USDA-ARS-PWA
Vegetable and Forage Crops Research Unit
Prosser, WA

POTATO TECHNOLOGY TRANSFER
For 2002 - 2005

by
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2005

Name of Scientist Involved: Dr. George J. Vandemark

End User of Information/Technology: Hispanic field workers and farm managers, cooperative extension, translators.

Technology Description: An overview of potato diseases commonly encountered in the Pacific Northwest, and methods for reducing losses due to these diseases

Means:
Vandemark, G. Un Resumen Sobre Las Enfermedades de la Papa (A review of diseases of potato). Presented as part of the "Taller de Producción de Papa en Espanol" Washington State Potato Conference. Moses Lake, WA. Feb. 1, 2005.

Description:
Losses to potato diseases can be reduced if field workers are trained to promptly detect the presence of disease in the field. Losses can also be reduced by training workers to identify and eliminate environmental conditions, such as free-standing water, which contribute to disease development. I provided training in Spanish to Hispanic agricultural workers on how they could reduce production losses on the job to potato diseases.

Name of Scientist Involved: Dr. James Crosslin

End User of Information/Technology: Potato growers, extension agents, consultants, researchers in the potato industry.

Technology Description: Causes and management of potato purple top disease.

Means: (i) Washington Pest Management Field Day, August 4, 2004, Agriculture Development Group, Eltopia, WA; (ii) Potato Phytoplasma Working Group, November

9, 2004, Hermiston Research and Extension Center, Hermiston, OR; (iii) Agri Northwest Employees Meeting, February 9, 2005, Pasco, WA.

Description: The potato purple top disease, also called potato yellows in some reports, is caused by an organism called the beet leafhopper-transmitted virescence agent (BLTVA), a phytoplasma. This organism is transmitted by the beet leafhopper and has occasionally been associated with one other leafhopper, *Ceratagallia* spp. Tests of individual beet leafhoppers indicate that approximately 15% of the insects collected from numerous sites around the Columbia Basin carry the phytoplasma and thus pose a significant threat to potatoes and some vegetable crops, especially beans and members of the mustard family. The incidence and severity of the disease have been significantly reduced by early-season (mid to late May) applications of relatively inexpensive pyrethroid insecticides that target early flights of the beet leafhopper.

Name of Scientist: Charles R. Brown

End User of Information/Technology: Growers, Extension specialists, private industry fieldmen and researchers, scientists in the public sector.

Technology Description: Development of new genotypes of potato with enhanced phytonutrients and the analysis of components.

Means: (i) Presentation given at the WorldNutra Conference, Nov 6, 2004, San Francisco, CA. (ii) Presentation given to the Annual Oregon Potato Conference, Portland, OR, January 30, 2005. (iii) Presentation at the Variety Discussion Meeting, February 2, 2005, Moses Lake, WA. (iv) Presentation given to the Annual Washington State Potato Conference, Moses Lake, WA, February 3, 2005. (vi) Seminar presented to Department of Horticulture and Landscape Architecture, Colorado State University, Fort Collins, CO, March 20, 2005. (vii) Presentation given to U. S. Senator Maria Cantwell, entourage and press corps at WSU-IAREC, Prosser, WA, May 18, 2005. (viii) Presentation given at Specialty Seed Potato Field Day, Toppenish, Washington, June 17, 2005. (ix) Presentation given to U. S. Congressman Doc Hastings, July 8, 2005, at WSU-IAREC, Prosser, WA.

Description: Consumers have become extremely health conscious and attuned to information concerning the health benefits of components in the foods they eat. At the same time traditional processed potato products have suffered a 10-20% decline in sales. Furthermore there is a mandate to exploit genetic variation in food crop breeding programs to enhance nutritional attributes. Potatoes have a number of attributes that promote good health that need to be described measured and the information promulgated to the public. In addition, the range of expression in cultivars, breeding lines and exotic potato types is quite large for certain traits. Potatoes have high amounts of potassium and vitamin C, and pigments found in potato are potent antioxidants, and anti-inflammatory agents. The research program at Prosser has addressed these issues with discovery of certain constituents in potato, measurement of their concentrations and antioxidant profiles and the generation of new breeding lines and possible new commercial cultivars.

