

## CLINTON CLEON SHOCK

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### EMPLOYMENT

<u>Dates</u>	<u>Rank or Position, Institution</u>	<u>Duties</u>	<u>Emphases</u>
1984 - present	Professor & Director (Associate professor '84-'91) Malheur Experiment Station Oregon State Univ., Ontario	Research and administration	Watershed stewardship, drip irrigation, plant nutrition, water quality, erosion control; Soil water sensors. Agronomy of potatoes, onions, poplars, sugar beets, alfalfa, new crops.
1982 - 1984	Assistant Professor Louisiana State Exp. Station Jeanerette, Louisiana	Research	Forage legume introduction, cultural practices, and pasture productivity and management.
1978 - 1982	Research Assistant & Graduate Student University of California, Davis	Research	Pasture and rangeland fertility; sulfur nutrition of forage plants; plant competition for scarce resources.
1978	Acting General Manager IRI Research Institute Brazil	Research and administration	Revegetation of infertile acid Amazon subsoil: specie adaptation for revegetation, soil fertility, practical operations manuals.
1975 - 1978	Manager and Superintendent IRI Experiment Station Matão, São Paulo, Brazil	Research and administration	Collection, identification of 700+ new accessions of grass & legumes. Amazon revegetation research.
1974 - 1975	Manager Coffee farms, Pedro Juan Caballero, Paraguay	Administration	450 hectares coffee & soybeans. Historic July 1975 frost killed coffee trees.
1973 - 1975	Project Leader IRI Research Institute São Paulo Mountains, Brazil	Research	Revegetation of infertile cut & fill subsoil: species adaptation, optimum fertilization, application of mechanical methods.
1972 - 1973	Laboratory Technician & Graduate Student University of California, Davis	Research	Development of laboratory procedures for better estimate of K availability from soils.
1968 - 1972	Extension/Social Missionary United Methodist Church Mato Grosso, Brazil	Extension, Farm Credit, & Coop. Admin.	Access to credit and free markets for homesteaders. Cultural practices of homesteaders' crops.

### EDUCATION

<u>Dates</u>	<u>Degree Earned</u>	<u>Name of Institution</u>	<u>Major Field</u>
1978 -1982	Ph.D.	University of California, Davis	Plant Physiology
1972 -1973	M.S.	University of California, Davis	Horticulture
1962 -1966	B.A.	University of California, Berkeley	Mathematics

## LANGUAGES

Portuguese: reasonably fluent  
Spanish: basic conversational

## TOTAL 1,262 PUBLICATIONS AND REPORTS THROUGH 1 JAN. 2014.

Refereed, 90: *journal articles 81, and book chapters 9*  
Non-refereed journal articles, 19  
Book format, 4: *research reports 1, and guides 3*  
Thesis, 1  
Invited presentations since 1994, 114 (*19 overseas*)  
Abstracts and proceedings, 311: *invited (12 tallied above) plus volunteered international 35, national 164, and regional 112.*  
For growers and other users, 647: *as annual reports 478, growers' proceedings 56, written reports not printed in proceedings 21, extension bulletins 37, adult education reports 2, only on the web 20, and field day presentations since 2009, 24.*  
Consultant reports, 40  
Watershed assessments, 4  
National, regional, and tri-state reports on potato development, 32

## QUICK HIGHLIGHTS

Led local research on environmental issues including erosion control, excessive sediment and nutrient losses in surface water runoff, and groundwater contamination with nitrate and Dacthal breakdown products. Effectively participated in several cooperative team efforts to correct environmental problems. Promoted sustainable agricultural projects and ethics through the Malheur Watershed Council, Owyhee Watershed Council, Northern Malheur County Citizens Groundwater Committee, the Malheur Basin Local Advisory Group (SB1010), Water Quality Interagency Team, and the Snake River TMDL Public Advisory Committee, and others.

Fostered the work of the Malheur Watershed Council and the Owyhee Watershed Council. Participated in watershed assessments in the US and Brazil. Conceived of the Owyhee Field Day to educate 5<sup>th</sup> graders about watersheds. The field day is led and implemented by the Owyhee Watershed Council with many cooperators.

Fostered cooperation of extension agents in SE Oregon and Idaho through the conception and creation of the Pacific Northwest Pest Alert Network. The network is being led by Jerry Neufeld of UI and others.

Demonstrated that onions grown under drip irrigation had improved yield and quality; results widely adopted by growers. Demonstrated reduced N fertilizer inputs with precision drip irrigation. Implemented research

initiatives to extend subsurface drip irrigation research to potatoes, poplars, alfalfa seed, native forb seed production, and long term crop rotations involving various crops.

Conducted research that led to reductions in the potato sugar end problem experienced by Oregon growers. Proved in the 1980's that sugar ends could be reduced by proper irrigation management, adoption of sprinkler irrigation, and the use of tolerant varieties.

Investigated new crops including native wildflower seed production for revegetation of rangeland, asparagus, soybeans, poplars, Hicksii yew for the anti-cancer drug taxol, corn lily for the anti-cancer compound IPI-926 and other pharmaceuticals. Native wildflower seed production seeks to provide seed for areas damaged by fire and infested with invasive weeds. Developed soybean germplasm adapted to the Pacific North West (PNW). Successfully produced organic soy in the PNW.

Planned, installed, and evaluated 1<sup>st</sup> erosion and revegetation research trials in the Amazon basin. Discovered revegetation methods, species adaptation, soil fertility, and critical minimum levels of soil fertility for infertile acid Amazon subsoils. Revegetated areas maintain adequate cover through the present.

Professionally active on editorial boards and as consulting editor, reviewer, and member of regional working groups. Current or past international consulting experience or involvement in Brazil, China, Paraguay, Peru, Senegal, Nigeria, and Venezuela. Demonstrated effective rural credit for small family farms in Brazil that led to credit becoming widely available.

## MEMBERSHIP IN PROFESSIONAL SOCIETIES

American Society of Horticultural Science, 1993 - present. Editorial Board of *HortScience*, 2009-Present. Associate Editor *HortScience*, 2000-2003.

Consulting Editor *HortScience*, 2004-present. Member of the American Society of Horticultural Science publication committee, 2008-9.

American Society of Agronomy, 1981 - present. Chair of Division A-7, 2004-2005.

American Society of Agricultural Engineers, 2000-present.

American Association for the Advancement of Science, 1981 - present.

American Society of Plant Biologists, 1981 - present.

Crop Science Society of America, 1981 - present.

Soil Science Society of America, 1981 - present.

Society for Range Management, 1981 - present.

Sigma Xi Scientific Research Society, 1981 - present.

Potato Association of America, 1986 - present. Physiology Section Director, 2003-2004.

National Onion Association, 1987 - present.

#### UNIVERSITY, SCHOOL, AND DEPARTMENT SERVICE

Oregon Governor's Independent Multidisciplinary Science Team (IMST) member, 2008-2012.

OSU representative to W2128 Microirrigation for sustainable water use, 2000 to present.  
Served as secretary, vice chair, and chair.  
Manage list serve and web site, 2001 to present.

OSU representative to W2008, Biology and management of *Iris yellow spot virus* (IYSV) and thrips in onions, 2007-present.

Malheur Watershed Council, member 1995 – present, Executive Committee, 1997-present.

Owyhee Watershed Council, 2000 – present, active on the education and assessment committees.

Malheur County Soil Water Conservation District  
Strategic Planning Committee, 2006 – present.

Member of Oregon Department of Environmental Quality committee on the Malheur River TMDL, 2006-2010. Participant in the interstate Mid-Snake river TMDL process, 2000 to 2003.

Member Treasure Valley Pest Alert Team, 2000 to present.

Member of Oregon Potato Variety Development Team, 1986 - present.

Member of WR-27 working group on potato variety development, 1997 – present.

NRCS Local Agricultural Practices Working Group committee member 1988 – present.

Citizens Advisory Council, Greenwood Resources (formerly Potlatch) poplar trees plantings and operations at Boardman, OR, 2003 – present.

CAS Administrators, past working groups on Priority Staffing, Water Issues, others.

OSU representative to S-1004, Development and Evaluation of TMDL Planning and Assessment Tools and Processes, 2003-2007.

OSU representative to a DEQ Technical Advisory Committee on Ground Water Contamination. 1989-1995.

Mentor, Apprenticeships in Science and Engineering, 1994-2000.

State Conservation Advisory Committee, Oregon Water Resources Department, 1993 - 1995.

Interagency Water Quality Team, Malheur County, March 1990 - 1998.

Local Advisory Group for the Oregon Department of Agriculture, advisor for the Malheur River Watershed, 1998-present.

Local Advisory Group for the Oregon Department of Agriculture, 2010-present.

#### SERVICE TO THE PROFESSION AND REVIEWS OF PROJECTS AND PAPERS

Editorial Board, *Journal of Integrative Agriculture*, formerly *Agricultural Sciences in China*, 2002 to present. Chinese Academy of Agricultural Science.

Editorial Board, *Scientia Agricultura Sinica*, 2002 to 2011. Chinese Academy of Agricultural Science.

Editorial Board, *Pesquisa Agropecuária Brasileira*, 2008 to present. EMBRAPA (Brazilian governmental agricultural scientific enterprise).

Editorial Board, *HortScience*, 2009-present.

Consulting Editor, *HortScience* 2004 - present.

Associate Editor, *HortScience*, 2000 - 2003.

Publication Committee, American Society of Horticultural Science, 2008 to 2009.

Reviewed papers for *HortScience*, *Agronomy J*, *Crop Science*, *Soil Science*, *J Environmental Quality*, *American Soc. of Agricultural Engineers*, *Am. J. of Potato Research*, *HortTechnology*, *Irrigation Science*, *Agricultural Science in China*, *Agricultural Water Management*, *Brazilian Journal of Agricultural Research*, and others.

Thoroughly revised the instructions in English for authors for the *Brazilian Journal of Agricultural Research (Pesquisa Agropecuária Brasileira)* in 2007.

Assisted Malheur County Officials in writing a successful "Regional Economic Development Strategy" Proposal for \$290,000. 1988. Funding for approximately \$ 1,400,000 through 1998.

Conservation practices evaluation for NRCS, 1988 to present.

Wrote list of practices to protect water quality for Oregon irrigators used by GWEB in writing the Oregon Plan for salmon protection program, 1998.

Edited Malheur-Owyhee Watershed Plan in 1999 and 2000, the Malheur County Groundwater Action Plan, 1991, the review of the groundwater action plan in 2003, and a Washington State TMDL in 2004.

Regularly reviewed project proposals for LISA, ARS, STEEP, SBIR, etc.

Reviewed AES projects from the Departments of Crop Science, Foods and Nutrition, Horticulture, and Entomology and from the branch experiment stations at Klamath Falls, Hermiston, Central Oregon, and Pendleton, 1986 - present.

Reviewed research proposals of faculty in the departments of Crop Science, Soil Science, Foods and Nutrition and Entomology and extension staff for Nampa-Nyssa Sugar Beet Growers, Idaho-Eastern Oregon Onion Growers, and the Oregon Processed Vegetable Commission, 1985 - present.

Reviewed papers prior to submission for University of Idaho, ARS, and OSU faculty and reports of the Oregon Department of Environmental Quality before publication.

Reviewed the Middle Owyhee Assessment, the Lower Owyhee Assessment, and the Upper Owyhee Assessment for the Owyhee Watershed Council, 2006 - 2011.

