

2006

Project Title:

Reducing Pesticide Use in Potatoes By Using Biocontrol Crops and Compost Tea

EPA Funding Program:

Strategic Agriculture Initiative Grant

Amount of Funds requested from EPA:

\$50,186

Amount of Funds provided as match:

\$66,375

Name of Organization applying for funds:

Colorado State University
San Luis Valley Research Center, Center, CO

Name of Primary Contact for this pre-proposal:

Merlin A. Dillon, Area Extension Agent, Agronomy

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DUNS Number:

78597-9618

PART 2: Threshold Criteria

1. Please describe the agency or organization applying for funding.

San Luis Valley Research Center is a regional arm of Colorado State University located 9 miles north of Monte Vista in south-central Colorado. This Research Center is the largest off-campus research center in Colorado and includes many faculty with both research and Extension assignments in potato physiology, pathology, and agronomy.

The land was first leased as an Extension Demonstration Farm in 1939 by potato growers looking for answers for poor potato yields and poor quality. The land was later purchased by local potato growers and donated to CSU. About 1960, the Research Center expanded its staff and began a potato variety development program. Many of the primary potato varieties grown in the San Luis Valley were developed through this successful potato breeding program.

Beyond research and potato seed certification services, the Research Center provides Extension information to regional growers and hosts educational events such as the Research Center Field Day in alternate years and the Southern Rocky Mountain Agricultural Conference. This Conference provides unbiased research-based information on potatoes, small grains, forages, water and livestock. Providing data and research results from locally conducted research is a priority for the Conference. Recent conferences have introduced the concept of using compost, green manure crops and other more sustainable methods of crop management.

Integrated Pest Management (IPM) methods were introduced many years ago and have been in common use for many years. The Research Center provides growing-degree day information

for starting early blight fungicide applications. A newer service is to provide soil growing degree-day information for beginning nematode control applications.

2. Briefly describe the activities that will be conducted.

This project will include three major research and demonstration components:

Green Manure Trial will include one year of green manure crops followed on the exact same plot areas by potatoes. Green manure and winter cover crops will be grown in 2007 followed by potatoes in 2008 to document the effect on Columbia Root-knot nematode (CRKN) levels and potato yield and quality in 2008 and 2009. The effect of the various green manure crops will be measured by determining nematode levels at potato planting, potato yield, potato size quality, and potato tuber damage.

The Early Blight Compost trial will be conducted both years. Potatoes will be planted and compost tea applied several times. Early blight disease control by fungicide, no control and compost tea will be compared. The effect on potato yield and quality will be measured by harvesting potatoes and by grading for size and grade.

The Powdery Scab trial will be conducted both years. A separate potato production field, selected for powdery scab infestation, will be planted to potatoes. Along with several other chemical control methods, compost tea applications will be applied. Potato tubers will be harvested and powdery scab disease severity will be rated.

The impacts of cover crops and compost tea on soil fungal communities will be analyzed using a DNA-based approach consisting of quantitative PCR and length heterogeneity analysis by capillary electrophoresis. The benefit of this technique is that allows for the simultaneous quantification of the entire community (i.e. diversity and abundance) and any individuals of interest within the community

ARS will collect soil samples and plant samples for analysis. He will determine nutrient uptake by green manure crop, dry matter production by green manure crop, effect of green manure crop on potato yield, tuber size, potato nutrient uptake, etc.

3. Describe the geographic location.

Unique in geography, the San Luis Valley (SLV) is the largest agricultural alpine valley in the world. Our valley, about 7700 feet above sea level, is surrounded by the San Juan and Sangre de Cristo Mountains. This irrigated production area produces about 3 million hundredweight of fall crop potatoes each year; the acreage is just less than 58,000 acres.

This area has a very short, very cool growing season which limits crop choices and limits growing green manure crops after a commercial crop. Fertile soil, warm summer days and cool nights, combine with center pivot irrigation and progressive growers to produce 90% of Colorado's potatoes, the fifth largest state in U.S. potato production. Fresh potatoes are cleaned, packed and shipped to most of the grocers and restaurants the southern half of the U.S.

Potatoes are normally grown in a two-year rotation with small grains, either malt barley or spring wheat. Both of these crops are hosts to CRKN, and nematode levels continue growing, sometimes reaching levels requiring fumigation. Some years nematode levels grow very high; in very warm years producing two generations and cause extremely expensive damage to tubers.