All sectors of the industry have shown an interest in this and new research and development activities have been spawned as well as new acreages planted with high antioxidant potatoes to exploit heretofore unexploited markets.

Name of Scientist Involved: Dr. Roy Navarre

End Users: plant pathologists, plant molecular biologists, plant breeders, potato industry

Technology description: Characterization of potato phenolics: compounds with multiple uses.

Means:

1) Potato Association of America Annual Meeting, Aug 2004, Scott's Bluff, Nebraska. 2) Columbia Basin Potato Crop Consultants Association, Jan. 11, 2005 Pasco, WA. 3) Columbia Basin Potato Crop Consultants Association, Jan. 12, 2005 Moses Lake, WA. 4) Western Washington Horticultural Association, Seattle, WA, Jan 12, 2005. 5) Washington State Potato Commission Research Meeting, Pullman, WA. Feb 11th. 6) Article in Potato Progress, May 2005.

Description: Potato phenolics are multifunctional compounds contribute to the plant's ability to resist pathogens and pests and may also be desirable in the human diet. We developed a high-throughput analytical method that simultaneously measures vitamin C, phenolic compounds and glycoalkaloids in potato tubers, something previously done by 3 laborious methods. This shortens analysis time by hours per sample. We identified various unknown tuber phenolics and established a baseline phenolic profile for mainstream potato varieties. Application of knowledge resulting from this work will facilitate the development of nutritionally enhanced varieties, improve potato pest and pathogen resistance and provide knowledge of ways to boost desirable phenolics in existing varieties. A post-harvest treatment that increases phenolic content beyond the basal amounts could be highly desirable from a nutritional standpoint.

Name of Scientist Involved: Dr. Rick Boydston, Research Agronomist, USDA-ARS, Prosser, Washington.

End User of Information/Technology: Potato, sweet corn, and field corn growers, processors, crop consultants, farm managers, extension and research faculty/scientists.

Technology Description: Improved management of volunteer potatoes in rotation crops in the irrigated Pacific Northwest.

Means: Presentations at 1) Potato Field Day, Paterson, WA July 8, 2004; 2) Pacific NW Vegetable Association Conference., Pasco, WA on November 18, 2004; 3) Washington State Potato Convention, Moses Lake, WA on February 3, 2005; 4) Western Washington Potato Workshop, Mt. Vernon, WA on February 25, 2005; and 5) Western Society of Weed Science, Vancouver, B. C. on March 8, 2005.

Description: Potato is grown in 3 to 4 year rotations to minimize the disease and pest problems. However, volunteer potatoes present in rotation crops harbor potato pests and diseases, which are carried through the non-potato rotation years and could become sources of infection when potato is planted in that ground. Transmission of these diseases and pests through volunteer potatoes, despite using certified clean seeds, results in increased production cost for pesticides to control these diseases and pests. We determined that mesotrione applied to volunteer potato at the time of tuber initiation eliminated 99% of new tuber production, thereby eliminating the volunteer potato problem in subsequent rotation crops. Integration of Colorado potato beetle with herbicides reduced the amount of herbicide needed for equivalent volunteer potato control. Use of these technologies will improve volunteer potato control, increase rotation crop yields, reduce herbicide use, and indirectly reduce fungicide use in the potato crop.

Name of Scientist involved: Harold P. Collins

End user of Information/Technology: Growers, extension specialists, crop consultants and other researchers.

Technology description: Reduced Tillage in Potato Production Systems.

Means: Connections Magazine Article, Washington State University, Oct, 2004. 2) Extension Educators Update. Dec. 14, 2004. IAREC, Prosser, WA. 3) Columbia Basin Potato Workshop, Jan. 11, Pasco, WA, and Jan. 12, Moses Lake, WA. 4) Columbia Basin Crop Consultants Association, Jan. 14, 2005 Moses Lake, WA. 5) 44th Washington State Potato Convention, Feb 2, 2005, Moses Lake, WA.