## SERVICE TO THE COMMUNITY

- Ontario Chamber of Commerce, 1985 - present.
  - Board of Directors 1987 - 1990.
  - Agricultural committee active member.
  - Leader of Ontario team to the Portland Marathon, 1986 - 1988.
- Ontario Development Corporation, 1989 - 1998. (Community development).
- Kiwanis Club, 1982 - present.
  - President, (acting 1983-1984 in Jeanerette, LA), 1989 - 1990 and 1996 - 1997 at Ontario, OR.
  - Board of Directors, 1983 - 1992, 1997 - 1998.
  - Vice President, 1988 - 1989.
  - Chairman of Youth Committee, 1987 - 1988.
  - Chairman of Tree Planting Committee, 1986.
- March of Dimes Walk America, 1985 - 2006.
  - Malheur County Chairman 2002 – 2006.
- Boy Scouts of America, adult leader 1980-present
  - Council Conservation Committee, member, 2010 – present.
  - Recruited cubs, scouts, and adults 1990 - 2009
  - Cubmaster, Pack 400, 1990 - 2007, rebuilt community cub pack.
  - Scoutmaster, Troop 400, 1991 - 2010, founded the community scout troop.
  - District Order of the Arrow Advisor 1987 - 1999.
  - District Camping Promotions Chairman, 1990 - 1993.
  - Asst. Scoutmaster, Troop 421, 1984 - 1989.
  - Organized Order of the Arrow service weekends in the 1980s.
  - Organized dozens of community service projects and four camporees.
  - University of Scouting instructor, 1994 - 1998, 2000 - 2007.
  - Adult staff, National Jamboree Troop 719, 1997
  - Adult staff, Senior Outdoor Leadership Experience (for older youth), 2000.
  - District basic training instructor 1992 - 2009.
- United Methodist Church, 1960 - 2010
  - Trustee, Wesley Foundation, 1962 - 1966.
  - Agricultural and development missionary for rural poor, Mato Grosso, Brazil, 1968 - 1972.
  - Co-Chairman of Outreach Committee, 1985 - 1990.
  - Member of the United Methodist Men - 2010.

## PROFESSIONAL AWARDS

- Onion Hall of Fame, 2012, Idaho-Eastern Oregon Onion Industry.
- William T. Hornaday Gold Medal, 2011, for Distinguished Service to National Conservation, National BSA
- Agriculturalist of the Year, 2010, Ontario Chamber of Commerce
- Appleby Service Award, 2010, Crop and Soil Science Department, Oregon State University.

Distinguished Service Award for Individual Contribution to the Agricultural Industry, 2008, Oregon Department of Agriculture  
 American Society of Agronomy, Division A-7 Innovator Award 2007  
 Briskey Award for Faculty Excellence, College of Agriculture Sciences, Oregon State University, 2003  
 Distinguished Service Award, Oregon Potato Commission, January 2003  
 Distinguished Services Rendered to the ASHS as Associate Editor, HortScience. 2003.  
 American Society of Agronomy Excellence in Educational Materials, Malheur Exp. Station Web Site, 2002  
 Certified Professional Horticulturalist, 2002 to present, American Society of Horticultural Science.  
 Governor's 2001 Spirit of the Oregon Plan Leadership Award (environmental leadership).  
 Educator of the Year, 2001, Ontario Chamber of Commerce.  
 American Society of Agronomy Excellence in Educational Materials, Publications over 16 pages, 2001  
 Hall of Fame 1999, Mentor to Apprenticeships in Science and Engineering by the Saturday Academy.  
 ESCOP/ACOP Leadership Development Program, Cert. of Completion, 1999  
 Outstanding and Dedicated Service, Malheur County Farm Bureau, 1998.  
 Certificate of Appreciation from Treasure Valley Opportunities (handicapped adults) 1986, 1989 and 1990.  
 Centers of Excellence Award, the Carborundum Company, October 1989.  
 FFA citation to Malheur Exp. Station for encouragement, cooperation, and assistance. Ontario FFA Chapter, 1988.  
 Sigma Xi, 1981  
 Regents Graduate Fellowship, University of California, 1979-1982.  
 Earl May Graduate Fellowship, University of California, Davis, 1978-1979.

## TEAM AWARDS

Joint Conservation Project of the Year, March, 2012, awarded by the Forest Service and the Bureau of Land Management to the "Great Basin Native Plant Selection and Increase Project".  
 Tri-State Potato Variety Development Program in partnership with PVMI was recognized in 2010 as an *Outstanding Regional Partnership* by the Far West Region of the Federal Laboratory Consortium for Technology Transfer in recognition for the program's success in variety development and subsequent utilization by the U.S. potato industry.  
 Environmental Achievement Award to the Malheur Water Quality Initiative from Renew America. 1996 and 1997  
 Environmental Progress Award to the Malheur Water Quality Initiative from Renew America. 1992.  
 Troop 400 recognized for 20 years of consecutive months of camping, April, 2011.

## COMMUNITY AND SERVICE ORGANIZATION AWARDS

Hall of Fame, Ore-Ida Council, Boy Scouts of America, 2009  
Arrowman of the Year, Tukarica Lodge, Order of the Arrow, 2006  
Kiwanian of the Year, 2004, Ontario, Oregon  
Kiwanis Recognition for Service, 1998  
Presidential Scoutmaster's Award, 1996.  
Silver Beaver, Boy Scouts of America, 1995.  
Wood Badge Beads, Boy Scouts of America, 1994 (completion and  
implementation of advanced leadership training attended in 1993).  
Scouters' Key, 1994.  
Cubmaster Award, 1993.  
Cub Scouter Award, 1992.  
Scouters' Training Award, 1992.  
Extra Mile Award, Boy Scouts of America, 1988, 1992, 2000.  
District Award of Merit, Boy Scouts of America, 1991.  
75th Anniversary Award, Order of the Arrow, 1991.  
Special Mission Recognition, United Methodist Women. 1991  
Founders Award, Order of the Arrow, 1990.  
Kiwanis Distinguished Service Award, 1983.



## SUMMARY OF PROFESSIONAL ACTIVITIES; SEPTEMBER 2013

**Director and Professor, (1992-present)**, Malheur Experiment Station,  
Ontario, Oregon

### Administration

Administered the Malheur Experiment Station. Responsible for management of station resources, financial planning, budgets, personnel management, research program stimulation, initiation of an OSU research and extension endowment account, and public relations.

Led the research program on environmental issues including erosion control, excessive sediment and nutrient losses in surface water runoff, and groundwater contamination with nitrate and Dacthal breakdown products. Effectively participated in several cooperative team efforts to correct environmental problems in Malheur County. Initiated new research in 2013 to address *E. coli* in irrigation and on onions.

Established capitalization and maintenance priorities. Identified deficiencies and corrected shortcomings in computer systems, irrigation systems, and environmental measurements. Obtained and invested \$1.4 M in capital improvements at the station since 1984, increasing the station's ability to address growers' research needs. Supervised detailed design, bidding and construction of capital improvements.

Wrote many of the station web pages. In 2013 we wrote two websites, one on "sustainable onion production" <http://cropinfo.net/sustainable/pmwiki.php/Onion/SustainableOnionProduction> and the other on "sustainable wildflower seed production" <http://cropinfo.net/sustainable/pmwiki.php/Wildflowers/SustainableWildflowerSeedProduction>. Insured timely web page updates.

Currently serve as Editorial Board member of *HortScience*, *Pesquisa Agropecuária Brasileira*, *Journal of Integrative Agriculture* (formerly *Agricultural Sciences in China*) and *Scientia Agricultura Sinica*. Also serve as Consulting Editor of *HortScience*. Previously served as Associate Editor of *HortScience*. Review many papers for many journals each year.

Actively cooperate in many team activities including 1) Microirrigation for Sustainable Water Use (Western Region Project W2128), 2) Oregon Potato Variety Development Program, 3) The Great Basin Native Plant Project, and 4) Biology and Management of Iris Yellow Spot Virus, Other Diseases, and Thrips in Onions (Western Region Project W2008).

Fostered cooperation of extension agents in SE Oregon and Idaho through the conception and creation of the Pacific Northwest Pest Alert Network. The network is being led by Jerry Neufeld of UI and others.

Demonstrated that onions grown under drip irrigation had improved yield and quality; results widely adopted by growers. Demonstrated reduced N fertilizer inputs with precision drip irrigation. Implemented research initiatives to extend subsurface drip irrigation research to potatoes, poplars, alfalfa seed, native forb seed production, and long term crop rotations involving various crops.

Promoted sustainable agriculture projects and ethics through the Malheur Watershed Council, Owyhee Watershed Council, Northern Malheur County Citizens Groundwater Committee, The Malheur Basin Local Advisory Group (SB1010), The Owyhee Basin Local Advisory Group (SB1010), Water Quality Interagency Team, and the Snake River TMDL Public Advisory Committee.

Built an Internet web site for identification of local vegetation, "Mid-Snake River Watershed Vegetation Database" for public education. Posted original pictures of over 400 species on this site and made it available to the public starting in 2004. Regularly make additions and corrections.

### Research

Obtained \$6 M in support of research and education since 1992.

Conducted research with emphasis in three areas: water quality issues (including soil water measurements), product quality, and new crops.

Soil water measurements using GMS were developed. Calibrations of certain instruments made at the Malheur Experiment Station are providing leadership of this technology world-wide.

The world's first regular working "PhaseAble™" motor was placed in operation at the station, demonstrating the reality of providing highly efficient three-phase motor operation on single phase power.

Water quality research made progress that was effectively implemented by growers. Groundwater quality is improving through voluntary means. Fertilization and irrigation methods were developed that saved growers N costs, protected profitability, and protected groundwater. Natural soil N-mineralization was discovered to contribute more available-N to the soil-plant environment in the Treasure Valley of Oregon and Idaho than previously thought. Growers' N fertilizer costs can be lowered. Environmental N loading to groundwater has been reduced. Erosion control practices with mechanical furrow mulching and polyacrylamide were developed and proven effective.

Increased quality of sugar beets by using soil N-mineralization credits for calculating N requirements. Better beets (more sugar, less conductivity) result from lower N fertilizer inputs. Consequently many growers now

- can use the beet crop in the crop rotation to "sop up" available-N, helping to protect the ground water from nitrate contamination.
- Investigated new crops including asparagus, soybeans as a rotation crop, poplars, native wildflower seed production, Hicksii yew (for the anti-cancer drug taxol), corn lily (*Veratrum californicum*) for anti-cancer precursors, and other pharmaceutical plants.
- Continued grower support trials that include variety and crop quality testing on onions, potatoes, sugar beets, small grains, and alfalfa.
- Demonstrated that onions grown under drip irrigation with irrigation criteria based on soil water tension had improved yield and quality. Work demonstrated that the optimization of N fertilizer inputs results in N application reductions with precision drip irrigation. These results have been adopted by growers on 50% of local acreage and to varying degrees elsewhere in the country.
- Developed and implemented research initiatives to extend subsurface drip irrigation research to potatoes, poplars, alfalfa seed, native wildflower seed production, pharmaceutical crops, and long term crop rotations involving various crops.
- Led the statewide effort to provide growers with real time potato late blight risk predictions for the Klamath Basin, Central Oregon, and the Treasure Valley. The practice was not adopted.
- Participated in the international team assessing the environmental vulnerability of the Baia da Ilha Grande, Rio de Janeiro, Brazil. Evaluated erosion around the Ilha Grande Bay. Developed specific recommendations for decreasing the potential for erosion.
- Provided consulting to correct poor growth of poplar tree plantations in the states of Parana and Santa Catarina (Brazil), to improve irrigation of sugar cane in Senegal, implement drip irrigation on potatoes in Inner Mongolia (China), develop cultivation practices for *Stevia rebaudiana* as a source of natural non-caloric sweeteners (US), and develop California Yerba Santa (*Eriodictyon californicum*) as a cultivated source of antioxidants (US).
- Evaluated long term Brazilian Amazon revegetation research in 2013 that was we started in 1975 and 1976.

