Research Proposal for 2001

Submitted to:
SLV Research Center Committee
and the
Colorado Potato Administrative Committee
(Area II)

Title: 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 Leaders: Richard Zink, Merlin Dillon, and Susie Thompson
Colorado State University

COLORADO POTATO ADMINISTRATIVE COMMITTEE

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September 24, 1999

Robert L. Newhall
Deputy Western SARE Coordinator
Ag Science Building, Room 322
Utah State University
4864 Old Main Hill
Logan, UT 84322-4865

Dear Mr. Newhall:

The Colorado Potato Administrative Committee (CPAC), strongly supports the efforts of Colorado State University Cooperative Extension, San Luis Valley Research Center, to obtain Sustainable Agriculture Research & Education (SARE) funding for compost research.

The CPAC supports this research proposal for the following reasons:

1. The San Luis Valley potato industry has limited facilities for the disposal of cull potatoes.
2. Cull potatoes are know to spread disease.
3. A strategy is needed to provide a sustainable location for proper cull disposal.
4. Growers need assurance that cull potatoes handled properly will not spread disease.
5. Compost will benefit growers by improving soil health.

This project will identify economic benefits for utilizing compost and will develop a market for compost. In turn, this will aid development of sustainable composting operations in the San Luis Valley. This is critical to potato growers because cull potato management can reduce the inoculum of diseases such as late blight. Also, growers need assurance that cull potatoes are not the source of spreading inoculum of late blight. Further, composting will provide a positive benefit to sustaining our soil health and productivity, long-term. The economic advantages of using compost need to be shown to potato growers.

The CPAC has requested and encourages the Research Center Committee to consider providing matching funds annually in the amount of $5,000, for three years, to support this research and demonstration activity.

Sincerely, Thomas Ford

Thomas Ford
Chairman

Western Region
Sustainable Agriculture Research and Education

Alaska
American Samoa
Arizona
California
Colorado
Guam
Hawaii
Idaho
Micronesia
Montana
Nevada
New Mexico
N. Mariana Islands
Oregon
Utah
Washington
Wyoming

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Host Institution:
Utah State University

28 April 2000 SW00-018

Richard Zink
CSU-Coop Ext.; SLV Research Center
0249 East Road 9 North
Center, CO 81125

Dear Dr. Zink:

Congratulations! The Western Region SARE Administrative Council has tentatively approved your proposal SW00-018, "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." Sixty-two proposals were submitted, and ten were funded. The funding level for this proposal has been reduced to $137,916.

Your specific project was not funded at the requested amount. This may be due to any of several factors (or a combination of factors): 1) there was a limited amount of funding and the Administrative Council chose to fund more projects across a larger geographic area at reduced amounts; 2) WSARE guidelines do not permit us to fund permanent improvements or capital equipment beyond 25% of the initial value; or 3) the Technical Review Panel recommended specific reductions in certain areas to more closely match the funding of similar projects. We realize that this places limitations on your ability to complete the project. However, we would hope that by your revising the objectives and procedures, that your project may still be viable. Please, let us know immediately if you do not wish to proceed with the project at this funding level.

Should you choose to accept this funding, **a revised budget and a summary of the changes in objectives and/or procedures must be sent to the WSARE office as soon as possible, but no later than June 1, 2000.** The original proposal plus your revisions will be sent to Washington, DC for final approval and release of funds. We anticipate that USDA-CSREES will release the funds by the end of September, and that the funds will arrive at Utah State University during the first part of October. Funding for all proposals is contingent upon funds continuing authorization by Congress.

Once the funding arrives, the process of writing subcontracts will begin. The subcontracting process takes approximately 90 days, but varies by institution. We anticipate that your subcontract should be fully executed by January 1, 2001. The subcontract will allow for reimbursement of expenses beginning July 1, 2000.

Enclosed, please find a Project Profile form. The Project Profile must be completed and returned to the Western Region SARE Office before funds will be released to your institution. This form is also due no later than June 1, 2000.

Congratulations on your successful proposal. We look forward to working with you in the coming months. Please feel free to contact me if you have any questions at (435) 797-2257 or by email at fnhinck@cc.usu.edu.

Sincerely,

Robert L. Newhall

Robert L. Newhall
WSARE Deputy Coordintor

enc.
cc: V. Philip Rasmussen, Ph.D.

I. A. **Project Title:**

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.

B. **Submitted to:** SARE: USDA/CSREES Sustainable Agriculture Research & Education program.

C. **Funding:**

	Requested Funds	Matching Funds
First Year Funding Request:	$46,798	$49,478
Second Year Funding Request:	$42,489	$37,927
Third Year Funding Request:	$51,129	$42,271
Total Funding Request:	$140,416	$129,676

D. **Project Contact:**

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E. **Contract & Grant Office**:

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F. **Project Coordinator:** Richard T. Zink, Ph.D. (see Project Contact above)

G. **Major Participants:**

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H. **Cooperators:**

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Wayne Thompson, Executive Director, Colorado Potato Administrative Committee - Area III, 1305 Park Ave., Monte Vista, CO 81144. Phone: (719) 852-3322

Businesses
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Phone: (719) 655-2400, Fax: (719) 655-2401

Joe Vederaime, Coors Brewing, Area Manager, Monte Vista, CO 81144 (719)852-2402

Farmers
Alfalfa Growers: Louie Entz, Alamosa County; George Kirkpatrick, Alamosa County
Potato/Barley Growers: Lyle Nissan, Alamosa Co.; Lynn McCullough, Rio Grande Co.