4. Describe how the project aligns with one or more of the regional priorities of Agriculture as described in Part 1, Section D.

As an agricultural priority for Region 8, the proposal focuses on sustainable agriculture and pesticide reduction in a whole systems approach. Research progress and results will be shared through demonstration on two farms and outreach activities to growers, including the regional agricultural conferences. Anticipated outcomes include increased number of growers using

alternative reduced-risk pest control methods that also reduce pesticide applications. The project will provide qualitative and quantitative benefits to human health, the environment, and communities, as a result of the partnership between a state agency, Colorado State University, EPA, and local producers involved in this project.

Towards implementing the Food Quality Protection Act (FQPA) within the Strategic Agricultural Initiative grant program, this project proposes an integrated, multi-disciplinary approach to addressing the whole system of growing potatoes in a potato/barley rotation, integrating conservation measures. The research seeks to support “transition” efforts by growers to adopt more environmentally sound pest management practices.

5. List the Strategic Plan Goals and objectives this proposal aligns with: EPA Strategic Plan Goal 4 – Healthy Communities and Ecosystems; Objective 4.1 – Chemical, Organism and Pesticide Risk

EPA Goal 4.1.3 – By 2011, reduce the concentration of pesticides detected in the general population by 50%. Reducing the amount of pesticides used on potatoes, specifically pesticides for nematodes, fungicides for early blight and powdery scab will help EPA meet its goal of reducing pesticides detected in the general population.

Within the broader EPA goals outlined within Goal 4, “Healthy Communities and Ecosystems,” the project seeks to:

- Protect, sustain, or restore the health of local communities and ecosystems through pesticide reduction and alternative biological controls.

As a result of this project, fewer pesticides will be applied to potatoes by local growers, reducing pesticide exposure for potato growers and hundreds of farm laborers and agricultural service workers. The research and demonstration project provides a model for other potato growers to implement throughout the San Luis Valley.

- Pesticide reduction and a sustainable agriculture whole systems approach will help protect the resource of agricultural lands and adjacent water systems.

A conservation plan will be developed to include winter cover crop, alternate methods of pest control for early blight, CRKN, and powdery scab. All parts of the production system are addressed in this project. Reduced pesticide use as a result of this project will help protect the Valley’s wetlands, the two Wildlife Refuges, the underground aquifer, and the Rio Grande.

- The project proposes a local initiative with regional, possibly broader, applications that could be used in other production areas. If effective and economical, many other potato production areas would be interested in using compost tea to reduce pesticide applications for early blight and powdery scab.
- The state/federal/local private partnership involves the grower community and promotes environmental stewardship to sustain environmental improvements.

The partnership involves the potato growers through Colorado Potato Administration Committee (CPAC) funding; CPAC support and Research Committee initiative to write this EPA proposal; and grower-cooperators to provide land and compost tea for the project. Winter cover crop is added and this component provides enhanced soil stewardship. Environment is improved through reduction in pesticide applications and reduced pesticide use may be broadened to other potato growing areas beyond the San Luis Valley.

6. For Strategic Agriculture Initiative proposals, describe any actions you have taken to determine that activities are not duplicative of work being done or already done.

A literature search was conducted to find previous research on green manure effects on Columbia Root-knot nematode (CRKN). Personal communications with Dr. Russ Ingham, nematologist, Oregon State University and Andy McGuire, Washington State University, Grant County, agreed that similar efforts conducted there show progress in using green manure crops.

Green manure cover crop research has been conducted in Oregon, Washington, and Idaho and has been shown to reduce Columbia Root-knot nematode (CRKN). Implementing alternative practices in this unique location, however, requires adapting and making changes in those production practices to fit this area, which has a very short, cool growing season. Instead of growing mustards after wheat as in Washington, here they must be grown as a summer crop. There is very little time for growth after wheat harvest and that growth would increase water use when it must be reduced. Green manure crops are proposed to be grown during summer and used as part of a conservation plan to reduce groundwater pumping. Winter cover crops such as winter wheat are proposed as a part of this system so that the soil is protected prior to planting green manure crops. Different green manure crops are favored by Dr. Hafez in Idaho, who prefers radish as a green manure crop, but he is targeting stubby root nematode, not CRKN.

7. N/A

8. Indicate whether you are submitting this same proposal for consideration by another funding program that is part of this solicitation.

This is the only application we are submitting as part of this solicitation.