**Associate Professor and Superintendent (1984-1991)**, Malheur Experiment Station, Ontario, Oregon.

Administration

Administered the Malheur Experiment Station. Was responsible for management of station resources, financial planning, budgets, personnel management, research program stimulation, and public relations.

Instituted long term crop rotation plan, increased special sponsored events at the station, and enhanced station relations with community organizations and news and trade journals.

Established capitalization and maintenance priorities. Identified deficiencies and corrected shortcomings in word processing, data analysis, irrigation systems, harvesting, product handling, storage, laboratory, and environmental condition measuring equipment.

Obtained \$ 500,000 for capital improvements at the station, increasing the station's ability to address growers' research needs. Supervised detailed design, bidding and construction of capital improvements.

Research

Conducted research with emphasis in three areas: product quality, water stress, and new crops.

Conducted research that led to reductions in the potato sugar end problem experienced by Oregon growers. Proved in the 1980's that sugar ends could be reduced by proper irrigation management, adoption of sprinkler irrigation, and the use of tolerant varieties. Growers could improve potato tuber quality by adopting sprinkler irrigation, delaying the onset of irrigation, and avoiding water stress coincident with heat stress any time from mid-June through mid-August.

Optimized onion population densities to maximize yield of jumbo and colossal sized onions. Simulated onion export exploring ways to improve quality of onion "arrival" at export markets.

Experimental changes increased sugar beet N plant response.

Found crop water stress index (CWSI) negatively related to potato quality and market value. Alfalfa seed yield positively related to CWSI. Using CWSI irrigation criteria can conserve 35 to 53 percent of irrigation water. Watermark soil moisture sensors proved valuable soil water monitoring devices.

**Assistant Professor (1982-1984)**, Louisiana State Experiment Station, Jeanerette, Louisiana.

Worked on forage legume introduction, cultural practices, and productivity.

Participated in a consulting mission with the IRI Research Institute to the Alto Huallaga region of Peru to examine pasture productivity and potential. Economic alternatives were needed since this is in the heart of the coca growing region.

**Research Assistant and Graduate Student (1978-1982)**, University of California, Davis California.

Worked on pasture and range land fertility with special emphasis on sulfur nutrition of forage plants in California.

Conducted preliminary cultivation trials of *Stevia rebaudiana* as a source of natural non-caloric sweeteners in California.

Participated in two consulting missions with the IRI Research Institute to the semi-arid Chaco in Paraguay for the United Nations Development Project in Paraguay. Introduced diversified forage species to the Paraguayan Chaco and sought more productive strains of forage and better means of utilization, establishment, and maintenance.

Collected heat resistant strains of *Azolla* in Paraguay for nitrogen fixation for use rice paddies.

**Acting General Manager for Brazil (1978)**, IRI Research Institute, Matão, São Paulo, Brazil.

Supervised all research and administrative work of the institute in Brazil with a staff of 60 employees.

Led a consulting mission from IRI to Paraguay for the United Nations Development Project to evaluate the economic and agronomic viability for colonization in the Chaco. Evaluated pasture and cattle productivity and developed a program of experimentation installed and managed by the UNDP at La Patria in the Chaco.

Directed final research report on revegetation of infertile acid Amazon subsoils. Wrote section on specie adaptation, soil fertility, and critical minimum levels of soil fertility. Guided publication of a practical operations manual for the revegetation of disturbed sites in the Amazon. Practices provided adequate cover and controlled erosion.

**Manager and Superintendent (1975-1978)**, Experimental Farm and Training Center, IRI Research Institute, Matão, São Paulo, Brazil.

Administered the experimental farm. Supervised all commercial seed production activities and training courses with a staff of over 20 personnel on 52 hectares.

Organized and supervised the collection and identification of over 700 new accessions for IRI's grass and legume collection to contain 2600 accessions. Directed evaluation of collection for forage and revegetation research.

Planned, installed, and evaluated erosion and revegetation research trials in the Amazon basin. Discovered revegetation methods, specie adaptation, soil fertility, and critical minimum levels of soil fertility for infertile acid Amazon subsoils. Revegetated areas remain with adequate cover through the present.

Initiated, planned and directed all experiments including selection of three soybean cultivars for commercial seed production, evaluation of *Centrosema* cultivars for low fertility soils, and collection, classification and testing of the persistent, rapid-establishing species *Homolepsis aturensis* as one of the most promising grasses for roadside revegetation on high aluminum, low fertility Amazon subsoils.

Characterized previously ill-defined soil structure and fertility problems and implemented corrective measures on the experimental farm, turning 20 hectares of formerly marginal into productive land.

Directed and helped teach courses in beef production and agricultural statistics.

Advised ranchers and farmers as to the most suitable forages for their areas and the correction of soil nutrient deficiencies.

Evaluated pasture potential in the derived guinea savanna of Nigeria as a short term consultant. Developed specific recommendations for making unproductive land highly efficient improved pasture. Consulted for projects in Venezuela, Paraguay and Brazil.

**Self-employed (1974-1975), Pedro Juan Caballero, Paraguay.**

Administered over 450 hectares of coffee and soybeans. The historic July 1975 frost killed the coffee trees.

Conducted preliminary cultivation trials of *Stevia rebaudiana* as a source of natural non-caloric sweeteners.

**Project Leader (1973-1975), IRI Research Institute, IRI-DERSA Roadside Revegetation Project, São Paulo - Santos Immigrants' Highway, São Paulo, SP, Brazil.**

Developed cost-effective cultural, fertilization, and planting practices for revegetation of infertile subsoil on cut and fill slopes in the Atlantic Coastal forest ("Serra do Mar"), including selection of cultivars, determination of optimum fertilization, and adaptation of mechanical

methods to Brazilian conditions and equipment. Practices provided adequate cover and controlled erosion. Revegetated areas remain with adequate cover through the present, evolving into coastal rain forest.

Collected, classified and evaluated native grasses and legumes.

Principal author of the first comprehensive roadside revegetation and erosion control manual written in Brazil.

**Laboratory Technician (1972-1973)**, Soil Chemistry Laboratory, Department of Pomology, University of California, Davis, California.

Part-time research on soil cation relationships during M.S. degree study.

Examined the K nutrition of tree fruit crops and differential ability of soils to supply K. Repeated extraction of K from soils demonstrated that some soils are apparently poor suppliers of K, but in fact have substantial K supplying ability.

**Agricultural Extension Agent (1968-1972)**, Glória de Dourados, Mato Grosso do Sul, Brazil, under the auspices of the Board of Missions of the United Methodist Church, New York, NY.

Wrote plans for and administered crop production loans for farmers as part of a cooperative rural credit program. This program demonstrated that poor farmers would repay loans, helping to facilitate the expansion of free market farming and modern bank loans into a region previously controlled by middlemen who had charged exorbitant prices, paid poorly for growers' commodities, and charged monthly interest rates of 10 to 12 percent per month. The demonstrated effective rural credit for small family farms became widely adopted in southern Mato Grosso.

Advised the local agricultural cooperative with respect to obtaining fertilizer, lime, and pesticide inputs for less and selling of its produce for more.

Introduced cultural and fertilization practices and improvements to farmers on small farms growing cotton, peanuts, upland rice, corn, soybeans, coffee, dry beans, and home garden and orchard crops resulting in increased crop yields.

Introduced and tested 300 cultivars of various crops and vegetables for adaptation to the local climate. One rice cultivar replaced all other cultivars' acreage within three years of the original introduction.

## **Impact of the programs of Clint Shock and cooperating colleagues**

### **I. Research accomplishments toward greater production, stronger competitive position, and sustainable practices**

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### **II. Effective communication**

- A. Research – Extension – Grower interaction ..... p 31**
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- D. Internet services on production practices ..... p 35**



## **I. A. Enhanced crop adaptation, productivity, and quality**

**Problem:** It is essential that growers have knowledge of and access to the best plant cultivars of key local products: onions, sugarbeets, and other crops. For growers to remain competitive, cultivars must be both productive and of high quality.

**Place and time:** Treasure Valley, 1942-present.

**Visualized solutions.** By cooperating with growers' associations and breeding programs, support for annual cultivar evaluations can be obtained. By testing plant materials using feasible moderate input production methods, experimental results should be immediately applicable by growers.

**Testing or demonstrations:** Variety evaluations are ongoing for alfalfa, small grains, sugar beets, and onions. Trials look carefully at quality parameters and disease resistance for all of these crops, as well as onion storability after harvest. The aim is to find those varieties most suited to Treasure Valley conditions. Onion growers in Oregon and Idaho along with the seed companies support cultivar trials that evaluate onions for yield, grade, appearance, internal quality, and storability. Onion varieties are rated for single centers (better raw materials for onion rings) and resistance to iris yellow spot virus.

Sugar beet grower associations in Idaho and Oregon and the seed marketing companies fund commercial and experimental sugar beet variety trials. Sugar beet varieties are evaluated for beet yield, sucrose content, pulp conductivity, pulp nitrate and varietal response to nitrogen rates, sugar yield per acre, and resistance to curly-top virus and rhizomania.

Similar trials are conducted for alfalfa and small grains. Varietal results for all these crops are distributed to growers in handouts and publications, as well as being posted on the internet.

**Outcomes:** Growers have rapidly adopted new cultivars of onions and sugarbeets, completely replacing older cultivars several times. The yield per acre and quality of crops grown in the Treasure Valley has continued to increase, while the inputs per acre of fertilizer, water, and labor have declined or stayed nearly the same.

**I. B. Elimination of Dacthal use and reduction in leaching of Dacthal residues to groundwater**

**Problem:** Groundwater in northeastern Malheur County had become contaminated with DCPA residues of the herbicide Dacthal used for onion production.

**Place and time:** Malheur County, Oregon 1985-2001.

**Visualized solution:** Find effective herbicides for onion production that are less costly and leave no residues that can pollute groundwater.

**Testing or demonstrations:** Weed control options were evaluated using less expensive products that could provide effective weed control led by Charles Stanger. The movement of Dacthal residues was measured in runoff and leachate led by Clint Shock.

**Outcomes:** Growers adopted alternative products for weed control in onion and the use of Dacthal was dropped voluntarily. Production costs to growers declined. Dacthal residues in northeastern Malheur County groundwater have subsequently declined by over two thirds.

### **I. C. Rational N Fertilization and the reduction in leaching of nitrate**

**Problem:** Groundwater in northeastern Malheur County had become contaminated with nitrate from crop production. Groundwater DCPA residues (discussed in the Elimination of Dacthal above) were highly correlated with groundwater nitrate contamination suggesting that a substantial part of the nitrate contamination was derived from onion production.