I. **Resubmitted Proposal:** No previous proposal has been submitted.

II. **PROPOSAL SUMMARY - Title:** ***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.***

The main objective of this SARE proposal is to improve water conservation and the sustainability of agronomic crop production on the low organic matter soils of the San Luis Valley (SLV) of Colorado. Through on-farm demonstrations this project will examine the impact field incorporating compost made from agricultural and forestry wastes has on: 1.) the potential for reducing the use of synthetic fertilizers and fungicides, by improving nutrient retention in the root zone and the health and diversity of the soil's biomass, 2.) the potential for improving water utilization and thereby reducing water and power use in center-pivot irrigation systems; 3.) crop yields and costs of production for potatoes, barley and alfalfa.

Two agricultural waste streams, sawdust and cull potatoes, being generated in the SLV have become problematic for their local industries. Logs harvested from the National Forests surrounding the valley are milled locally, generating sawdust for which there are very few feasible uses. In a 1997 Colorado State University (CSU) survey of western Colorado mill operators, the second most mentioned problem, was that of mill residues (sawdust).[1] Most of this sawdust has been just stacking up at locations near the mills. Potatoes are the valley's most economically important crop, and the foundation of the local economy. On average about 9.6% of each year's potato crop is not marketable, due to size, appearance or presence of disease.[2] These cull potatoes have become particularly problematic, since the devastating disease late blight (*Phytophthora Infestans*) is now present in the valley. Late blight spores from cull piles of infected potatoes can be transported by air to infect the new growing crop, repeating the disease cycle. Research conducted in Maine has demonstrated that properly managed, hot aerobic composting of cull potatoes with sawdust will destroy disease pathogens and produce an excellent soil conditioner, with each ton of fresh compost containing 12 lbs of nitrogen, 4 lbs of phosphorus, 9 lbs of potash, 18 lbs of calcium and about 400 lbs of organic matter.[3] The sustainability of most soils used for crop production in the SLV would be improved by the addition of this compost. Sawdust and cull potatoes are produced in the SLV on a fairly consistent basis, in close proximity to one another, and in quantities complimentary to what is needed for hot aerobic composting using the basic Maine recipe and methodology.[4] While making the compost is logistically possible, there is no established local end market for the compost, and the SLV's isolated location makes it cost prohibitive to ship to more distant markets. Local growers are reluctant to purchase and apply compost because they are trying to minimize production costs after several years of receiving low market prices, and they fear that they may be introducing disease into their crop through the compost. They don't recognize the long-term productivity gains that can be realized by improving their soils with compost.

The objectives of this project are to develop local end markets for agricultural and forestry wastes while improving the sustainability of agronomic crop production in the San Luis Valley by demonstrating the impact compost applications have in typical cropping rotations of potatoes/barley, and continuous alfalfa. The project will examine and report on changes in the diversity of the soil's microbiology and biomass, disease levels in the crops, use of fertilizers and pesticides, water utilization, nutrient retention in the root zone and net economic value of compost applications.

Results will be disseminated to farmers in the SLV to encourage the adoption of applying compost to low organic matter soils. Field tours will be given. Results will be presented at CSU's Forage & Livestock Conference and Potato-Grain Conference. Following Years 2 & 3 summary bulletins will be developed and mailed to SLV producers, and be posted on the CSU Website. Articles on the results will also be printed in the *Spud Items* newsletter of the Colorado Potato Administrative Committee.

III. PROJECT NARRATIVE

A. Background Rationale

Late blight is now present in the San Luis Valley potato crop, requiring an increase in fungicides used as protection against this devastating disease. This is an additional economic burden to growers and adds a negative burden to the environment. Composting cull potatoes with locally generated waste sawdust will help to minimize the spread of late blight, by removing the culls as a spore source, while providing an excellent soil conditioner that can improve the sustainability of the soils used to produce agronomic crops in the valley.

Soils in the SLV used to produce agronomic crops are sandy and extremely low in organic (less than 0.5% OM). The water table in many areas of the valley is quite shallow, 5 to 30 feet below the surface. This creates the potential for nutrients applied to the crops to be leached through the soil to the water table, resulting in the loss of nutrients and contamination of the ground water.

Addition of organic matter through incorporation of compost, would help to improve the soil structure and its nutrient and water holding capacity, reducing the potential for nutrient leaching and improving water conservation.

Nutrients present in the compost are released more gradually, through the decomposition performed by microorganisms that tend to be more active during the warm growing season, when plant's root system are growing and able to take up the nutrients.

Compost also been demonstrated to have disease suppression qualities, which may help to improve the health of crops and reduce the need for fungicides. This too could lead to a more sustainable system, with reduced input cost and reduced risk of water contamination.

B. Related Current Work in the Area

Disease Suppression: Research done by the University of Maine and Woods End Laboratories has shown that the heat generated by hot aerobic composting of cull potatoes and sawdust will destroy most potato pathogens.[5] Disposal of infected cull potatoes by composting, not only will help to minimize the spread of late blight, it is a more environmentally friendly disposal method than burial. Application of compost has been advocated by organic growers for many years as a means to eliminate pesticides and fumigants. Suppression of soil-borne plant pathogens by organics has been well documented by some researchers, through a phenomenon known as antagonism or amensalism.[6]

Yield improvements in potatoes in response to field incorporation of compost have been documented in Maine and Idaho. Greg Porter at University of Maine saw increases in yields of US#1 potato after applying compost made with sawdust and cull potatoes.[7] Dale Westermann, Soil Scientist, at the USDA-ARS, Research Farm in Kimberly, ID has also documented yield increases in potatoes and malting barley resulting from the application of composted dairy manure in combination with nitrogen fertilizer.[8]

Recent work done with compost treated soils has shown an overall improvement for production agriculture purposes. Using an organic amendment led to an improved percentage of available water in all cases in research in New Mexico. The increase in available water was between 7% and 33%.[9]