PART 3: General Criteria

1) Programmatic Capability of Applicant, incl. history of meeting reporting requirements

A. Successfully managed similar federal agreements:

1. USDA-NRCS Conservation Innovation Grant, 2005-2007, \$75,000. *San Luis Valley Drip Irrigation Initiative*. Ongoing. In progress; drip tape installed; routine progress reports submitted. Merlin Dillon, Samuel Essah, Robert Davidson.

2. USDA-SARE grant, 2001-2003, \$137,916. *Utilization of Compost Made from Agricultural and Forestry Wastes for Improving the Economic and Ecological Sustainability of Agronomic Crop Production on Low Organic Matter Soils in the San Luis Valley of Colorado*. Project conducted and final report submitted by Richard T. Zink and Merlin A. Dillon.

3. USDA-ARS grant, 5-32052, 2003-2006, \$18,000 total. *Characterization of Potato Cultivar Response to Powdery and Common Scab*. Robert D. Davidson and Richard T. Zink. Report filed each year and final report submitted.

4. USDA-ARS grant, 5-32142, 2004-2006, \$76,964 total. *Identification and Characterization of Biological Factors and Control Options for Powdery Scab*. Robert D. Davidson and Richard T. Zink. Report filed each year and new grants received each year..

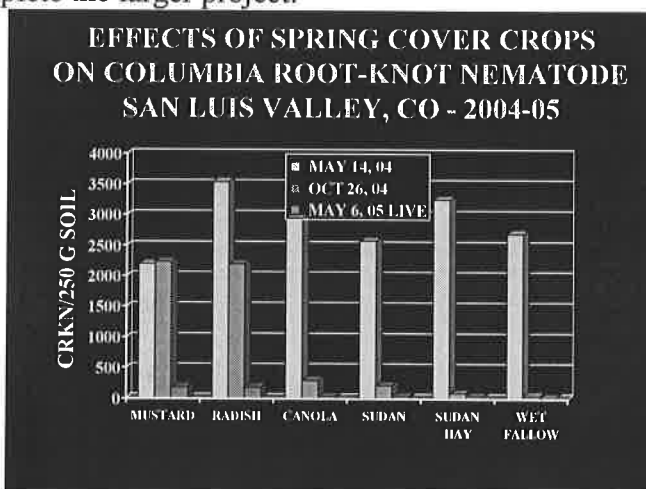
5. USDA-CREES Grant. 2004-6. \$392,161 total. *Potato Breeding and Cultivar Development in the Southwest*. Dr. David Holm and Dr. Samuel Essah. Report filed each year and new grants received each year for the past 10 years..

This Research Center and these primary participants have an excellent history of completing projects and meeting deadlines successfully. Previous research is always made available to growers because of the integration of research and Extension at the SLV Research Center.

Demonstrated Past Success in Project Area:

Crop rotations with cover crops are providing farmers with a viable alternative to ensure sustainability of water resources, conservation of soil water, increase in yields, and even increase in tuber quality. Under commercial farmer field operations, the total marketable tuber yield was increased by 12 to 30% when potatoes followed a sorghum-sudan cover crop instead of fallow plots (Delgado personal communications; Delgado et al. 2007). Delgado observed superior tuber quality, with 40% more tubers greater than 8 ounces when compared to tuber quality and production rates that followed a fallow plot. These preliminary results conducted under commercial field studies show that there is potential to generate additional income (\$60 to 400/acre), which would be more than enough to cover the cost of the cover crop sudan system.

A much smaller project, financed by local growers, successfully demonstrated CRKN reduction following green manure crops. This small study has prepared us to launch a bigger, more aggressive research and education project. Each cooperator is important conducts a coordinated part of the project. All aspects of the proposed larger study have been successfully completed within the small study, indicating that the participants have the knowledge and ability to complete the larger project.



Here is an example of outreach provided to regional growers. This Powerpoint slide was presented at the 2006 growers conference. Data shown here reveals a definite reduction in CRKN as a result of certain green manure crops. Sorghum-sudan, canola, and wet fallow successfully reduced nematode levels. Mustard and radish did not. No where else has potato yield and quality improvements been reported. Preliminary data from 2' x 2' plots and 6' x 10' plots indicate a 10 to 30% potato yield increase. These initial results cry for further substantiation of yield and potato size improvements. Outreach and Extension have already started some growers using green manure cover crops. Locally produced research data can influence growers in the region to gradually adopt and implement these reduced-risk pest management methods with reduced pesticide applications and therefore reduced health risks to growers, farm labor and farm service providers.