Description: Conventional field cropping systems have been criticized as being unsustainable because they contribute to environmental degradation (on-farm and off-farm), and are often economically uncertain. Reducing production costs, through the use of conservation tillage and reducing inputs as a means of increasing environmental and economic sustainability of cropping systems are needed. A reduced tillage system for potato based rotations was developed using existing commercial field equipment with minor modifications. Compared to conventional tilled systems that leave little crop residue on the soil surface, our system maximizes residue retention and requires fewer trips across the field thereby saving time, labor, capital, and energy. This strategy reduced the total number of passes in potato rotations from nine to six and soil disturbance operations from seven to four, including harvest, compared to those used in conventional tilled treatments. After two years of reduced tillage little change has been observed in microbial communities or activities. We have found that a significant amount of N is lost (0.86 kg N/ha d^{-1}) as N_2O within 12 hours of fertigation. This may account for as much as 50% of the N lost annually from potato fields.

Name of Scientist involved: Harold P. Collins

End user of Information/Technology: Growers, extension specialists, crop consultants and other researchers.

Technology description: USDA-ARS and WSU-IAREC Prosser, WA. Potato Cropping Systems Research: 2004 Progress Report

Means: USDA-ARS, Prosser Technical Report, 85pp. April 2004

Description: The technical report describes the USDA-ARS Integrated Farming Systems Group (Prosser, WA) past accomplishments at the Paterson research site, in addition to outlining research for the 2004 cropping season. The report is available to regional potato producers.

2004

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Native American students from the Makah and Yakama Nations

Technology title: Application of genetic markers to determine the origin of native plants.

Means: Makah Potato Genomics Workshop, June 23-July 2, 2003, USDA/ARS Potato Genetics Lab, Prosser, WA.

Description: Workshop participants received training in genetics, use of genetic markers to fingerprint distinct genotypes. The Makah participants intend to use this training to determine the origin of the Ozette potato, an heirloom variety important to their culture and nutrition that was received hundreds of years ago from unknown sources. The Yakama participant is using the training received to study native plants used by the Yakama nation for nutrition, basketweaving, and medicinal purposes.

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Breeders and food scientists in public research, the potato industry, organizations that promote potato consumption, such as the Washington State Potato Commission, National Potato Council, the National Potato Board, and the consuming public.

Technology title: Health benefits of potatoes.

Means: Potato Association of America Annual Meeting. Spokane, WA, August 12-15, 2003

Description: New germplasm with high concentrations of health benefiting pigments was described in one presentation. In another presentation at the same meeting a new

technique for measuring the antioxidant properties of lipophilic compounds extracted from potato flesh was presented. The presentations have lead to the transfer of a large number of high pigment clones to all the major potato processors for pilot testing. The data presented, new germplasm and new techniques have been of interest, to scientists working in food chemistry, breeding and genetics in public and private situations. The grower community is actively interested. Seed growers and commercial crop growers have received samples of materials.

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Scientists from Land Grant Institutions, National Program Staff and Project Leaders of USDA/ARS, Scientists of the INIFAP, the Mexican Ministry of Agricultural Research, Faculty of the University of Post-Graduates of Chapingo, and the Director of the Cornell Eastern Europe Mexico Late Blight Research Program, Ithaca, NY.

Technology title: Screening durable resistance to late blight in potatoes.

Means: Late Blight Workshop, Toluca, Mexico, August 2-5, 2004, Toluca, Mexico.

Description: Late blight is the most important oomycetic disease of potato. Resistance in potato that lasts a long time is difficult to define and select. Selection in the Toluca Valley of Mexico assists in the achievement of durable resistance because the disease organism originated there. The state of screening, types of germplasm being tested in Mexico and results to date were presented. A vigorous and wide ranging discussion occurred.