At Magic Valley Foods, in Rupert, ID, Richard Johnson was able to reduce the amount of water applied through the irrigation system, in potato fields where compost had been incorporated.[10]

C. Proposal Objectives

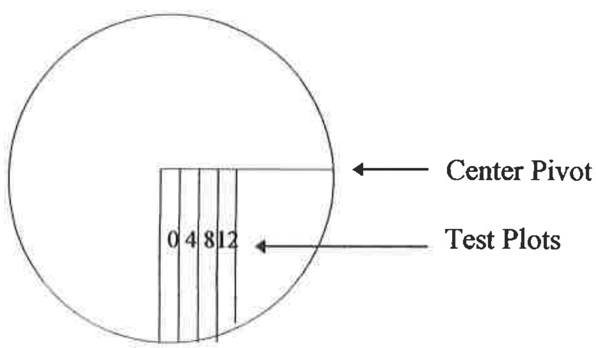
1. Develop local end markets for agricultural and forestry wastes, while improving the sustainability of potato, barley and alfalfa crop production in the San Luis Valley by demonstrating the impact field incorporation of various rates of compost has on production, by measuring:

    a. The change in the diversity of the soil's microbiology and biomass.
    b. Variations in disease levels in the crops.
    c. The potential improvement in nutrient retention in the root zone.
    d. The potential reduction in the use of synthetic fertilizers and pesticides.
    e. The potential improvement in water utilization, and associated reduction in water and electrical power use by center-pivot irrigation systems.
    f. The net economic value of compost applications.

2. Dissemination of results to farmers growing agronomic crops in the San Luis Valley, demonstrating the economic and ecological value of using compost to the long term sustainability of their farming operations.

D. Approach: Materials & Methods

Test plot design for alfalfa, barley and potatoes will all be the same. The test plots will be grown under center-pivot irrigation systems. Three rates of compost, 4 tons/acre, 8 tons/acre, and 12 tons/acre will be applied each of the three years in side by side plots measuring 100 feet wide by 1300 feet long (130,000 square feet or ~3 acre strips). A control plot of the same dimension will be along side of the test plots. See diagram below for plots design. Diagram is not to scale.



Potato-Barley-Potato Rotation Plot Design- Two of the valley's leading growers have been selected as cooperators for this part of the three year project. One is located in Rio Grande County in the center of the potato growing region. The second grower is located in Alamosa County in the eastern edge of the potato production area. Each grower will have two replicated test plots on their farm, in which potatoes are grown in Year 1 of the rotation, barley grown in Year 2, and potatoes grown again in Year 3. Russet Norkotah and Russet Nuggets varieties, which account for about 85% of the area's potato production, have been selected as the varieties to be grown. Coors malting barley will be grown in Year 2.

Continuous Alfalfa Plot Design: Two experienced, and reliable alfalfa growers have been selected as cooperators for the three-year continuous alfalfa plots. Both farms are located in Alamosa

County, on some of the SLV's sandiest soil, with the lowest organic matter. Each grower will have one irrigated circle of alfalfa where replicated strips with 0, 4, 8, and 12 tons/acre of compost will be applied. These plots will be harvested three times each year. Yields will be measured by harvesting plots 17' x 10' with CSU's John Deere 3430 swather adapted with electronic weigh bars.

To ensure the project's objectives are met, the following measurement procedures will be taken:

1. Develop local end markets for agricultural and forestry wastes, while improving the sustainability of potato, barley and alfalfa crop production in the San Luis Valley by demonstrating the impact field incorporation of various rates of compost has on production, by measuring:

a. **The change in the diversity of the soil's microbiology and biomass.**
Change will be measured over the course of the three year project by taking composite soil samples of each test plot (by the field staff the Monte Vista Co-op) each year in mid-April and mid-September, and a microbial foodweb assay performed on the sample. The microbial foodweb assay will be performed by Soil Foodweb, Inc., in Corvallis, OR, using methodology developed by Oregon State University. The method uses allow the numbers, types and activity of each important soil organism in the soil foodweb to be quickly assessed. Measurements are taken of the number of individuals or biomas of each group, type of organisms present and who is dominant, how active the organisms are, and the relationship of soil organisms to plant available nitrogen. The assay results will be reported in the summary bulletins and conferences.

b. **Variations in disease levels in the crops.**
Measurement of Potato Disease Levels: In Year 1 and Year 3 visual inspections for disease incidence in potatoes will be made in the three compost treated plots and the control plot. The inspections will be made by CSU, Research Associate, Coleen Golden with supervision of Extension Potato Specialists, Rick Zink and Rob Davidson. Diseases to be monitored and reported on are:

Early Blight (*Alternaria solani*) - Visual ratings will be made every other week, from mid-season on.

Rhizoctonia canker (*Rhizoctonia solani*) - visual inspection of stems and stolens will be made at 40 days post planting. Visual inspection of the tubers will be made at harvest.

Potato Early Dying (*Verticillium dahilae*) - visual inspection of the plants will be taken at 70 days post planting.

Measurement Barley Disease Levels: Harvested grain from the barley test plots will be taken to the Coors grain elevator in Monte Vista and rated for disease and damage, as well as screening percentage and protein levels.

c. **The potential improvement in nutrient retention in the root zone.**
The purpose of the nutrient monitoring program associated with this project is to examine the potential improvement in nutrient retention in the root zone and nutrient uptake by the crop as a response to compost applications. The hypothesis is that with larger applications of

compost, there shall be more organic matter, better nutrient retention in the root zone, and an increased nutrient availability to the crop. Since the four plots on each field shall be adjacent to each other it shall not be feasible to adjust the producers normal fertilizer management program. Instead the soil and crop response to compost applications made above the producers normal fertilization regime shall be measured.