**Place and time:** Malheur County, Oregon, and surrounding areas, 1985-present.

**Visualized solutions:** We sought options where growers could choose how to make N fertilizer use more efficient. An important intent was to place greater emphasis on tissue testing to avoid heavy blanket fertilizer applications to assure yields, especially fall N fertilizations. We needed to develop more efficient irrigation and N fertilization alternatives so that crop yield and quality were improved while inputs were used more efficiently. As in the problems of surface erosion, better irrigation methods were needed to reduce nitrate leaching.

**Testing and demonstrations:** Many nitrogen fertilization options were tested on onions, potatoes, wheat, and sugar beets. Nitrogen rates could be reduced for furrow- and drip-irrigated onion. Nitrogen rates were tested for furrow- and sprinkler-irrigated potato. Drip, sprinkler and furrow irrigation were compared for onion and potato production as discussed below in “Reduction in irrigation-induced erosion and sediment loss to surface water”. Forty commercial fields were used for multiple demonstration strips with different reduced N fertilizer inputs, including zero applied nitrogen. Sugarbeets followed various rotation crops with different N fertilizer regimes and were evaluated for yield, sugar content, nitrate, total N and the leaves were evaluated for N content and soil was evaluated for available N at harvest and N mineralization.

**Outcomes:** Growers modified N fertilizer practices using less N and more efficient N timing. Growers have greatly reduced fall N applications, applications that proved to be of low efficiency and greatly subject to leaching losses. Growers have adopted split N applications during the growing season to get more efficient use of N.

We demonstrated that onions grown under drip irrigation with precise irrigation scheduling (discussed in Irrigation Scheduling below) had improved yield and quality with lower inputs of water and N fertilizer, hence lower chemical input costs and lower potential for N leaching. Onion drip irrigation combined with precise irrigation scheduling and reduced N fertilizer use has been widely adopted by growers locally and in other production regions. Many growers are substituting sprinkler irrigation for surface furrow irrigation on crops other than onion. Groundwater nitrate contamination has decreased and continues to decrease.

#### **I. D. Irrigation scheduling**

**Problem:** Imprecise irrigation has substantial economic and environmental consequences. Over-irrigation and excessively frequent irrigation wastes water, labor, and energy. Over-irrigation can favor disease and can also result in nutrient leaching and surface water contamination. Deficient irrigation often results in losses of crop yield and crop quality. Precision irrigation scheduling is needed to optimize production under the constraint of minimal environmental impact.

**Place and time:** Malheur County and beyond world wide, 1985-present.

**Visualized solutions:** We thought that soil moisture sensors could help growers to better schedule irrigation to avoid early irrigation (and unnecessary waste) yet achieve ideal crop yield and quality. We seek irrigation criteria to optimize productivity and quality by minimizing plant stress according to each plant species' needs. We sought to evaluate and calibrate soil moisture sensors so that these sensors could be used by growers as effective tools for irrigation scheduling.

**Testing and demonstrations:** Extensive field evaluations were conducted with over a dozen types of soil moisture sensors. Tensiometers and neutron probe data were calibrated against other types of devices that might be more amenable to use on family farms. Readings of soil water potential and soil temperature were made for Watermark soil moisture sensor resistance. New meter designs were suggested to manufacturers and new Watermark models were also tested and calibrated.

Research determined the optimal soil water potential readings for sprinkler-irrigated potato, furrow-irrigated potato and onion, and drip-irrigated onion and poplar trees. Irrigation scheduling demonstration plots were established in dozens of growers' fields.

**Outcomes.** Many growers avoided unnecessarily frequent irrigations, saving soil, water, and unnecessary contamination. The use of soil water tension (SWT) criteria for irrigation scheduling expanded. Potato quality improved and sugar-ends could be reduced by 60 to 70% just through irrigation scheduling. US number one tuber yield increased with wetter irrigation criteria. With drip irrigation, criteria wetter than 30 cb provided no additional benefit. Small irrigation scheduling errors on onions with 3-6 leaves were avoided, resulting in most bulbs having single centers. Onion yield and quality was increased as the SWT irrigation criteria approached 20cb. Irrigation at 12 cb resulted in greater bulb decomposition in storage. Poplar tree growth increased as the SWT irrigation criteria approached 25cb.

### **I. E. Reduction in irrigation-induced erosion and sediment loss to surface water**

**Problem:** The rate of soil loss from surface furrow irrigation in northeastern Malheur County is high. Irrigation-induced erosion is contaminating surface water with sediment, *E. coli*, and phosphorus.

**Place and time:** Malheur County, Oregon, 1985-present.

**Visualized solutions:** Find irrigation methods and other cultural practices to reduce irrigation-induced erosion. Since the predominant surface furrow irrigation methods make inefficient use of water and fertilizer, more efficient irrigation practices are needed to protect surface water, improve crop yield and quality, and improve input utilization.

**Testing or demonstrations:** Drip, sprinkler and furrow irrigation were compared for onion and potato production. Many trials tested polyacrylamide (PAM), straw mulch, and surge irrigation to reduce soil and bacteria losses. Many partners helped make the trials successful. Demonstrations of filter strips, sedimentation ponds, and minimum tillage have been conducted. Most recently strip tillage was tested on 4 grower fields during two consecutive years.

**Outcomes:** We demonstrated that onions grown under drip irrigation had improved yield and quality with lower inputs of water and N fertilizer, hence lower chemical input costs. Results of onion trials have been widely adopted by growers locally and in other production regions. Many growers are substituting sprinkler irrigation for surface furrow irrigation on crops other than onion. Groundwater nitrate contamination is decreasing in northeast Malheur County. Growers have adopted sprinkler irrigation systems, PAM, sedimentation ponds, and pump-back systems to reduce sediment, bacteria, and phosphorus losses to streams and reservoirs. Straw mulch and PAM substantially reduced irrigation-induced erosion by 90 to 95 percent. Growers are joining together to replace open canals and drain ditches and construct large piping projects to make sprinkler irrigation system conversions feasible. A number of growers have adopted no till and strip tillage practices.

## **I. F. Potato “sugar-end syndrome” and water stress**

**Problem:** Potatoes produced in many Pacific Northwest locations were of inadequate quality to meet processors needs due to the “sugar-end syndrome” that caused fried tuber strips to turn black at the “sugar” end of the tuber.

**Place and time:** Pacific Northwest, 1984-1990.

**Visualized solutions:** By carefully managing irrigation and measuring soil moisture, it should be possible to reduce the water stress suffered by potato, hence reduce the expression of sugar ends. It might be possible to do a better job of irrigating potato - -- even with less water --- by conversion of irrigation systems from surface furrow irrigation to sprinkler irrigation.

**Testing or demonstrations:** We conducted research to determine the point of soil moisture that was the threshold for the development of sugar ends, evaluated devices to monitor soil moisture, evaluated variety susceptibility to the syndrome, and compared potato performance under different irrigation systems. Demonstrations of sprinkler vs furrow irrigation and irrigation scheduling were conducted in dozens of growers’ fields.

**Outcomes:** Growers adopted irrigation techniques and new varieties less subject to sugar-ends. Acres lost to Oregon growers with poor raw materials were regained as producers made better use of irrigation scheduling and adopted sprinkler irrigation. Less total water was used in producing a better quality crop with sprinkler irrigation. Potato varieties relatively tolerant to sugar ends were identified and eventually adopted by potato processors. Less water was lost to runoff from sprinkler-irrigated fields and N fertilizer use was improved.

## **I. G. IPM Strategies for thrips and iris yellow spot virus (IYSV) control in onions**

**Problem:** Onion thrips developed resistance to commonly used insecticides. Insecticides available were extremely harmful to beneficial insects. Iris yellow spot virus (IYSV), which is vectored by onion thrips, along with increasing thrips damage is causing severe economic pressure to growers.

**Place and time:** Pacific Northwest, 1990-present.

**Visualized solutions:** Develop a more sustainable approach to controlling thrips which would include 'soft' chemistries with more choices for modes of action. Utilize naturally occurring predators to enhance insecticide control. We want to have several insecticides, each with different modes of action, available for growers to be able to rotate, thus reducing the risk of resistance. We want to manage onion environmental stress factors, such as soil moisture, soil temperature, and plant N status, that might be related to IYSV disease expression. Also onion varieties might have differing susceptibility to IYSV.

**Testing or demonstrations:** In cooperation with onion growers, Lynn Jensen conducted efficacy tests with Clint Shock's cooperation to screen potential insecticides for their ability to control thrips. Soft chemistries have been screened for safety towards predators and effectiveness in controlling thrips. Insecticide efficacy and rotation trials have been conducted to determine if 'soft' chemistries might leave beneficial insects to supplement control.

Support has come from industry, growers, government and Oregon State University. Trials have been conducted, both on station, and in grower fields to identify those insecticides, insecticide rotation and cultural practices which reduce thrips and IYSV. Clint Shock examined the effects of irrigation criteria and irrigation systems on soil temperature, IYSV infection, and IYSV symptoms. Onion varieties might vary in their responses to IYSV.

**Outcomes:** Two relatively 'soft' insecticides have been identified which promote beneficial insect populations. Spinosad was first identified and a label developed, followed by the insecticides spinetoram and spirotetranat. Growers now have three insecticides with different modes of action to choose from, with two of them classified as 'soft' on beneficial insects. These have been adopted and successfully used by growers to control IYSV and its vector, onion thrips.

We discovered that in the presence of IYSV, onions irrigated with criteria wetter than 30 cb show less disease expression and suffer less yield losses. We determined that half a dozen onion cultivars have significantly greater IYSV tolerance than the leading commercial cultivar, Vaquero. Growers are using these findings to reduce the financial losses to thrips and IYSV.

**I. H.1. Alternate crops: Seed production technology of native plants.**

**Problem:** Following fire in the Great Basin, nonnative species tend to invade many burned areas. Burned areas are being replanted largely with nonnative grass species. There is increasing interest by the public, BLM, and the US Forest Service to replant burned areas with native mixtures of grass, wildflowers, and shrubs. Although native forbs (wildflowers) are components of most native communities, their use in re-vegetation has been limited, largely due to inadequate seed supplies.

**Place and time:** Great Basin of the western US, 2005-present.

**Visualized solution:** Develop seed production practices and seeding technology of key native forb species for revegetation. Develop information so that growers will know how to plant, control weeds and pests, irrigate only as necessary, harvest, and clean seed of key forb species.

**Testing or demonstrations:** Current research in cooperation with US Forest Service and BLM through the “Great Basin Native Plant Selection and Increase Project” seeks to help develop seed production technology focused on weed control, irrigation, and stand establishment. We are also mechanizing other operations such as direct planting of seed, harvest, and seed cleaning when possible.

**Outcomes:** Results are being shared with other researchers and growers through reports, tours, and our web site. Excellent seed yield can be obtained. Very little irrigation water is needed for maximum seed yield. Irrigation water requirements for consistent seed yields are only 100 to 200 mm, with some species not needing irrigation at all. Deep placement of the drip irrigation tape saves water and discourages weed emergence. Several herbicides have proven to be effective to control most weeds. Forb species that were considered difficult to establish for seed production have been successfully established using systems that include row cover, rodent control, and other factors.



## **I. H. 2. Soybeans as an alternate crop**

**Problem:** The Pacific Northwest has few supplies of high protein supplements for dairy cattle on organic feeding regimes and few local sources of high quality food grade soybean products.