Staff knowledge and qualifications:

- **Principal Investigator/contact: Merlin Dillon**, Extension Agronomist, SLV Area. Current position for 25 years. SLV Research Center. Has conducted field research trials for 34 years total; including Master's research plus 5 years at Tribune Branch Experiment Station, Tribune, Kansas.
1970 M.S., Agronomy, Colorado State University, Ft. Collins, CO;
1967 B.S., Agronomy, Panhandle State University, Goodwell, OK.

Field research for 7 years (1999-2006) directed at biocontrol green manure crops funded by area potato growers through grower check-off funds, CPAC Area II Research Committee.

Project Partners:

- **Dr. Samuel Essah**, Research and Extension Scientist (Potato Production and Physiology), SLV Research Center. Service 3 years. E-mail: sessah@lamar.colostate.edu
1999 Ph.D., Plant and Soil Science, Alabama A&M University; 1994 M.S., Crop Production and Physiology, University of Guelph, Ontario; 1993 P.G.C., University Teaching, University of Guelph, Ontario; 1989 B.S., Agricultural Science, Univ. of Science and Technology, Ghana. Essah has worked as farm manager in Ghana 10 years, Instructor and Teaching Assistant 10 years, research scientist for ARS or present position, 6 years. He has published 3 theses and 13 articles in scientific journals.
- **Dr. Russell E. Ingham**, Professor, Nematology, Department of Botany and Plant Pathology, Oregon State University, Corvallis, OR 97331-2902, (541) 737-5255. Current position 21 years. Email: inghamr@science.oregonstate.edu 1981 Ph.D. Zoology (Ecology), Colorado State University, Fort Collins, CO; 1977 M.S. Biology (Parasitology), Texas A&M University, College Station, TX; 1974 B.A., (cum laude), Biology, St. Olaf College, Northfield, MN Many refereed journal publications: Extension presentations to growers (100+). Dr. Ingham has been conducting research on nematodes in potato cropping systems since 1986 and has been studying nematode suppression with green manure crops since 1991
- **Dr. Robert Davidson**, Research and Extension Seed Potato Specialist and Associate Professor, Horticulture and Landscape Architecture, Colorado State University, San Luis Valley Research Center. 25 years service (719) 754-3496 x15; Email: rddavid@ext.colostate.edu Davidson has been intimately involved with the certified seed potato industries in Colorado and North America for 32 years and has focused largely on methods to reduce disease problems through better production and management systems, incl. Masters and Ph.D. research. Publication summary: Recent refereed journal publications: 5; book chapters: 2; extension and related publications: 20. 1994 Ph.D., Plant Pathology, Colorado State University; 1982 M.S., Plant Pathology, Montana State University; 1979 B.S., Botany, Montana State University; 1975 B.S., Microbiology, Montana State University.
- **Dr. Jorge Delgado**, ARS (Agricultural Research Service), Soil Scientist, Fellow American Society of Agronomy, Soil Science Society of America, and Soil and Water Conservation Society, 110+ publications.
- **Dr. Daniel K. Manter**, Ph.D. Plant Physiologist, ARS Ph.D. Forest Science (2001), Oregon State University, Corvallis, OR. Manter has been advising and teaching since 2000. Peer-Review Publications: 18; Non-Refereed Publications: 19; Abstracts: 28.
- **Richard Sparks**, USDA-NRCS, Regional Agronomist, has worked in resource conservation in the Southwest Region (includes the San Luis Valley) for 35 years.
- **Agro-Engineering**, crop consultants, a staff of agronomists and engineers, located in Alamosa, Colorado, will assist with data collection and evaluations of crops and results.

Organizational experience and plan for timely and successfully achieving project objectives (See Timetable for timelines, outcomes plan, etc)

With the partnership and cooperation already, though recently, established; timely execution and success in reaching project objectives are expected. The project, coordinated by Dillon, allows each cooperator to focus on gathering the data he needs. The partners can work separately on specific project niches towards project completion. The current, smaller project on CRKN, nutrition uptake, and potato yield and quality, mentioned above has successfully

conducted very important local research. Dillon has planted and maintained green manure crops; Ingham analyzes soil samples for CRKN; Delgado analyzes nutrients; Manter analyzes PCR-DNA; Essah harvests potato yield and grades quality. The proposed EPA Grant will allow this very successful project to be continued and expanded to include the whole farm and more aspects of the potato production system.