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Researchers in the potato industry, scientists in the public research sector, seed growers, commercial growers, fieldpersons of the agricultural equipment and chemical industry, raw product fieldpersons of the processing industry.

Technology title: Genetic variation in antioxidant content in potatoes.

Means: Specialty Potato Field Day, September 25, 2003, Paterson, WA; Washington State Annual Potato Conference, Moses Lake, WA, February 5, 2004.

Description: A technical presentation was given to explain genetic variation in pigmented potato varieties, health benefits, and physical descriptions of raw and cooked potatoes. Potatoes that were grown in the field were harvested and displayed in bags and piles. Participants were allowed to cut open potatoes and take samples for taste testing and pilot processing in test kitchens. Participants also sampled some baked samples prepared for the field day.

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Farm laborers, Farm Management consultants whose first language is Spanish.

Technology title: Management of storage losses of potato (Manejo de perdidas durante el almacenamiento de la papa)

Means: Spanish Language Potato Conference, Moses Lake, WA, February 3, 2004.

Description: Principles and practices that can reduce losses in storage were presented. The practices included selection of new varieties that are resistant to both biotic and abiotic incited losses in storage. Proper and timely use of soil fumigants to prevent nematode caused diseases, use of insecticides to prevent aphid and leafhopper transmitted pathogens were described. The impact that proper physical handling can have on losses was explained. The control of parameters in the potato storage in terms of levels of moisture, temperature, fresh air changes and the timing of these in reference to the physiological processes that potato tubers go through during maturation in the field and in storage. In particular the origin factors that exacerbate tuber rots were clarified so that a field worker can see the signs of future rot-conducive conditions, and consult with co-workers and supervisors on management prior to the onset of rot.

Name of Scientist Involved: Dr. Charles Brown

End User of Information/Technology: Commercial growers, seed growers, fieldpersons of the agricultural equipment and chemical industry, raw product fieldpersons of the processing industry representatives of the San Luis Valley Potato Growers Association, researchers in the public and private sector, journalists of trade magazines.

Technology title: Developing resistance to Columbia root-knot nematode.

Means: Colorado Potato and Small Grains Conference, Monte Vista, CO February 10, 2004.

Description: Germplasm developed by the USDA/ARS, Prosser WA and Aberdeen, ID helps to control two nematode-caused problems in potato without use of soil fumigants. Resistance to corky ringspot a tuber necrosis caused by transmission of a virus by a nematode into the tubers is available in named varieties. Resistance to Columbia root-knot nematode which caused deformed tubers and internal discoloring of the tuber is available in advanced germplasm. These traits in new varieties will decrease the cost of production and reduce the use of pesticides that can pollute groundwater.

Name of Scientist Involved: Dr. Roy Navarre

End Users: Plant pathologists, plant molecular biologists, plant breeders, biotech industry

Technology description: Exploiting Induced Plant Defenses for Disease Control.

Means: American Society of Plant Biology, Hawaii, July/Aug 2003; Moses Lake Potato Conference, Moses Lake, Washington February 2004; Nationwide Associated Press Article, March 2004; KXL-Talk Radio, Portland Oregon, April 2004; Potato Association of America Annual Meeting, Aug. 2003.

Description: The most desirable method for control of plant diseases is to use plants that have high levels of natural disease resistance or exploit a plant's own natural inducible resistance (IR) capabilities. The disease resisting ability of plants can be turned on by spraying with natural compounds that have no effect on the pathogen, but stimulate the plant to resist disease on its own. Our discoveries about IR in potato help us understand the best way to use this technology in potato and provides information on one of the most important ways plants are able to resist diseases.

Name of Scientist Involved: Dr. Peter Thomas

End user of information/technology: Plant virus disease epidemiologists, potato growers and the potato seed production industry, consultants.

Technology description: Epidemiology and control of the beet leafhopper-transmitted viresence agent (BLTVA) and the potato yellows disease.