**Place and time:** Pacific Northwest, 1987 to present

**Visualized solution:** Transform soybeans through breeding and selection so that non-GMO soybeans would become a crop adapted to Oregon. Breed and select soybeans for the ability to fill pods in cold weather and for decreased stature and lodging, reduced seed shatter, and increased harvest index. Select individual plants for light seed color, large size beans, and light colored hilum to increase their suitability for food products.

**Testing and demonstrations:** Plant materials with the desirable traits described above were identified through trials at the Malheur Experiment Station. These lines are crossed, selected, and subjected to production trials. Field demonstrations have been conducted by growers.

**Outcomes.** Growers have achieved yields in the range of 55 to 68 bu/ac. Four OSU Malheur Experiment Station lines are ready for release. Soybean production is expanding and seed producers are starting to provide our high quality materials to other growers.

### **I. H. 3. Corn lily (*Veratrum californicum*) as an alternate crop**

**Problem:** Human cancer can be avoided to some extent by a healthy life style. Once an individual has cancer the approaches to curing the disease are surgery, radiation, and chemotherapy. An alternative approach would be to find a way to prevent or retard the formation of new tissue systems. Some plants affect the population of their herbivores through suppressing tissue formation in developing fetuses. Corn lily, a native plant of the Pacific Northwest has such activity where the hedgehog pathway is suppressed. Some cancers over express the hedgehog pathway. Cyclopamine from corn lily is being used as a precursor to manufacture IPI-926 currently in limited skin cancer trials. No sustainable source of corn lily with high pharmaceutical precursor content is known. Previous experiments have shown that corn lily is difficult to grow. Information on successful cultivation practices is non-existent.

**Place and time:** Pacific Northwest, 2009 to present

**Visualized solution:** Discover plant lines rich in pharmaceutical precursors. Understand the ecological niche of corn lily in its natural environment. Discover ways to propagate corn lily by transplanting and direct seeding. Initiate studies to understand the complex physiology of corn lily and how it responds to the environment. Develop cultural practices for cultivation including planting, irrigation, cultivation, pest protection, and harvest.

**Testing and demonstrations:** Selections of corn lily with high cyclopamine content and productivity are being sought in the wild. In 2010-2012 we conducted a full array of 22 experiments in four states to begin uncovering this plant's native environment and the cultural practices necessary for its cultivation.

**Outcomes.** We have discovered a limited number of corn lily clumps with very high levels of cyclopamine. We have developed methods to successfully start corn lily from seed and transplants. Methods were developed to reliably establish plant stands both from seeds and transplants. The soil moisture and irrigation requirements for corn lily production were determined. One plant growth regulator was shown to stimulate flowering and vegetative reproduction. Fourteen parts of the early research have been reported, six of which are available among the publications on the station web site at [www.cropinfo.net](http://www.cropinfo.net). Two aspects were published in a MS thesis in 2013.

## **I. I. Year-round marketing of onion**

**Problem:** While onions are a major source of Treasure Valley income, onions are not available for sale all year from local production. Increasingly processors and retailers require year-round supplies.

**Place and time:** Treasure Valley 2000 to present.

**Visualized solutions:** Onions could be marketed out of prolonged storage through better storage conditions and cultivars adapted to very long term storage. Onions grown from transplants or sets might be harvested earlier in the summer.

**Testing or demonstrations.** Onion bulb crops have been grown from transplants and sets. Transplants were grown under various environmental conditions. Sets were grown and stored under various storage conditions prior to planting. Onions have been subjected to long term storage.

**Outcomes.** Onions can be harvested up to three weeks early from transplants and up to five weeks early from sets. Sets of certain long-day onion cultivars were successfully grown and the sets grew into excellent bulbs, in spite of conventional wisdom that said that long-day onion sets could not be grown. Several cultivars, including Crocket have excellent long term storage.

## **I. J. Aiding the development of new potato varieties**

**Problem:** As of 1985, Russet Burbank was the predominate potato variety in the Pacific Northwest. Russet Burbank stored well but was poorly matched to the environment. Varieties were needed to better meet processing demands and attend fresh market opportunities.

**Place and time:** Pacific Northwest, 1985-present.

**Visualized solution:** Malheur Experiment Station would help visualize solutions and cooperate with potato breeders, agronomists, and pathologists to breed and select new varieties.

**Testing or demonstrations:** The Oregon varietal development team, with active programs at three OSU branch experiment stations and in Corvallis, develops improved potato varieties, including typical russet types with high levels of starch, low reducing sugars, and good fry color for the frozen processing industry; round-white chipping types; and fresh market varieties. Developing varieties with pest and disease resistance is an important aspect.

Oregon crosses currently emphasize virus and late blight resistance and gourmet specialty types including colored-flesh clones. Some 30,000 clones from Oregon crosses are produced and field tested annually. Growers and processors are strongly encouraged to attend all field trials and planning meetings and to actively pursue marketing rights to Oregon clones approaching release.

**Outcomes:** Oregon's OSU team in cooperation with colleagues from ARS, WSU, and UI have released 21 varieties during the last ten years (Century Russet, Russet Legend, Umatilla Russet, Klamath Russet, Wallowa Russet, Mazama, Winema, Modoc, Willamette, Premier Russet, Highland Russet, Yukon Gem, Classic Russet, Clearwater Russet, Alpine Russet, Galatin Russet, A84180-8, Red Sunset, Crimson Red, Purple Pelisse, AmaRosa, Owyhee Russet, and Yukon Nugget). Additional releases are in the works.

Umatilla Russet, released in 1998, is now among the top 10 U.S. varieties by acreage. Umatilla Russet is grown in more than 10 Oregon counties because of its outstanding processing potential under a wide range of conditions. Wallowa Russet, released in 2001, appears to have even better processing potential than Umatilla but is somewhat more susceptible to late blight tuber decay. Many other promising clones are currently under evaluation in statewide, tri-state and western regional trials.

### **I. K. Amazon revegetation**

**Problem:** Disturbed vegetation along roads and construction sites in the Amazon were resulting in radical erosion with no spontaneous healing. These opening sores in the landscape were easily caused since in many areas the soil is very shallow and the subsoil is highly acid and infertile.

**Place and time:** Amazon, Brazil, 1975-1978

**Visualized solution:** Vigorous vegetation could stop erosion and legumes could help provide nitrogen on a regular basis to help stimulate new sod and soil formation.

**Testing or demonstrations:** Species were tested for effectiveness of revegetation (individually and in mixtures). Essential nutrient corrections and planting methods were determined. We needed to discover tropical legumes capable of fixing nitrogen and growing vigorously in very acid, infertile soils to provide a continuous nitrogen supply.

**Outcomes:** Species were discovered that grew well including legumes that had not been previously used in tropical agriculture. Vigorous vegetation was established and this vegetation has evolved through the present towards a natural native composition. Research reports and a practical manual were written, allowing wide knowledge of effective practices. Many legume collections were made and shared with germplasm banks in Brasilia and elsewhere.

Detailed observations of natural plant succession, soil formation, and soil retention were made in 2013 confirming the early successes. New journal articles are being prepared.

### **I. L. Revegetation in the Atlantic Forest of Brazil**

**Problem:** Clearing of land in the tropical Atlantic rain forests of Brazil was resulting in vast losses of soil due to erosion and landslides.

**Place and time:** Serra do Mar, Brazil, 1972-1975

**Visualized solution:** Vigorous vegetation could stop erosion and roots could bind the soil together,

**Testing or demonstrations:** Species were tested for effectiveness of revegetation (individually and in mixtures). Essential nutrient corrections and planting methods were determined.

**Outcomes:** Species were discovered that grew well. Vigorous vegetation was established on unstable slopes. This vegetation has evolved through the present toward a natural native composition. Research reports and a practical manual were written. Commercial operators implemented solutions on a large scale.

**I. M. Ending the cycle of poverty among some of the rural poor in Mato Grosso do Sul, Brazil**

**Problem:** Homesteaders in the interior of Brazil were prisoners to a cycle of poverty. They had no access to a free economy due to high interest rates paid to middlemen.

**Place and time:** Southern Mato Grosso, Brazil, 1968-1972

**Visualized solution:** Bring in modern banking institutions and use the homestead as collateral to help finance operations.

**Testing or demonstrations:** Developed farm plans for 52 individual poor farm families out of many thousands. Used NGO funds to deliver resources to the families at modern lending institution rates through an existing but previously non functional poor farmer's cooperative. Accounts were 100% paid over two consecutive years.

**Outcome:** The selected farm families became more prosperous and escaped abject poverty. Modern banking credit replaced exploitive credit as government representatives and national banking institutions observed the results and served over a thousand homesteaders in the third year. Money lenders mostly converted their businesses to become suppliers and representatives.

## **II. A. Effective communication: Research – Extension – Grower interaction**

**Problem:** Effectively communicate research results and stewardship information to growers and the public. There was a time 25 years ago when extension and experiment station personnel did not have a close relationship, and the programs were seen as separate and unrelated organizations.

**Place and time:** Malheur County, 1984 to the present.

**Visualized solution:** The Experiment Station researcher and the extension educator would have a shared vision of the needs of the agricultural industry. Clientele would view the programs as one single program that promotes their welfare through seamless research and education.

**Testing or demonstrations:** Extension agents developed areas of expertise along with extension efforts and researchers have developed extension activities.

**Outcomes:** Most growers view extension and experiment station personnel as part of Oregon State University, with high value placed on the information provided. The Malheur County community approved a tax service district via referendum in 2012 to support OSU research and extension.

## **II. B. Effective communication: Cooperation with watershed partners; projects and education**

**Problem:** The community needs to have a sound understanding of watershed stewardship and sustainable irrigation and land use practices. The community needs cooperative action to address many watershed stewardship issues including irrigation efficiency, irrigation-induced erosion, contaminated surface and ground water, invasive weeds, etc. Youth in our schools need to develop objective knowledge about watersheds, avoiding the adoption of extreme unbalanced views.

**Place and time:** Malheur County, Oregon, 1989-present

**Visualized solution:** Help foster the formation and growth of watershed councils and other associated groups. Conduct research and education programs promoting watershed health complementary to watershed councils' efforts. Build aspects of watershed internet services that provide access to information to educate the public on valuable plants, invasive weeds, and locally adapted technology. Provide a "hands on" experience to all 5th graders in the county (and some surrounding cities) so that they have a notion of the complexities of watersheds.

**Testing or demonstrations:** Provided and continue to provide technical advice to local leaders when possible. We conducted demonstrations of improved irrigation practices with reduced erosion. A database was established on the Internet that has thousands of pictures of the vegetation of local watersheds, as well as pictures of outstanding geological/geographic sites of Malheur County. The vegetation database has a special search function so that the public can find the plant of interest using fragmentary information about the plant's name or appearance. See <http://www.malag.aes.oregonstate.edu/wildflowers/>.

With the Owyhee Watershed Council acting as the lead, we initiated annual "Owyhee Watershed 5th Grade Field Days" incorporating water quality, irrigation, aquifers, crop production, energy, energy conservation, range management, fire, wildlife, wild horses, erosion, soils, cattle nutrition, noxious weeds, geology, rafting, etc. The purpose of this field day is to provide a fun, hands-on way for students to learn about the watershed in which they live. Watershed Internet services include a virtual "Owyhee Field Day" for fifth graders. See <http://www.cropinfo.net/owyheefieldday.htm>.