2) Environmental Results Past Performance:

- The USDA-SARE grant completed in 2003. (See Part 3, #1.2). Even though the study found inconclusive results for the type of compost used, awareness of the compost study and use of improved compost has greatly increased compost use since the grant was proposed in 2000.
- The USDA-ARS Disease Suppression grant 5-32052, 2003-6. (See Part 3, #1.3). Cultivar susceptibilities were rated and scores put into current cultivar management profiles, which are provided to regional potato growers. Potato growers can compare powdery scab susceptibility of varieties before they decide to plant.
- The USDA-ARS Disease grant 5-32142, 2004-6. (See Part 3, #1.4). Identified fluazinam (Omega) as an effective powdery scab control fungicide. A Section 24C label is pending. This grant brought better understanding of temperature and soil relationships in Powder Scab symptom development. This disease information has been provided to potato growers.

PART 4. Program Criteria

1. Sustainable agriculture using conservation planning and a whole systems approach

This project proposes an integrated, multi-disciplinary approach to addressing the whole system of growing potatoes in a potato/barley rotation, implementing a conservation plan with a winter cover crop, a summer green manure crop and sustainable, alternative pest control methods. (NRCS Conservation Plan for crops, crop rotation, and tillage allows only a certain amount of erosion.) Sustainable aspects include cover crops and alternative pest control. The project addresses all major potato pests in the potato/barley rotation. Research progress and results will be shared through demonstration on two farms and outreach activities to growers.

Green manure cover crops will reduce groundwater pumping compared to the common commercial rotation crops. A winter cover crop, such as winter wheat or winter rye, added to the summer green manure crops will reduce soil erosion during the windy late winter/spring months. A biocontrol green manure crop, sorghum-sudan, will reduce the applications of the highly toxic nematicides, Telone and Vydate. Preliminary research trials indicate that sorghum-sudan green manure can reduce Columbia Root-knot nematode (CRKN) in a potato/barley rotation. The application of compost tea will be an alternative to potato chemical fungicide, possibly reducing fungicide applications for early blight and powdery scab.

Towards the larger goals of pesticide use reduction and sustainability, reducing the farm use of nematicides and fungicides by growers adopting alternative control methods will reduce the risk of finding pesticides in the groundwater. Many San Luis Valley soils are very coarse and not very deep; pesticides could leach into the groundwater.

Green manure crops can be grown with 4-8 inches of water compared to 16-18 inches for the barley crop it replaces. Rainfall will be measured, and irrigation amounts will be logged as to date and amount of each irrigation.

Adding a winter cover crop to this system will help provide soil protection during the windy months of April and May.

2. The importance of the project in relation to the Food Quality Protection Act (FQPA).

This project aims to reduce the use of nematicides for control of CRKN. This product is very expensive for the growers (\$170-200 per acre). Fewer applications of this product would be

good for the environment. The project also aims to reduce the use of Vydate, an in-season product that controls the damage from nematodes but does not remove or kill them; it allows the crop to be produced in the presence of the nematodes. This project focuses on finding concrete data to make available for growers to evaluate. It will help them shift from targeted pesticides to alternative methods of reduced-risk pest management. Telone is not always totally effective, but for certain is highly toxic and very expensive.

This project will greatly reduce the need to use these highly toxic pesticides because other, economical and effective methods will have been proven. Alternative methods of pest control will reduce the soil nematode levels and reduce the need to use either Telone or Vydate.

Compost tea is suggested for center pivot application for control of early blight and powdery scab. If compost tea proves to be an effective, economical control for these pests, growers will be informed and encouraged to use these alternative pest control methods instead of pesticides such as strobilins. Several strobilins are used on barley in the potato rotation to control mold. Using the same product year after year ultimately leads to resistance development in the fungus. The locally generated data from this project will likely demonstrate these alternative methods as effective, reduced-risk methods, and the information will be disseminated to growers in the region. We anticipate more farmers will adopt these reduced-risk alternatives once local data shows these methods are effective and economical.