Top and Subsoil samples shall be collected in each of the four plots in both the spring and fall of each year. The top soil sample is collected from the top foot of the root zone. The subsoil sample is collected from the second foot of the root zone. A minimum of twenty cores shall be collected in each plot to make up the composite sample. Agro Engineering (Agro) will use Servitech to analyze soil samples. Analysis shall include: pH, salinity, excess lime, organic matter, nitrate, phosphorus, potassium, sulfur, calcium, magnesium, sodium, zinc, iron, manganese, copper, cation exchange capacity, and the percent of each cation that makes up the exchange capacity.

In the potato tests, petiole tissue samples shall be collected bi-weekly from each of the four plots. A total of five samples shall be taken across the course of the growing season from 80% cover to the start of senescence. Each sample shall have a complete analysis performed which includes nitrate, phosphate, percent phosphate, percent potassium, percent calcium, percent magnesium, percent sulfur, copper, zinc, iron, manganese, and boron. A minimum of twenty petioles shall be collected to make up each tissue sample from each plot. No tissue samples shall be collected from the fields in small grains or alfalfa. Agro shall provide interpretation of both the soil and petiole results. Agro shall also monitor all fertilizer applications made by the producer.

A water sample shall be collected from each irrigation system to ascertain the amount of nitrogen being contributed to the system from the irrigation water. This water sample shall include results for nitrate, chloride, sulfate, carbonate, bicarbonate, calcium, magnesium, sodium, potassium, boron, total dissolved solids, hardness, alkalinity, electrical conductivity, sodium adsorption ratio, percent sodium, and pH. Agro shall also take an aerial photograph of each field to ascertain visual differences between the plots. Agro shall also GPS the field and plot boundaries, and provide a GIS map of each field study.

d. **The potential reduction in the use of synthetic fertilizers and pesticides.**
Because these plots are being done on commercial farms, fertilizer rates will not be varied by the farmer-cooperator, to ensure that their crop yields are not reduced. CSU Extension Agronomist Merl Dillon and CSU Potato Research Horticulturalist, Susie Thompson, will use soil test analysis and nutrient analysis provided by Agro Engineering as well as crop yield data to determine what levels of reduction in fertilizer rates are possible. Observations of plant health are also key indicators that can be used to assess if fertilizer levels can be reduced.

Information gathered about disease levels in the test plots will be interpreted to determine if any reduction in fungicide applications may be possible.

e. **The potential improvement in water utilization, and associated reduction in water and electrical power use by center-pivot irrigation systems.**
The purpose of a soil moisture monitoring program associated with this project would be to examine the potential improvement in water utilization, increase in soil water holding capacity, and associated reduction in water and electrical power use by center-pivot irrigation

systems as a response to compost applications. Since all four plots in each field shall be located adjacent to each other, it will not be feasible to adjust the producer's irrigation water management (either depth or timing) between plots. Instead the soil moisture shall be monitored in each of the plots to examine whether the rate of soil moisture depletion decreases with increasing compost applications. The soil moisture shall be measured hourly in each plot using automated tensiometers. The soil moisture for the control plot shall also be modeled daily using a soil moisture model based upon the water inputs to the root zone.
To accomplish these goals, three types of information shall be collected. First, the soil in each plot shall be characterized annually. This shall include a soil type/soil texture analysis, a determination of available water holding capacity, and an analysis of the soil moisture retention curve. The soil moisture retention curve (or matric potential) provides an understanding of the amount of water that a particular soil can hold at different capillary pressures. This curve provides an effective calibration between tensiometer readings and the soil moisture. Since it is expected that the differences in readings between the compost plots shall be small, it is important that the soil moisture retention curve be well defined, especially between the soil moisture range at field capacity to 30% deficit. CSU shall conduct the soil characterization including the determination of the soil moisture retention curve for each plot annually.

The second type of information that shall be monitored is water applications. Agro Engineering (Agro), shall maintain a record of irrigation applications and rainfall events during the growing season. Wet events shall be measured using an automated rain collector in each field. Agro shall also monitor crop stage of development, planting, and harvest dates and calculate daily crop consumptive use for each field individually. Based upon this information, Agro shall model daily soil moisture for the control plot of each field.

The third type of information that shall be collected is the actual soil moisture in each plot. There shall be two tensiometer stations in each plot to provide replicated results. At each station there shall be two tensiometers, one measuring the soil moisture in the shallow root zone (5" depth for Norkotahs, 6" depth for Nuggets, 6" depth for small grains, and 8" depth for alfalfa) and the other measuring the soil moisture in the deep root zone (10" depth for Norkotahs, 12" depth for Nuggets, 14" depth for small grains, and 16" depth for alfalfa). In addition, there shall be two deep tensiometers per field, one in the control plot and one in the high rate compost plot to measure the soil moisture below the root zone. These automated tensiometers shall collect readings every hour.

The tensiometer readings at the three different depths shall allow us to watch the wetting front penetrate through the soil profile following a water event to evaluate the efficacy of the irrigation amount. It shall also let us watch the rate of soil drying as a function of crop water use to evaluate the efficacy of the irrigation interval. The hypothesis of the project is that increasing rates of compost application will increase the water holding capacity of the soil which will decrease the rate of penetration of a single irrigation event but keep the soil from drying out as quickly enabling a longer irrigation interval, or decrease in the amount of water applied per irrigation.

Agro will service and install the tensiometers, maintain the tensiometers through each irrigation season, download the data, collect soil samples, monitor water events, and analyze the data. Tensiometers shall be installed soon after planting, removed for cultivation of potatoes and then reinstalled, and removed before vine-kill or swathing. The tensiometers shall be checked bi-weekly for maintenance. The data shall be downloaded monthly and then analyzed following each growing season. It is estimated that 71 hours shall be required on each field, but any time overages shall be covered by Agro.