**Outcomes:** The Malheur-Owyhee Watershed Council developed effective restoration projects and spawned the Malheur Watershed Council, the Lower Willow Creek Working Group in association with the Malheur Watershed Council, the Owyhee



Watershed Council, and the Jordan Creek weed management area in association with the Owyhee Watershed Council. All four groups actively involve growers and ranchers in numerous watershed restoration and improvement projects each year. Substantial irrigated lands in the county are being transformed with modern, efficient irrigation systems largely eliminating irrigation induced erosion, the loss of soil, and the contamination of surface water from the newly developed areas.

About 600-700 students participate each year in the Owyhee Watershed 5th Grade Field Day, with each group of 15 students guided by an FFA student as a behavior role model. The field day experience provides students with an introductory conceptual framework of watershed factors and interactions.

In 2009 the Owyhee Watershed Council started sponsoring an annual Hydrology Camp to interest high school students in watershed science.

Seven local residents working within these watershed groups have received honors from the Oregon governor for environmental leadership during the past decade.

## **II. C. Effective Communication: PNW Crop Alert Network**

**Problem:** There are insufficient extension agents to attend all the local crop production needs in each county, since many different crops are produced over diverse landscapes in the Pacific Northwest.

**Place and time:** To begin with, the Treasure Valley of Oregon and Idaho, 2000-present.

**Visualized solution:** Develop a cooperative network to expand the ability of extension agents to reach wide audiences through an interactive Internet program. Build a Treasure Valley Pest Alert Network and later a Pacific Northwest Pest Alert Network to communicate production problems rapidly among diverse clientele when the problem first appears. Send out email alerts tailored to each producer's or stakeholder's interest and link the emailed alerts of interest automatically to the most recent university recommendations and alternative pest control information.

**Testing or demonstrations:** Cooperating with University of Idaho and Oregon State University extension personnel, a preliminary system was devised in 2000 and went "on line" in 2001.

**Outcomes:** Extension agents in Idaho and Oregon cooperate with many growers and fieldmen to operate The Pacific Northwest Pest Alert Network serving southeastern Oregon and all the way across Idaho. The service is provided with no considerations of home turf and is currently led by Jerry Neufeld. Pest control information is timely. Wasted preventive sprays are less often used by growers. See <<http://www.pnwpestalert.net/>>.

## **II. D. Effective communication: Internet services on production practices**

**Problem:** OSU needs to effectively communicate research results and stewardship information to a wider audience of growers and the public. Growers often don't realize that they are going to need specific information, and then when they need it, they need it right now.

**Place and time:** Pacific Northwest and beyond, 1996-present.

**Visualized solution:** Maintain a station web site containing all station results, recommendations on best management practices, and links to other valuable information.

**Testing and demonstrations:** All station publications have been posted on a website since 1996.

**Outcomes.** The station's Internet website provides information that addresses grower needs and more general information about watershed stewardship and plant identification. The page is linked to many sources of relevant information at OSU and outside of OSU. Explanations are posted about drip irrigation, fertilization, and irrigation practices to increase fertilizer and water use efficiency and protect water quality. The web site has special sections on Best Management Practices and micro-irrigation. Extension brochures on sustainable practices are linked to the website. See <<http://www.cropinfo.net/>>.

Station weather data are posted daily. It is linked to many useful sites that provide, for example, daily crop consumptive water use.

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### **Invited Presentations since 1994**

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- Ontario Kiwanis, 20 February
- Malheur Watershed Council, 21 February

Shock, C.C. J. Felix, J. Ishida, and E.B.G. Feibert. 2013. A surface drip example: sweet potato. Clearwater Supply Drip Irrigation Conference, Four Rivers Cultural Center, Ontario, OR, 5 February.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and N.L. Shaw. 2013. A local example of long term SDI: native wildflower seed production. Clearwater Supply Drip Irrigation Conference, Four Rivers Cultural Center, Ontario, OR, 5 February.

Shock, C.C. 2013. An Example of Long Term SDI: Corn in Kansas (Based on slides from Freddie Lamm). Clearwater Supply Drip Irrigation Conference, Four Rivers Cultural Center, Ontario, OR, 5 February.

Shock, C.C. and C.B. Shock. 2013. False ideas about Eastern Oregon Rivers. Real ways to improve water quality. Powder River Watershed Council, Baker City, OR, 5 June.

Shock, C.C. 2013. Preliminary studies on *E. coli* in water and on onions. Certified Onion Inc. Food Safety Tour. Ontario, OR, 26 September.

- Shock, C.C., E.B.G. Feibert, L.D. Saunders. 2012. Onion Plant Population Studies. Pacific Northwest Vegetable Association, November 14, Kennewick, WA.
- Shock, C.C. and E.B.G. Feibert. 2012. Irrigation Criteria and Systems for Onions. Pacific Northwest Vegetable Association, Kennewick, WA, November 14.
- Shock, C.C. and K.A. Foley. 2012. Strip Till – For Soil Protection and Profitability. 3<sup>rd</sup> Annual Sustainable Agriculture Symposium. 16 February 2012. Ontario, OR.
- Shock, C.C. 2012. Progress on Cleaning up Groundwater through BMPs. Idaho/Malheur County, Oregon Onion Growers 52<sup>nd</sup> Annual Meeting. 07 February. Ontario, OR.
- Shock, C.C. and C.A. Shock. 2012. Malheur County Landscapes. Four Rivers Cultural Center, Gallery Exhibit. 20 January 2012. Ontario, OR.
- Foley, K.M. and C.C. Shock. 2011. Strip Tillage Role in Improving Water Quality. Treasure Valley Irrigation Conference. 06 December 2011. Ontario, OR.
- Shock, C.C., E.B.G. Feibert, L.B. Jensen, and P. Richerson. 2010. Improving onion production while reducing nitrate loading. *In* Reducing Water Quality Impacts From Horticultural Crop Production. Annual Conference of the American Society of Horticulture Science, August 1-5, 2010, Palm Desert, CA.
- Shock, C.C. and F.X. Wang. 2010. Soil Water Tension, a Powerful Tool for Productivity and Stewardship. *In* Water Management and Plant Performance in a Changing Climate. Annual Conference of the American Society of Horticulture Science, August 1-5, 2010, Palm Desert, CA.
- Shock, C.C. 2009. Increasing Vegetable Crop Yields and Quality Through Irrigation Scheduling by Soil Water Potential. China Agricultural University, April 17, Beijing, China (presented in two different provinces).
- Shock, C.C. 2008. Surge Irrigation. Richard Toll, Senegal, January 2008.
- Shock, C.C. 2008. Irrigation management for potato. AS Wilcox Potato Conference, Pukekohe, New Zealand, August 28, 2008.
- Shock, C.C. 2008. Research initiatives. AS Wilcox Potato Conference, Pukekohe, New Zealand, August 28, 2008.
- Shock, C.C. 2008. Is your TMDL your friend? Oregon Potato Conference. Oregon Potato Conference, Portland, OR, January 29, 2008.
- Shock, C.C. 2008. Perspectives on onion irrigation scheduling and drip irrigation. Stress on onion and its impact on ISYV development. 48th annual meeting of the Malheur County and Eastern Idaho Onion Growers Annual Meeting, Four Rivers Cultural Center, Ontario, February 5, 2008.
- Shock, C.C. 2008. Perspectives on onion irrigation scheduling and drip irrigation. Drip Irrigation Conference, Clearwater Supply. February 6, 2008.
- Shock, C.C. 2008. How have Malheur County rivers changed over the last 200 years? Ontario Kiwanis Club. Ontario, OR. June 11, 2008.

Shock, C.C. 2008. How have Malheur County rivers changed over the last 200 years? Ontario Chamber of Commerce, Ontario, OR. August 11, 2008.

Shock, C.C. 2008. How have Malheur County rivers changed since the time of Lewis and Clark? Malheur Historical Society, Ontario, OR, April 10, 2008.

Shock, C.C. 2008. The surprising geology of Malheur County, Ontario Lions Club. Ontario, OR. September 16, 2008.

Shock, C.C. 2008. Soil moisture requirements for onions. Pacific Northwest Vegetable Association Annual Conference and Trade Show, Three Rivers Convention Center, Kennewick, WA, November 19-20.

Shock, C.C. 2007. Irrigation scheduling for potato. Potato Irrigation and Nutrition Workshop. Malheur County Extension, Ontario, OR, January 3, 2007.

Shock, C.C. 2007. What we have learned from drip irrigation of potato. Potato Irrigation and Nutrition Workshop. Malheur County Extension, Ontario, OR, January 3, 2007.

Shock, C.C. 2007. Drip irrigation systems - potential for alternative crops" Winter Irrigation Workshop: Growing Pains in Irrigation Water Management, January 30, Ontario, OR.

Shock, C.C. and L. Phillips. 2007. Malheur County irrigation systems strategic plan and analysis, Winter Irrigation Workshop: Growing Pains in Irrigation Water Management, January 30, Ontario, OR.

Shock, C.C., E.B.G. Feibert, J.K. Ishida, and C.V. Ransom. 2007. Cultural practices for native forb seed production. SRM, Sparks, NV, February 12-16, 2007.

Shock, C.C. 2007. Irrigating onions for high productivity. Brigham City, Utah. February 20, 2007.

Shock, C.C. 2007. Water in Malheur County before recorded history and afterward. Malheur Historical Society, Ontario, OR, April 12, 2007.

Shock, C.C. 2007. Living, farming, and ranching in Brazil. Owyhee Watershed Council, Marsing, Idaho, May 9, 2007.

Shock, C.C. 2007. Subsurface drip irrigation for seed production of intermountain wildflowers. Native Wildflower Seed Production Symposium, Orlando, Florida July 19-20, 2007. <http://nfrec.ifas.ufl.edu/norcini/WFSympWeb/ShockPPT.pdf>

Shock, C.C. 2007. Backpacking in the Big Horn Crags, Frank Church River of No Return Wilderness. Ontario Kiwanis, Ontario, OR. September 12, 2007.

Shock, C.C. 2006. A brief history of water: why we irrigate in Malheur County. Malheur Historical Society, Ontario, Oregon, January 12, 2006.

Shock, C.C. 2006. Cultural practices for native forb seed production. Great Basin Native Plant Selection & Increase Project Annual Meeting, Salt Lake City, Utah. January 25, 2006.

Shock, C.C. 2006. An overview: irrigation techniques that reduce soil loss and optimize crop yields and returns. Malheur County Irrigation Workshop, January 24, 2006, Ontario

Boulevard Grange, Ontario, OR. Growers also received a 5 page handout on this topic prepared for this meeting along with three irrigation extension brochures and bookmarks with the station's web page address.

Shock, C.C. 2006 Irrigation management for potato quality. Malheur Potato Growers. OSU Extension, Ontario, OR. February 9, 2006. We also provided extension brochures on drip irrigated potato and soil moisture monitoring.

Shock, C.C. 2006. An insight into Brazilian watershed problems and interests. Malheur Watershed Council, February 16, 2006.

Shock, C.C. 2006. Melhores praticas de manejo da irrigação (Better practices for irrigation management). Embrapa Cerrados, Planaltina, DF, Brasilia, Brazil, 11 October, 2006.

Shock, C.C. 2006. Precision irrigation scheduling based on measurements of soil water tension (In Portuguese). Embrapa Agricultural Instrumentation, São Carlos, São Paulo, Brazil, 16 October 2006.