3. On-farm demonstration with opportunities for multiple growers and other participants.

This proposal will involve the cooperation of two growers. One grower is an experienced brewer of compost tea and will provide the project with compost tea. Another grower is beginning to use compost tea and will supply land, fertilizer, tillage, and irrigation for the green manure trial. The CPAC Research Committee supports this research in biocontrol crops, encourages this direction in their funding and will hear research reports each year. Agro-Engineering, a local crop consulting firm, will help in data collection, crop scouting, and fertility recommendations. They will also help rate the potato crop for early blight disease severity.

4. Outreach/Use of Extension to enhance likelihood of grower adoption.

Participants Dillon, Essah, Davidson, located at SLV Research Center, have CSU Cooperative Extension appointments. As Extension specialists or Agents, they organize a winter workshop, Southern Rocky Mountain Agricultural Conference (SRM Ag Conference), which will include this project in 2008 and 2009. Summer Field Days (August) will help introduce the growers to these alternative methods by seeing the treatments in the field. Newsletters by Davidson and Dillon will include articles on all aspects of this whole farm system including conservation planning to reduce wind erosion for those that adopt the summer green manure crop system to save irrigation water. A Fact Sheet will be prepared as well and will include all aspects of this alternative pest management system. The questionnaire at the SRM Ag Conference will continue to ask their acreage of green manure crops; it will be expanded to ask acreage of compost tea as well. Even asking these questions helps raise awareness.

5. Commodity's region-wide significance and transferability of results to other areas

The potato crop is vitally important to the Valley. It occupies nearly 58,000 acres but produces a high proportion of the growers' income. Potatoes produce about 1/3 of the Valley's agricultural crop income. This proposed alternative pest control will offer growers a better choice—an environmentally safer choice. Nematode control in potatoes is critical for this region since potatoes provide a substantial portion of growers' income, much more than the other rotational crops. Nematode control is also critical because nematodes can cause the crop not to be sold. The entire field of a crop with over 10% tubers damage usually cannot be sold. Control

with the fumigant, Telone, is very expensive and some growers just will not use it. Vydate does not reduce the nematode population and may not always prevent the damage. Another control method must be found.

Idaho and the Pacific Northwest have a similar rotation and similar pest problems. Green manure crops and compost teas could be used there. As stated previously, green manures would probably be grown differently in that climate. If they needed to save irrigation water as we do, they could grow green manures as we propose. Discoveries about the benefits of compost teas on potato pests could be shared, and compost teas could be easily adapted to those areas.

6. Measurable Objectives:

- 1) Study biocontrol green manure crops and compost tea as alternative reduced-risk control methods, increasing nutrient use efficiencies and nutrient cycling.
- 2) Demonstrate green manure reduction of CRKN at potato planting and reduced tuber damage, potato yield and size quality.
- 3) Increase the number of growers using compost tea.
- 4) Increase the growers and acreage of green manure crops.
- 5) Reduce groundwater pumping compared to commercial crop production.
- 6) Demonstrate reduced wind erosion through use of winter cover crops.
- 7) Increase the use of winter cover crop (winter wheat or rye) to protect the soil.
- 8) Disseminate project findings to local growers through reports, conferences, etc.

7. Environmental Results—Measurable or Quantifiable Outputs and Outcomes, Evaluation Plan

Anticipated outputs for Strategic Agriculture projects include but are not limited to:

- **Educational and outreach materials for growers.**
 1. Prepare a fact sheet focusing on water savings, soil savings, reduced CRKN levels, and alternative early blight control methods.
 2. Prepare two Extension newsletter articles on trial results.
 3. Create Powerpoint presentation to show trial results to present at '08 and '09 SRM Ag Conference and Trade Fair.
- **Conferences, seminars, and on-site field training.**
 1. Include alternative pest control methods in '08 and '09 SRM Ag Conference. SLV Research Center staff plans the agenda and can include this seminar.
 2. Include alternative pest control methods as part of the SLV Research Center Field Days in alternate years. A Sustainable Ag Tour will be organized in 2008, an off-year. Growers will not be able to see nematode numbers; however, they will see the green manure crops used to reduce CRKN.
- **Conservation Plans for growers that include reduced-risk pest management.**
 1. Develop a conservation plan encompassing the entire potato/barley production system including winter cover crop to protect the soil, various green manure crops to reduce CRKN, and compost tea to reduce early blight as important IPM components.
- **Partnerships established between federal and non-federal programs to provide reduced-risk/IPM programs for crop producers.**
 1. Manter and Delgado, USDA-ARS Ft. Collins, are partners with this CSU in helping develop this reduced-risk pest control program.
 2. USDA-NRCS is charged with helping conserve natural resources, reducing wind erosion an improved Conservation Plan as part of this reduced-risk/IPM program.
 3. EPA is the funding partner that may make this project possible.