CSU Extension Economist, Rodney Sharp will work with the farmer-cooperators in interpreting any cost savings in water and electrical costs from reductions in water use that can be made.

f. **The net economic value of compost applications.**
CSU Extension Economist, Rodney Sharp will work with the farmer-cooperators, and the project's coordinator to assess the net economic value compost applications in alfalfa, barley and potato production in the San Luis Valley. To arrive at the net economic value, changes in the crop yield, water utilization, and recommended fertilizer and fungicide use will be evaluated.

Creating a local end market for the waste streams of sawdust and cull potatoes, also has an economic value to the forestry and potato industries. Rodney Sharp will work with industry personnel to try and arrive at a value for this new "waste handling service."

2. **Educational Objective:** Dissemination of results to farmers growing agronomic crops in the San Luis Valley, demonstrating the economic and ecological value of using compost to the long term sustainability of their farming operations.

Each year the local Research and Extension staff of CSU conduct two educational conferences in the San Luis Valley. In the fall the CSU Forage and Livestock Conference is held, and in the spring the Potato/Grain Conference is held. In Year 1 of this SARE project, the study's objectives will be outlined and presented at both of these conferences to create awareness for the project. In Years 2 and 3 results from the project will be reported, with emphasis on alfalfa presented at the Forage and Livestock Conference by Merl Dillon, and emphasis on potato and barley results presented at the Potato/Grain Conference by Dillon, Zink and Thompson.

In Year 2 a summary bulletin will be printed and distributed by CSU to producers in the San Luis Valley, and made available to producers outside of the area upon request. At the completion of the study a more thorough summary bulletin, will be printed and distributed in the same manner. Both bulletins will also be posted on the San Luis Valley Research Center's page on the CSU Website.

Articles on the research will be printed periodically in *Spud Items*, the newsletter of the Colorado Potato Administrative Committee, and the Pomme de Terre newsletter written by Rick Zink, both newsletters go to potato growers in the SLV.

E. **Anticipated Schedule for Achieving Objectives**
Baseline soil samples would be taken in the late summer of 2000 and analyzed to establish the nutrient level and microbial levels of each test plot. A water sample would also be taken from each of the center pivot systems and analyzed prior to compost applications. Compost would be applied in the fall of each of the project, since it is the normal farming practices of the area to do field preparation in the fall for planting the following spring. During the growing season, ratings for disease levels, crop health, water utilization and nutrient uptake will be made. Three cuttings of alfalfa will harvested and rated for yield during each growing year. Crop yield data will be collected at the end of the growing season for the potato and barley crops. All data collected will

be summarized at the end of each growing season. In Year 2 and Year 3 summary bulletins will be published in print and on the CSU Website. Field days at each site will be held every year during the growing season. Summary results will be reported each year at CSU grower conferences in the SLV.

F. **Impact Assessment**

Impact of this project will be assess as follows:

- Quantity of compost applied to SLV cropland will be monitored annually
- The number of acres that have compost applied to them will be recorded
- Growers using compost will be surveyed to assess changes in water and fertilizer utilization.
- Volumes of waste sawdust and cull potatoes that are transformed into compost will be monitored.

IV. **BUDGET**

A. **Salaries and Wages**

Time worked on this project by the following Colorado State University personnel will be contributed to the project as in-kind matching funds:

- Project Coordinator, Rick Zink, Ph.D., will spend approximately 10 percent of his time on this SARE projected, at an estimated value of $6,000 per year.
- Potato Research Horticulturalist, Susie Thompson, Ph.D., will spend approximately 10 percent of her time at an estimated value of $5000.00 per year.
- Extension Agronomist, Merl Dillon will spend an estimated 15 percent of his time each year at a value of $7500.00.
- Soil Scientist, Jessica Davis, will spend 3 days per year at an estimated value of $500.00.
- Ag Economist, Rodney Sharp will spend 20 hours in Year 3 at an estimated value of $700.00.
- Extension Potato Specialist, Rob Davidson, Ph.D., will spend one week per year on the project at an estimated value of $1200.00
- Weed Specialist, Scott Nissen will spend three days a year at an estimated value of $876.00.

CSU Research Associate, Coleen Golden, will be responsible for disease monitoring in the potato crops and will assist the project coordinator in oversight of the project. She will spend an estimated 25 percent of her time on the project at a value of $5000.00 per year.

An estimated $1000.00 per year will be needed for hourly labor to assist in harvesting the alfalfa, barley and potato test plots and collecting yield data. In Year 1 & 2 this expense will be paid by matching funds contributed by the potato industry through the Research Committee of CPAC.

B. **Fringe Benefits**

A rate of 17.8 percent of salaries was used to calculate the fringe benefits for CSU personnel.

C. **Total Salaries & Benefits**

D. **Nonexpendable Equipment**

CSU will use its current alfalfa swather for harvesting the alfalfa test plots. However, a trailer is needed to transport the swather from the CSU research center to the alfalfa plots twenty miles away. Cost for the trailer is $2900.00.

E. **Materials and Supplies**

Three thousand dollars have been allocated in Year 1 toward, office supplies, supplies needed for field plot marking and harvesting, and for putting farmer field days. Since many of these supplies can be reused in the following years, only $1500 was allocated in Year and nothing in Year 3. This expense is being paid by matching funds donated by the potato industry.

F. **Travel (domestic)**

Each year, Scott Nissen and Jessica Davis, will each make one, three-day trip from Ft. Collins to the San Luis Valley at a cost of $600 per trip, per individual, for a total of $1200.00.
An additional $1200.00 per year is needed for local travel expense of CSU researchers within the San Luis Valley. A contribution of $2000.00 per year from U.S. Forest Industries will be used to offset travel expense.