Shock, C.C. 2006. Reflections on Brazilian Potato production (In Portuguese). Potato Growers Association, Vargem Grande do Sul, São Paulo, Brazil. 19 October 2006.

Shock, C.C. 2005. Nutrient and water management in United States agriculture: Issues and research priorities. 45th Anniversary of *Scientia Agricultura Sinica* and Symposium on the Frontiers of World Agricultural Sciences, Beijing, Peoples Republic of China, November 20, 2005.

Shock, C.C. 2005. Development of irrigation best management practices for potato production from a research perspective. Symposium on Best Management Practices for Nutrients and Irrigation: Research, Regulation, and Future Directions. Oregon Potato Association of America annual meeting, July 17-21, 2005, Calgary, Alberta, Canada.

Shock, C.C. 2005. Irrigation for productivity and environmental protection, Limeria Department of Environmental Protection and Public Works, Limeira, São Paulo, Brazil, June 20, 2005.

Shock, C.C. 2005. Algumas ideias para o cultivo de batata e cebola. Vargem Grande Potato Growers. City Convention Center, Vargem Grande do Sul, SP, Brazil, June 21, 2005.

Shock, C.C. 2005. (I provided three spontaneous presentations when a major part of the program failed to materialize.) "The right amount of water for each drip irrigation". "N requirements for drip-irrigated onion". "Growing corn with drip tape installed for alfalfa seed production". 6th Annual Growers Meeting, Clearwater Supply. Four Rivers Cultural Center, Ontario, Oregon, January 31, 2005.

Shock, C.C. 2005. Nitrogen management with drip and sprinkler irrigation. Western Nutrient Management Conference. Salt Lake City, UT, March 3-4, 2005.

Shock, C.C. 2005. Potato irrigation management. Malheur Potato Growers, OSU Extension, Ontario, OR.

Shock, C.C. 2005. Eagle Scout projects and scouting. Ontario Chamber of Commerce, Sizzler Restaurant, Ontario, OR August 15, 2006.

Eldredge, E.P. and C.C. Shock. 2005. Special colored potato varieties. Ontario Kiwanis, Treasure Valley Community College. December 7, 2005.

Shock, C.C., 2005. Onion water management. Treasure Valley Last Chance Certified Crop Advisor Workshop. University of Idaho Parma Research and Extension Center, Parma ID, December 8, 2005. (We provided draft extension brochures on drip irrigated onion and soil moisture monitoring.)

Shock, C.C., 2005. Irrigation by soil water potential. Treasure Valley Last Chance Certified Crop Advisor Workshop. University of Idaho Parma Research and Extension Center, Parma ID, December 8, 2005.

Shock, C.C. 2005. Our native plant vegetation database on the internet. Ontario Kiwanis, December 21, 2005. (We provided bookmarks with directions to the web address of the experiment station and to the vegetation database.)

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2004. Drip irrigation for alfalfa seed production. Annual Meeting of the Idaho Alfalfa Seed Growers Association, Nampa ID, January 14, 2004.

Shock, C.C. 2004. Onion fertility research update. Clearwater Supply Winter Seminar. February 2, 2004, Four Rivers Cultural Center, Ontario, Oregon.

Shock, C.C. 2004. Onion moisture monitoring. Clearwater Supply Winter Seminar. February 2, 2004, Four Rivers Cultural Center, Ontario, Oregon.

Shock, C.C. 2004. Irrigation management. 2nd Annual Wastewater Conference, Eastern Oregon Utilities Training Association, September 20, 2004

Shock, C.C. 2004. Soil moisture monitoring. 2nd Annual Wastewater Conference, Eastern Oregon Utilities Training Association, September 20, 2004.

Shock, C. C. 2003. Automation of drip irrigation research. WSU Prosser, WA. January 13.

Shock, C. C. 2003. Alfalfa seed drip irrigation research. Oregon and Idaho Alfalfa Seed Growers' Winter Meeting, Four Rivers Cultural Center, Ontario, OR January 15.

Shock, C.C. 2003. Phosphorus in the Malheur River. Malheur Watershed Council. Ontario, OR. January 16.

Shock, C.C. 2003. Potato irrigation management. Potato Production Workshop, Oregon Potato Conference, January 27.

Shock, C.C. 2003. Avoiding potato dark-ends. Potato Production Workshop, Oregon Potato Conference, January 27.

Shock, C.C. and K. Pratt. 2003. Phosphorus effects on water quality and phosphorus TMDL development. Western Nutrient Management Conference, Salt Lake City, March 6-7. Proceedings p 211-220.

Shock, C.C. 2003. Scouting, an opportunity for youth development. Ontario Kiwanis, September 3.



Feibert, E.B.G. 2003. Non-standard additives. Pacific Northwest Annual Vegetable Conference. November 19-20, Pasco, WA.

Feibert, E. B. G., C. C. Shock, and L. D. Saunders. 2002. Improving irrigation efficiency for onions. Improving Irrigation Efficiency in Agriculture, New Mexico State University, Las Cruces, NM. March 21.

Shock, C. C. 2002. Irrigation management in relation to potato and onion diseases. 2002 Intermountain Pest Management Seminar, Klamath Falls, OR. January 17.

Shock, C. C. 2002. Construction and operation of a cost effective SDI system for alfalfa seed production. Idaho/Oregon Alfalfa Seed Growers Winter Meeting, Nampa, ID. January 23.

Shock, C.C. 2001. Stand count and row spacing for maximum yield. Western Laboratories, Onion Workshop. Four Rivers Cultural Center, Ontario, OR, December 18.

Shock, C.C. 2001. Irrigation scheduling instruments. Western Laboratories, Onion Workshop, Four Rivers Cultural Center, Ontario, OR, December 18.

Shock, C.C. 2001. Advances in potato irrigation. OSU Malheur County Extension and Malheur County Potato Growers Association, Potato Workshop. Four Rivers Cultural Center, Ontario, OR, December 17.

Shock, C.C. 2001. Hard red winter wheat as an alternative to soft white winter wheat. American Society of Agronomy, Charlotte, North Carolina.

Shock, C.C. 2001. Instrumentação automatizado para monitoramento dos fluxos da água no solo. Federal University of Rio de Janeiro, September 27. Rio de Janeiro, Brazil.

Shock, C.C. 2001. Potato aberrations and disease development in response to irrigation management. Presented twice, once at the Agronomic Institute of Campinas, Campinas, São Paulo, Brazil and once at Piracicaba, São Paulo, Brazil. September 24 and 26.

Shock, C.C. 2000. Groundwater contamination in eastern and central Oregon, cooperative efforts by individuals and agencies to identify and implement solutions. First Monday Lecture Series, OSU Central Oregon, Bend OR.

Shock, C.C. 2000. Water quality improvements in the Malheur and Owyhee Watersheds. OWEB Ridgetop to Ridgetop Conference, Eugene, OR.

Shock, C.C. 2000 Irrigation Water Management Workshop. USDA NRCS, Emmett ID, June 21, 2000.

Shock, C.C. 2000. Irrigation management consistent with environmental protection and high quality production. Western Region Sustainable Agriculture Research and Education. Proceedings of the Farming and Ranching For Profit, Stewardship, and Community Conference, Portland, OR, pp. 34-35.

Shock, C.C., E.B.G. Feibert, E.P. Eldredge, and L.D. Saunders. 2000. Irrigation and N fertilization of Umatilla Russet. Proceedings of the 39th Annual Washington Potato Conference and Trade Show, Moses Lake, WA. pp. 91-101.

Shock, C.C, 2000. Irrigation management that produces value for growers and environmental stewardship. Oregon Department of Agriculture, Salem, OR.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2000. Poplar growth in response to irrigation management. In Blatner, K.A., J.D. Johnson, and D.M. Baumgartner (Eds) Hybrid Poplars in the Pacific Northwest: Culture, Commerce, and Capacity. Symposium Proceedings. April, 1999. Pasco, WA. Washington State University. MISC0272. pp. 77-81.

Shock, C.C. 1999. Environmental degradation or sustainable use: The Malheur County groundwater story. Crop and Soil Science Winter Seminar Series, Corvallis, OR.

Shock, C.C. 1998. Instrumentos para determinação da humidade do solo. Simpósio de Energia, Automação e Instrumação. XXVII Congresso Brasileiro de Engenharia Agrícola, Poços de Caldas, MG, Brasil. pp. 137-149.

Shock, C.C. 1998. Manejo de irrigação. XXVII Congresso Brasileiro de Engenharia Agrícola, Poços de Caldas, MG, Brasil.

Shock, C.C. 1998. Instrumentos para determinação da humidade do solo para melhor produtividade e qualidade de produtos agrícolas. Federal University of Rio de Janeiro, Rio de Janeiro, Brazil, July.

Shock, C.C. and J. Jones. 1998. Cooperation towards sustainable use of land and water in the Malheur-Owyhee watersheds. Governor's Watershed Enhancement Board (GWEB) bi-annual conference, Ontario, Oregon.

Feibert, E.B.G., C.C. Shock, and L.D. Saunders. 1997. Nitrogen management of precision irrigated onions. In: Proc. Western Nutrient Management Conference. Salt Lake City, UT. pp. 60-67.

Shock, C.C. 1997. Nitrogen and water management for sugarbeet production. 1997 Intermountain Sugarbeet Seminar. Merrill, Oregon. December.

Shock, C.C. 1997. Principles of gardening for a new location. Green and Growing Garden Club, Ontario, Oregon. December.

Shock, C.C. 1997. Contributions toward profitable and sustainable wheat production. Malheur County Annual Meeting, Oregon Wheat League, Ontario, Oregon. November.

Shock, C.C. 1997. Stimulating the interest of youth in the natural sciences; the example of integrated pest management. Oregon Science Teachers Annual Conference, Redmond, October.

Shock, C.C. 1997. Revegetation and plant succession of drastically disturbed areas in the Serra do Mar, Brazil. Federal University of Rio de Janeiro, Brazil. May.

Shock, C.C. 1997. Erosão na bacia da Baía da Ilha Grande, Rio de Janeiro, Brasil. Conference on Sustainable Development of the Ilha Grande Bay, Angra dos Reis, RJ, Brazil, May.

Shock, C.C. 1997. Drip irrigation for onion production. 37th annual meeting of the Malheur County and Eastern Idaho Onion Growers Annual Meeting, Caldwell, Idaho. February.

Shock, C.C. 1997. An integrated approach to groundwater protection. Seventh Annual Nonpoint Source Water Quality Monitoring Results Workshop. Boise State University, Boise, Idaho. January 7-9.

Shock, C.C. 1997. Use of "Blitecast" to predict late blight and reduce costs. Annual Oregon Potato Conference. Klamath Falls, Oregon. January.

Shock, C.C., B. Simko, L. Jensen, G. Capps, R. Jones, J. Nakano, and R. Kepler. 1996. Malheur County's integrated approach to water quality protection. Agriculture and Water Quality in The Pacific Northwest. Yakima, Washington.

Shock, C.C. 1996. Irrigation to optimize returns while protecting groundwater. Pacific Northwest Vegetable Association, Annual Meeting. Pasco, WA December.

Shock, C.C. 1996. Onion irrigation practices; systems, irrigation criteria, and erosion control. Pacific Northwest Vegetable Association, Annual Meeting. Pasco, WA December.

Shock, C.C. 1996. Efficient irrigation scheduling --- The Oregon experience. 11th Annual Maine Potato Conference and Trade, Exhibit, Caribou, Maine, January.