Anticipated outcomes for Strategic Agriculture projects include but are not limited to:

- **Increased number of growers using reduced-risk/IPM tools and techniques.**
 1. More growers will adopt these reduced-risk/IPM tools as a result of this grant. Seeing on-farm treatments and test results will strongly influence them to try these alternatives.
- **Quantitative, qualitative benefits to human health, environment, and communities.**
 1. Quality of life will be improved for potato growers, farm laborers, field service workers and field consultants through reduced exposure to chemicals such as Telone and Vydate. Potato growers often complain about having to use these products.
 2. The environment is improved when fewer chemical pesticides are used. These reduced-risk/IPM methods will allow crops to be grown successfully with fewer applications of chemical pesticides.
- **Partnerships between crop producers, EPA, other federal/state/local agencies, and others to implement reduced-risk/IPM programs and to leverage funds from other sources to increase the scope of the FQPA/SAI program.**
 1. Partnerships are a strong part of this project, including: potato growers (Colorado Potato Administrative Committee: CPAC, Area II), the Mosca-Hooper Conservation District and the regional NRCS agency, ARS Ft. Collins, EPA through funding, and the Research and Extension personnel of SLV Research Center.
 2. A small funding grant from potato growers' check-off (\$7000; from CPAC, Area II) is used to leverage this EPA grant. Leveraging CPAC Area II funds will enlarge the project, increase its scope, and help make growers more aware of these alternative pest control methods. The funds from CPAC shows that growers think that a green manure project is important enough to put their own funds into the project. The local funds will help support the start of the project until EPA grant funds are received in August 2007.
- **Evaluation Plan.** A survey instrument will be prepared for mailing to random growers to determine whether more growers are using reduced-risk alternative pest control methods compared to 2006. Growers will also be asked:
 - Groundwater pumping will be estimated by compiling and comparing amounts applied to green manure crops vs. commercial crops.
 - How many acres have they applied compost tea and when they began using compost tea on substantial acreage.
 - Whether their applications of Telone and Vydate have increased or decreased and how many acres of green manure crops they grow and when they began growing a substantial acreage.
 - Whether they have applied early blight fungicide and whether compost tea has reduced their chemical fungicide applications.
 - About their use of winter cover crops—how much acreage of winter cover crops they grow and when they started growing a substantial acreage.Chemical pesticide dealers will be surveyed to document sales of Telone and Vydate compared to previous years. Dealers will be asked to estimate whether early blight fungicide use is decreasing or increasing.

8. Project Leverages Funds from other sources/partners

This project will leverage soil analysis and DNA analysis from USDA-ARS in Ft. Collins. These in-kind contributions will not have to be paid; simply provided because it fits the goals of ARS. The small grower funded project conducted over the past 4 years leverages an in-kind contribution of soil and DNA analysis by ARS, Ft. Collins which then helps leverage a

larger EPA funded grant. The ARS in-kind contribution is valued at \$62,000. A \$52,756 grant from EPA will have added to it \$7,000 in local grower funds and \$62,000 ARS in-kind contribution for a total project of \$121,756.

The cooperation of ARS, Ft. Collins, is immeasurably important and Dr. Ingham, Oregon, is very important to successfully managing trials involving the CRKN nematode. Success has improved immeasurably since he began advising.

PART 5. Project Timeline and Deliverables

- **Green Manure Trial I:**

- * Start preliminary soil samples March 2007. Soil sample survey farm field for CRKN are very necessary. (Local funds to be used prior to receiving grant funding in August.)

- * Plant green manure crops 2007. **Outcome:** The preliminary soil survey allows selection of the part of the field with higher levels of CRKN. Higher starting levels allow some possibility that treatments might reduce those CRKN levels.

- * May 2007: Remove winter wheat for green manure plots, plant. **Outcome:** This allows summer green manure crops to follow winter wheat. Soil sample to establish initial CRKN levels; hold samples for later analysis after funds are received.

- * June 2007: plant summer green manure crops such as canola, mustard, sorghum-sudan, etc

- * July: apply roundup to canola and wet fallow treatments. **Outcome:** control weeds so that weeds will not host CRKN.