G. **Publication Costs/Page Charges**

In Year 1 newspaper and newsletter articles will be printed to create awareness for the project. In Year 2 a summary bulletin will be published at an estimated cost of $2500.00 A more comprehensive bulletin will be printed at the end of Year 3 at a cost of $5000.00. These publication costs, include cost of photography taken during the project. These expenses will be covered under the $5000.00 annual contribution from the potato industry.

H. **Computer (ADPE) Costs** (no ADPE costs are anticipated)

I. **All Other Direct Costs**

Two subcontractors will cooperate on the project. The fertilizer division of Monte Vista Cooperative (a Farmland Cooperative), will be responsible for developing the compost and applying it. The cost of the compost and application will be $ 24.85 per ton. A total of 432 tons of compost per year will be needed for a total of $10,735.20. The Monte Vista Co-op is contributing $3823.20of this amount per year as an in-kind matching contribution to the project, leaving the cost of compost and application at $6912.00 per year. The Monte Vista Co-op will also collect soil samples in the spring and fall of each project year, in each test plot and have microbial foodweb assay performed. A total of 48 samples will be collected and assayed each year (24 in the spring, 24 in the fall). Cost of collection is $2.00 per sample, for a total of $96.00, which the Co-op will donate as an in-kind contribution. The microbial foodweb assay costs $150.00 per sample x 48 samples = $7200.00 per year.

Agro-Engineering, a crop consulting firm based in the SLV, will be responsible for the water and nutrient monitoring portion of the project. Nutrient monitoring will be done on all six fields, each year of the project. To reduce project expense, only one alfalfa field, and one potato/barley field on each cooperator's farm will be monitored for water utilization, for a total of three fields. To collect and analyze eight top soil and eight subsoil samples (2 for each strip) in each field of barley or alfalfa will cost $695.00. In potatoes, petiole samples will be taken and analyzed five times during the growing season at a cost of $1910.00 per field in addition to the $695.00 for the soil samples, for a total of $2605.00 per potato field, for the four potato fields (Years 1 & 3). This price reflects a $880.00 discount per potato field, donated as an in-kind contribution.

Each of the three fields where water utilization will be monitored shall require the following equipment: 18 - Tensiometers (12" Tensiometers for shallow, 18" or 24" Tensiometers for deep), 18 - Pressure Gages, 18 - Pressure Transducers, 11 - Dataloggers, 1 - Automated Rain Collector, 1 - Specware Software.

Based on present market costs, it is assumed that the equipment for each field shall cost $9,140. Assuming that Agro purchases the equipment, it shall have a residual value to Agro of $2,077 once the project is complete and Agro is willing to pay this amount of the equipment costs in kind. Agro would also be willing to purchase the equipment up front and amortize the cost of the equipment to the project over the three years of the project with a capital recovery factor. As such the project would need to budget $3,239 per field annually to cover equipment costs.

Agro will service and install the tensiometers, maintain the tensiometers through each irrigation season, download the data, collect soil samples, monitor water events, and analyze the data. Tensiometers shall be installed soon after planting, removed for cultivation of potatoes and then reinstalled, and removed before vine-kill or swathing. The tensiometers shall be checked bi-weekly for maintenance. The data shall be downloaded monthly and then analyzed following each growing season. The cost associated with this research shall be $3030 per field. It is estimated that 71 hours shall be required on each field, but any time overages shall be covered by Agro.

Total Costs per Field for each of the Three Years of the Life of the Project

Equipment = $ 3,239
Labor = $ 3,030
TOTAL = $ 6,269 x 3 fields = $18,807

Agro's In Kind Allocation per Field During the First Year of the Project

Equipment = $ 2077 x 3 fields = $6,231

Overall Budget

ATTACHEMENT A: USDA/CSREES BUDGET

Colorado State University Cooperative Extension Rick Zink, Ph. D., Extension Potato Specialist	SARE FUNDS 2000	NON-FEDERAL MATCHING 2000	SARE FUNDS 2001	NON-FEDERAL MATCHING 2001	SARE FUNDS 2002	NON-FEDERAL MATCHING 2002	TOTAL SARE	TOTAL MATCHING
A. Salaries and Wages 1. No. of Senior Associates a. 1 (C0)-PI(s)/PD(s)		$6,000		$6,000		$6,000	$0	$18,000
b. 6 Senior Associates		$15,076		$15,076		$15,776	$0	$45,928
2. No. of Other Personnel (Non-Faculty) a. 1 Research Associates-Postdoctorate	$5,000		$5,000		$5,000		$15,000	$0
b. ___ Other Professionals							$0	$0
c. ___ Graduate Students							$0	$0
d. ___ Hourly Labor		$1,000		$1,000	$1,000		$1,000	$2,000
e. ___ Secretarial-Clerical							$0	$0
f. ___ Technical, Shop, Other							$0	$0
Total Salaries and Wages	$5,000	$22,076	$5,000	$22,076	$6,000	$21,776	$16,000	$65,928
B. Fringe Benefits (If charged as Direct Costs)	$0	$4,642	$0	$4,642	$0	$4,766	$0	$14,049
C. Total Salaries, Wages & Fringe Benefits (A + B)	$5,000	$26,718	$5,000	$26,718	$6,000	$26,542	$16,000	$79,977
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)	$2,900						$2,900	$0
E. Materials and Supplies		$3,000		$1,500			$0	$4,500
F. Travel (domestic)	$400	$2,000	$400	$2,000	$400	$2,000	$1,200	$6,000
G. Publication Cost/Page Charges		$1,000		$2,500		$5,000	$0	$8,500
H. Computer (ADPE) Costs							$0	$0
I. All other Direct Costs (Attach list of items and dollar amounts. Each subcontract should have a separate budget sheet.)	$38,498	$16,760	$37,089	$5,209	$44,729	$8,729	$120,316	$30,699
J. **Total Direct Costs** (C through I)	$46,798	$49,478	$42,489	$37,927	$51,129	$42,271	$140,416	$129,676
K. Indirect Cost/Tuition Reimbursement (Not allowed)								
L. **Total Amount of This Request**	$46,798	$49,478	$42,489	$37,927	$51,129	$42,271	$140,416	$129,676