Shock, C.C. 1996. What growers need to know about drip irrigation. Irrigation Technologies in The 90's. Caldwell, Idaho and again in Payette, Idaho, Idaho Department of Water Resources. February.

Shock, C.C., 1995. Reduced nitrogen fertilizer for sugar beet production. Proceedings of the James A. Vomocil Water Quality Conference, Corvallis, Oregon, November 1995. Oregon State University Extension Service Special Report 957: 58-70.

Jensen, L., C.C. Shock, and J. Hobson. 1995. Furrow mulching to reduce surface water quality pollution. Proceedings of the James A. Vomocil Water Quality Conference, Corvallis, Oregon, November 1995. Oregon State University Extension Service Special Report 957: 93.

Shock, C.C., 1995. Water and fertilizer management in potato production. Proceedings of the James A. Vomocil Water Quality Conference, Corvallis, Oregon, November 1995. Oregon State University Extension Service Special Report 957: 42-46.

Shock, C.C. 1995. Team approach to reduce groundwater nitrate. Nitrogen, Environment, and People Proceedings. International conference at Everett, Washington. February.

Shock, C.C. 1995 Environmental Science Demonstrations. OSTA/EEA Wilsonville, Oregon. October.

Shock, C.C. 1994. Irrigation and fertilization of potatoes for high yields and environmental protection. Agronomic Institute of Campinas, Campinas, Sao Paulo, Brazil, December.

Shock, C.C. 1994. Environmental problems of irrigated agriculture in an arid area and their solutions. UNICAMP (university), Campinas, Sao Paulo, Brazil, December.

## **Research Reports: Abstracts and Papers at International Professional Meetings**

Shock, C.C., E.B.G. Feibert, and J.M. Pinto. 2013. Review of two decades of progress in the development of successful drip irrigation for onions. International Irrigation Show, November 5-7, Austin, TX.

Shock, C.C., E.B.G. Feibert, L.D. Saunders N.L. Shaw and R.S. Sampangi. 2012. Long term SDI for seed production of western rangeland native wildflowers. International Irrigation Show, November 4-6, Orlando, FL.

Felix, J., C.C. Shock, J. Ishida, and E.B.G. Feibert. 2012. Irrigation criteria for sweet potato production using drip irrigation. International Irrigation Show, November 4-6, Orlando, FL

Shock, C.C., C.B. Shock, and P.M. Richerson. 2011. Practices to improve production while reducing groundwater contamination. International Irrigation Show. 6-8 November 2011. San Diego, CA.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, L.B. Jensen, H.R. Pappu, S.K. Mohan, and R.S. Sampagni. 2009. Effect of selected cultural practices in Suppressing Iris yellow spot virus in Onion. IX International Symposium on Thysanoptera and Tospoviruses, 31 August – 4 September 4 2009, Sea World Resort, Gold Coast, Queensland, Australia.

Shock, C.C. 2009. Irrigation scheduling by soil water potential. International Irrigation Show, Irrigation Association, December 2009. San Antonio Texas.

Pappu, H.R. and C.C. Shock, 2008. Progress toward understanding and managing Iris yellow spot tospovirus epidemics in onion bulb and seed crops. The 3rd Conference of the International Working Group on Legume and Vegetable Viruses (IWGLVV), 20-23 August 2008, Ljubljana, Slovenia.

Shock, C.C. R. Flock, E.P. Eldredge, A.B. Pereira, and L.B. Jensen. 2007. Irrigation scheduling of a water stress sensitive crop, lessons from potato, Irrigation Association, 2007 Conference proceedings p 759-770. 28th Annual International Irrigation Show, December 9 - 11. San Diego, CA.

Shock, C.C., E.B.G. Feibert, C.A. Shock, A.B. Pereira, and E.P. Eldredge. 2005. Research using automated irrigation systems. Irrigation Association, 26th Annual International Irrigation Show, Emerging Irrigation Technology. November 6-8, 2005, Phoenix, Arizona. Conference Proceedings p. 31-39.

Herman, S., Mittlestadt, B., English, M. and C.C. Shock. 2004. Development of Procedures for Estimating Infiltration Model Parameters. ASAE. World Water and Environmental Resource Congress 2004, Salt Lake City, Utah. June 27-July 1, 2004.

Shock, C.C., E.B.G. Feibert, A.B. Pereira, and C.A. Shock. 2004. Automatic collection, radio transmission, and use of soil water data. International Irrigation Show 2004 Proceedings, The Irrigation Association. Tampa Bay, FL. November 14-16, 2004.

Pereira, A.B., N.A. Villa Nova, and C.C. Shock. 2004. Estimation of reference evapotranspiration by a modified Bowen method. International Irrigation Show 2004 Proceedings, The Irrigation Association. Tampa Bay, FL. November 14-16, 2004.

Shock, C.C., A. I. Akin, L. A. Unlenen, Erik B. G. Feibert, and Cedric A. Shock, 2003. Precise irrigation scheduling using soil moisture sensors. International Irrigation Show 2003 Proceedings, The Irrigation Association. San Diego, CA. November 18-20. p. 25--262.

Bertolino, A.V.F.A., A.P. Souza, N.F. Fernandes, A.M. Rangel, T.M.P. de Campos, and C.C. Shock. 2002. Monitoring the field soil matrix potential using mercury tensiometer and granular matrix sensors, Unsaturated Soils. Proc. 3rd Int. Conf. on Unsaturated Soils (UNSAT 2002), Recife, Brazil (ed. Jucá, J.F.T., T.M.P. de Campos, and F.A.M. Marinho), Lisse: Swets & Zeitlinger.; Vol. 1, pp. 335-338.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and E.P. Eldredge. 2002. Automation of Subsurface Drip Irrigation For Crop Research. American Society of Agricultural Engineers. World Congress on Computers in Agriculture and Natural Resources. Iguazu Falls, Brazil. pp. 809-816.

Shock, C.A., C.C. Shock, L.D. Saunders, and L. Jensen. 2002. Delivery of Risk Assessments for Potato Late Blight in Oregon. American Society of Agricultural Engineers. World Congress on Computers in Agriculture and Natural Resources. Iguazu Falls, Brazil. pp. 548-553.

Shock, C.C., J.D. Neufeld, B.C. Simko, C.A. Shock, B. Geary, S. Reddy, L. Jensen, and E. Ellis. 2002. An Interactive Internet Site For Rapid Delivery of Regional Pest Alerts. American Society of Agricultural Engineers. World Congress on Computers in Agriculture and Natural Resources. Iguazu Falls, Brazil. pp. 683-688.

Eldredge, E.P., C.C. Shock, and L.D. Saunders. 2002. Early and Late Harvest Potato Cultivar Response to Drip Irrigation. 26th International Horticultural Congress and Exhibition. Toronto, Canada. August. p 123 (abstract).

Shock, C.C., E.B.G. Feibert, L.D. Saunders. 2002. Plant population and nitrogen fertilization for subsurface drip-irrigated onion. 26th International Horticultural Congress and Exhibition. Toronto, Canada. August. p 97-98 (abstract).

Feibert, E.B.G., C.C. Shock and L.D. Saunders. 2002. Evaluation of Non-Conventional Additives for Onion Production. 26th International Horticultural Congress and Exhibition. Toronto, Canada. August. p 98 (abstract).

Shock, C.C., E.P. Eldredge, and L.D. Saunders. 2002. Irrigation Criteria and Drip Tape Placement for 'Umatilla Russet' Potato Production. International Irrigation Show 2002 Proceedings, The Irrigation Association. New Orleans, LA. October 24-26. p 8.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 2002. Drip-Irrigated Onion More Responsive to Plant Population Than to Fertilizer Nitrogen. International Irrigation Show 2002 Proceedings, The Irrigation Association. New Orleans, LA. October 24-26. p 7.

Shock, C.C., A. Corn, S. Jaderholm, L. Jensen, and C.A. Shock. 2001. Evaluation of the AM400 Soil Moisture Data Logger to aid irrigation scheduling. International Irrigation Show 2001 Proceedings, The Irrigation Association. pp. 111-116.

Shock, C.C., 1999. Irrigation Management That Produces Value for Growers and Environmental Stewardship. Irrigation Association. Proceedings of the International Irrigation Show. pp. 101-108. Orlando, Florida.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 1999. Quality Potato Production Dependence on Irrigation Scheduling. Irrigation Association. Proceedings of the International Irrigation Show. pp. 133-139. Orlando, Florida.

Shock, C.C., R.J. David, C.A. Shock, and C.A. Kimberling. 1999. Innovative, Automatic, Low-Cost Reading of Watermark Soil Moisture Sensors. Irrigation Association. Proceedings of the International Irrigation Show. pp. 147-152. Orlando, Florida.

Shock, C.C., E.B.G. Feibert, and M. Saunders. 1998. SDI irrigation scheduling for profit and environmental protection. Irrigation Association. Proceedings of the International Irrigation Show. pp. 33-39. San Diego, CA.

Shock, C.C., J. Barnum, and M. Seddigh. 1998. Calibration of Watermark soil moisture sensors for irrigation management. Irrigation Association. Proceedings of the International Irrigation Show. pp. 139-146. San Diego, CA.

Shock, C.C., E.B.G. Feibert, and L.D. Saunders. 1996. Precision irrigation scheduling with granular matrix sensors. ASAE. Proceedings of the International Conference on Evapotranspiration and Irrigation Scheduling pp. 1105-1108. San Antonio, TX.

Mitchell, A.R. and C.C. Shock. 1996. A Watermark data logging system for ET measurement. ASAE. Proceedings of the International Conference on Evapotranspiration and Irrigation Scheduling pp. 468-473. San Antonio, TX.

Mitchell, A.R., C.C. Shock, and J.M. Barnum. 1993. Furrow irrigation modeling and management for reduced nitrate leaching. Proc. Int. Conf. on Groundwater Quality. Tallin, Estonia. September, 1993.

Gardner, B.R. and C.C. Shock. 1989. Interpreting the crop water stress index. Paper 892642, 1989 International Winter Meeting American Society of Agricultural Engineers, New Orleans, December 1989.

Thro, A.M. and C.C. Shock. 1985. Summer forage legume introduction in Louisiana. Proceedings of the XV International Grassland Conference. Kyoto, Japan.

Saito, H.M., C.C. Shock, and R.P. Bosshart. 1984. Pesquisas de revestimento vegetal de taludes na Amazonia. First Symposium for the Humid Tropics. IPEAN/EMBRAPA. Belem, Para, Brazil.

Shock, C.C. 1978. Collection, evaluation and distribution of forage germplasm by the Instituto de Pesquisas IRI, Brazil. Invited seminar presented at CIAT, Cali, Columbia. May 1978. (Conference on the collection and evaluation of tropical forage legumes.)

### **Research Reports: Abstracts and Papers at National Professional Meetings**

Shock, C.C., E.B.G. Feibert, L.D. Saunders, N.L. Shaw, and R.K. Sampangi. 2013. Modest Supplemental Irrigation for Great Basin Native Wildflower Seed Production. National Native Seed Conference, Santa Fe, NM, 8-11 April.

Shock, C.C., E.B.G. Feibert, L.D. Saunders, and N.L. Shaw. 2013. Tolerance of three Great Basin wildflower species to rates and mixtures of postemergence herbicides. National Native Seed Conference, Santa Fe, NM, 8-11 April.

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