- * August 2007: Harvest winter wheat. Chop and soil incorporate green manure crops such as barley, canola, sorghum-sudan. Leave sufficient crop residue on the surface to protect soil from wind erosion.

- * October 2007: Soil sample green manure plots for intermediate results of CRKN.

- * May 2008: Sample green manure plots just prior to planting potatoes. This final CRKN sampling tells the risk nematodes pose to the potato crop and shows CRKN reduction, if any, caused by previous green manure crop.

- * September 2008: Harvest potatoes, September 2008. Sample potato tubers for yield, size quality, and nematode penetrations. Document increased potato yield and quality resulting from the previous green manure crop. Document reduced nematode damage from green manure crops.

- **Green Manure Trial II:**

Same as Trial I but one year later, 2008.

- **Potato Compost Tea Early Blight Trial I:**

- * Start May 2007: Initial soil samples for nutrients and PCR-DNA. Establish nitrogen rates; plant potato variety plots.

- * July 2007. Start early blight treatments: fungicide or compost tea.

- * August 2007: rate potato plots for early blight severity. **Outcome:** treatments are expected to differ greatly in amount and severity of early blight.

- * September 2007: Harvest potato plots. Sample soil for ending level nutrients and PCR-DNA.

Outcome: Expect differences in early blight severity, in nutrient uptake; influence on microbial biomass and diversity.

- * October 2007: determine size, grade, and yield of potato plots.

- **Potato Compost Tea Early Blight Trial II:**

Same as Trial I but one year later, 2008.

- **Potato Compost Tea Powdery Scab Trials I & II:** the timetable for these 2 year trials are essentially the same as Early Blight (see above).

- **Grower Survey:** This document to be prepared in late 2007, mailed to growers in Spring

- **Outreach Activities Timeline:**
 - a. Distribute newsletter articles in 2008
 - b. Present results in Powerpoint at the SRM Ag Conferences in 2008 and beyond.
 - c. Highlight biocontrol green manure crops and compost tea at Field Days 2007/2009.
 - d. Organize Sustainable Pest Control Tour in 2008 to show actual plots and the results of the treatments in the field.
 - e. Complete the Conservation Plan in 2008/2009, after the two growing seasons.
 - f. Prepare a fact sheet in 2008, showing trial results.

Attachment B Project Budget

Line Item	Detailed Description	EPA funds	Match funds
Personnel	* Project Manager @ \$592/wk x 12 weeks * Project laborers @ \$8.67/hr x 30hrs/wk x 12 weeks x 3 Total	\$ 7,110 \$ 9,363 \$16,473	\$0 \$0 \$0
Fringe Benefits	Total Fringe Benefits	\$ 2,527	\$0
Travel	*Local Travel Mileage – Office to plot=20 mi (2000 miles x \$0.33) *Partner (ARS) travel Ft. Collins to SLV for sampling & measurements (mileage + per diem + lodging x 3 trips) *Partner Air Fare & expenses for 1 person (Oregon to SLV (2 trips) Total	\$ 660 \$0 \$2,500 \$3,160	\$0 \$3,000 (ARS) \$0 \$3,000
Equipment	* Purchase tents & frames to shade plots from unwanted application *Stakes, bags, herbicide, fungicide, *Chemical tank Total	\$1,920 \$ 500 \$ 600 \$3,020	\$0 \$0
Supplies	* 200 pamphlets for community members @ \$2 Total	\$400 \$400	\$0 \$0
Contractual	*Shipping soil cost (10 box @ \$100) *Nutrient analysis (soil & plant) 35 x 6 dates \$35 by USDA-ARS PCR-DNA analysis 35 plots x 6 dates x \$50 By USDA-ARS Nematode soil testing - 35 samples @ \$35 x 7 sample dates (survey samples = match) Verticillium soil testing – 35 samples x \$20 x 6 sample dates Total	\$1,000 \$0 \$0 \$8,600 \$3,500 \$13,100	\$0 \$32,000 ARS \$30,000 ARS \$1,225 (CPAC) \$0 \$63,225
Other	Office needs (postage, phone, fax, etc.) Survey materials and mailing Total	\$ 150 \$1,000 \$1,150	\$150 0 \$150
Total Direct Charges		\$39,830	\$66,375
Indirect Charges	26% of total direct charges	\$10,356	\$0
Total s		\$50,186	\$66,375
Total Cost of Project		\$116,561	