ATTACHEMENT A: USDA/CSREES BUDGET

Colorado State University Cooperative Extension Rick Zink, Ph. D., Extension Potato Specialist	SARE FUNDS 2000	NON-FEDERAL MATCHING 2000	SARE FUNDS 2001	NON-FEDERAL MATCHING 2001	SARE FUNDS 2002	NON-FEDERAL MATCHING 2002	TOTAL SARE	TOTAL MATCHING
A. Salaries and Wages 1. No. of Senior Associates a. ___ (C0)-PI(s)/PD(s)							$0	$0
b. ___ Senior Associates							$0	$0
2. No. of Other Personnel (Non-Faculty) a. ___ Research Associates-Postdoctorate							$0	$0
b. ___ Other Professionals							$0	$0
c. ___ Graduate Students							$0	$0
d. ___ Hourly Labor							$0	$0
e. ___ Secretarial-Clerical							$0	$0
f. ___ Technical, Shop, Other (Water Monitoring)	$9,090		$9,090		$9,090		$27,270	$0
Total Salaries and Wages	$9,090	$0	$9,090	$0	$9,090	$0	$27,270	$0
B. Fringe Benefits (If charged as Direct Costs)							$0	$0
C. Total Salaries, Wages & Fringe Benefits (A + B)	$9,090	$0	$9,090	$0	$9,090	$0	$27,270	$0
D. Nonexpendable Equipment (Water monitoring equipment.)	$3,486	$6,231	$9,717		$9,717		$22,920	$6,231
E. Materials and Supplies (Nutrient Analysis)	$11,810	$3,520	$4,170		$11,810	$3,520	$27,790	$7,040
F. Travel (domestic)							$0	$0
G. Publication Cost/Page Charges							$0	$0
H. Computer (ADPE) Costs							$0	$0
I. All other Direct Costs (Annual water sample analysis, annual aerial color/infrared photograpy, GPS map.)		$3,090		$1,290		$1,290	$0	$5,670
J. **Total Direct Costs** (C through I)	$24,386	$12,841	$22,977	$1,290	$30,617	$4,810	$77,980	$18,941
K. Indirect Cost/Tuition Reimbursement (Not allowed)								
L. **Total Amount of This Request**	$24,386	$12,841	$22,977	$1,290	$30,617	$4,810	$77,980	$18,941

Colorado State Univers ty

ATTACHEMENT A: USDA/CSREES BUDGET

Colorado State University Cooperative Extension	SARE FUNDS	NON-FEDERAL MATCHING	SARE FUNDS	NON-FEDERAL MATCHING	SARE FUNDS	NON-FEDERAL MATCHING	TOTAL SARE	TOTAL MATCHING
Rick Zink, Ph. D., Extension Potato Specialist	2000	2000	2001	2001	2002	2002		
A. Salaries and Wages 1. No. of Senior Associates a. 1 (C0)-PI(s)/PD(s)		$6,000		$6,000		$6,000	$0	$18,000
b. 6 Senior Associates		$15,076		$15,076		$15,776	$0	$45,928
2. No. of Other Personnel (Non-Faculty) a. 1 Research Associates-Postdoctorate	$5,000		$5,000		$5,000		$15,000	$0
b. ___ Other Professionals							$0	$0
c. ___ Graduate Students							$0	$0
d. ___ Hourly Labor		$1,000		$1,000	$1,000		$1,000	$2,000
e. ___ Secretarial-Clerical							$0	$0
f. ___ Technical, Shop, Other							$0	$0
Total Salaries and Wages	$5,000	$22,076	$5,000	$22,076	$6,000	$21,776	$16,000	$65,928
B. Fringe Benefits (If charged as Direct Costs)	$0	$4,642	$0	$4,642	$0	$4,766	$0	$14,049
C. Total Salaries, Wages & Fringe Benefits (A + B)	$5,000	$26,718	$5,000	$26,718	$6,000	$26,542	$16,000	$79,977
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)	$2,900						$2,900	$0
E. Materials and Supplies		$3,000		$1,500			$0	$4,500
F. Travel (domestic)	$400	$2,000	$400	$2,000	$400	$2,000	$1,200	$6,000
G. Publication Cost/Page Charges		$1,000		$2,500		$5,000	$0	$8,500
H. Computer (ADPE) Costs							$0	$0
I. All other Direct Costs (Attach list of items and dollar amounts. Each subcontract should have a separate budget sheet.)							$0	$0
J. **Total Direct Costs** (C through I)	$8,300	$32,718	$5,400	$32,718	$6,400	$33,542	$20,100	$98,977
K. Indirect Cost/Tuition Reimbursement (Not allowed)								
L. **Total Amount of This Request**	$8,300	$32,718	$5,400	$32,718	$6,400	$33,542	$20,100	$98,977

