|---|---|---|
| **Project Director** | | |
| **Authorized Organizational Representative** | | |
| **Signature (for optional use)** | | |



Form CSREES-2004 (12/2000)

## IX. Budget Justification

Salary/ Fringe: Approximately three months salary and benefits will be paid for Research Associate.

Materials/Supplies: Covers fees for survey company to map corners of rotation plots using GPS technology.