Monte Vista Co-op

ATTACHEMENT A: USDA/CSREES BUDGET

Colorado State University Cooperative Extension Rick Zink, Ph. D., Extension Potato Specialist	SARE FUNDS 2000	NON-FEDERAL MATCHING 2000	SARE FUNDS 2001	NON-FEDERAL MATCHING 2001	SARE FUNDS 2002	NON-FEDERAL MATCHING 2002	TOTAL SARE	TOTAL MATCHING
A. Salaries and Wages								
1. No. of Senior Associates								
a. ___ (C0)-PI(s)/PD(s)							$0	$0
b. ___ Senior Associates							$0	$0
2. No. of Other Personnel (Non-Faculty)								
a. ___ Research Associates-Postdoctorate							$0	$0
b. ___ Other Professionals							$0	$0
c. ___ Graduate Students							$0	$0
d. ___ Hourly Labor							$0	$0
e. ___ Secretarial-Clerical							$0	$0
f. ___ Technical, Shop, Other (Soil sampling)		$96		$96		$96	$0	$288
Total Salaries and Wages	$0	$96	$0	$96	$0	$96	$0	$288
B. Fringe Benefits (If charged as Direct Costs)							$0	$0
C. Total Salaries, Wages & Fringe Benefits (A + B)	$0	$96	$0	$96	$0	$96	$0	$288
D. Nonexpendable Equipment (Attach supporting data. List items and dollar amounts for each item.)							$0	$0
E. Materials and Supplies (Compost & Appication)	$6,912	$3,823	$6,912	$3,823	$6,912	$3,823	$20,736	$11,469
F. Travel (domestic)							$0	$0
G. Publication Cost/Page Charges							$0	$0
H. Computer (ADPE) Costs							$0	$0
I. All other Direct Costs (Soil microbial foodweb analysis.)	$7,200		$7,200		$7,200		$21,600	$0
J. **Total Direct Costs** (C through I)	$14,112	$3,919	$14,112	$3,919	$14,112	$3,919	$42,336	$11,757
K. Indirect Cost/Tuition Reimbursement (Not allowed)								
L. **Total Amount of This Request**	$14,112	$3,919	$14,112	$3,919	$14,112	$3,919	$42,336	$11,757

V. REFERENCES

[1] Professors Betters, Pellicane, Shuler, and Lynch, *Survey of Western Colorado Wood Industry,* Colorado State University, 1997, p

[2] USDA, Colorado Agricultural Statistics Services, *Colorado Agricultural Statistics 1998. Potatoes: Production and disposition by seasonal group, Colorado, 1987-96.* p 55.

[3] Woods End Laboratory in collaboration with Maine Department of Agriculture, Food and Rural Resources, *Composting Potato Culls and Potato Processing Wastes, A Feasibility Study,* 1990. p. 38

[4] Neal D. Hallee, Ph.D., *Cull Potato Composting,* Bulletin #2415, University of Maine, Cooperative Extension, 1997.

[5] Woods End Laboratory in collaboration with Maine Department of Agriculture, Food and Rural Resources, *Composting Potato Culls and Potato Processing Wastes, A Feasibility Study,* 1990. p. 38

[6] Hoitink,H.A.J., R. Inbar,and M.J. Boehm (1993) *Compost can suppress soil-borne disease in container media.* American Nurseryman. p.178.

[7] Porter, Gregory A., Ph.D., *Cull Potato Compost: 1991-1992 Aroostook Farm Field Trials,* University of Maine.

[8] Westermann, Dale T., *1997 Compost Study*, USDA, Agricultural Research Service, Kimberly, ID.

[9] Nhib, Sable, Mactari, New Mexico State University, *Co-composting Agricultural and Industrial Wastes and Its Application as a Soil Amendment.* December 1997.

[10] Johnson, Richard, Magic Valley Foods, Rupert, ID, *Compost Education & Resources for Western Agriculture - Satellite Broadcast,* January 14, 1999.

ATTACHMENT B

CURRENT AND PENDING SUPPORT

UNITED STATES DEPARTMENT OF AGRICULTURE COOPERATIVE STATE RESEARCH SERVICE

INSTRUCTIONS:

1. Record information for active and pending projects.
2. All current research to which project coordinator(s) and other major participants 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 research which is being considered by, or which will be submitted in the near future to other possible sponsors including other USDA programs.

NAME	SUPPORTING AGENCY AND PROJECT NUMBER	TOTAL $ AMOUNT	EFFECTIVE AND EXPIRATION DATES	% OF TIME COMMITTED	TITLE OF PROJECT
	Current:				
Rick Zink	CPAC*	$16,500	1/99 - 6/00	10%	Late Blight Fungicide Testing
Merl Dillon	CSU-AES 15-9186	$600	10/99 -10/00	3%	Winter Wheat Variety Trial
Merl Dillon	CSU-AES 15-9186	$7,695	10/00 - 10/03	8%	Three-year Alfalfa Variety Trial
Merl Dillon	CPAC 53-8327	$2,500	3/99 - 3/00	5%	Biocontrol Crops to Enhance Potato Production
Merl Dillon	CSU- Coop. Ext.	$1,500	12/98 - 12/99	3%	Encouraging Adoption of Cropflex Irrigation System
A. Thompson	CSU Ag Exp. Station	$17,500	7/99 - 6/00	10 %	Cultural Management & Physiological Factors Affecting Potatoes
A. Thompson	CPAC	$23,550	7/99 - 6/00	20%	Cultural & Physiological Studies
A. Thompson	CPAC	$3,000	7/99 - 6/00	10%	Nitrogen Management Investigations for Advanced Selections
A. Thompson	National Crop Insurance Services	$2,000	5/99 - 4/00	10%	Hail Research
A. Thompson	Hydro Agri	$2,500	7/99 - 6/00	10%	Calcium Nitrate Research
	Pending:				
A. Thompson	USDA-CSREES	$100,000	6/99 - 5/00	30%	Potato Breeding & Cultivar Development in the Southwest

* CPAC = Colorado Potato Administrative Committee