Means: Presentations in grower meetings: (1) Columbia Basin Potato Workshop, January 7, Moses Lake; (2) AgriNorthwest Winter Meetings. February 11, 2004, Pasco WA; (3) Ag.Development Group, Pasco. August 6, 2003, Pasco, WA. (5) Industry Extension meeting: Review of Growers' 2003 Results, December 16, Pasco; (6) Columbia Basin Potato Workshop, January 8, Pasco; (7) Columbia Basin Fieldmens' Association Meeting, July 31, 2003, Pasco, WA; (8) Potato Association of America Annual Meeting, August 12, 2003, Spokane, WA.

Description: A new yellows-type disease, previously identified as beet leafhopper-transmitted virescence agent (BLTVA) by P.E. Thomas, markedly decreased yields and quality of potatoes in the Columbia Basin in 2002. Growers were seeking advice during the subsequent winter and spring on potential methods to control the disease in the 2004 season. Calling upon results of current as well as previous research, Dr. Thomas described the major aspects of BLTVA epidemiology in the Columbia Basin, including the life cycles and over-wintering sources of both the insect vector and pathogen, and he was able to pin-point timing of the insect migration flight that carries the pathogen from over-wintering hosts to potato fields. Growers targeted insecticide applications to coincide with the spring beet leafhopper migration flight and largely eliminated the disease in treated fields in 2004.

Name of the scientist involved: Dr. Peter E. Thomas

End user of information/technology: Plant virus disease epidemiologists, potato growers and the potato seed production industry, consultants.

Technology description: Provided assistance to vegetable growers of the Yakima Valley, Washington, in controlling beet curly top virus and surviving its disastrous economic impacts.

Means: Presentations in grower meetings: (1) Hispanic Growers Advisory Committee and USDA-FSA Yakima County Committee, July 11, 2003, Gilbert Gonzalez Farms, Toppenish WA. Expert documentation to support a successful growers' petition for U.S, Government Disaster Loans: at the request of Brian Miller, USDA, Farm Service Agency, Yakima, WA.

Description: Beet curly top virus periodically causes extreme to complete devastation in many vegetable crops of the Yakima Valley including all melons, cucumbers, squash, pumpkins, tomatoes, and peppers. The virus over winters in and is disseminated by beet leafhoppers, and the intensity of the disease is governed by environmental factors that influence leafhopper populations. The disease can be substantially controlled in most crops by targeting the application of pesticide to coincide with the spring migration of leafhoppers from over wintering hosts to summer hosts.

Name of Scientist Involved: Dr. Ashok Alva

End Users of Information/Technology: Growers, consultants, extension specialists, researchers, agribusiness.

Technology Description: Recycling of nitrogen from crop residues in a potato rotation cropping system.

Means: (i) Potato Cropping Systems Field Day, Paterson, WA, July 8, 2004; (ii) Washington State Potato Information Exchange meetings, Kennewick, March 24, 2004; and Moses Lake, March 25, 2004.

Description: Transformation of organic nitrogen (N) in soil organic matter and in crop residues into inorganic forms (Defined as N mineralization) renders this N available to crop plants and/or subject to leaching in the soil with water front. Estimation of N contribution from crop residues is important to determine the crop N requirement in an effort to finetune N application to minimize excess application that may lead to leaching losses. In potato production systems, wheat, field corn, sweet corn, and alfalfa are used as rotation crops. Depending on which crop is in rotation, after the product of economic value is harvested, residue of the crop is incorporated. Nitrogen mineralized from this residue contributes to N requirements of the subsequent crop in rotation. Our three years' study showed in predominantly irrigated production systems in the Pacific Northwest, the annual amount of N mineralized from soil organic matter and crop residue accounts for 85, 83, 75, 59, and 44 mg/kg for sweet corn, alfalfa, field corn, wheat, and potato residues, respectively. The mineralized N during May through August period accounted

for 44 to 58 percent of total annual N mineralization for the above crop residues. This period represents the ideal temperature and soil moisture conditions for maximum mineralization. This is also a period of active plant growth, thus, plant uptake of mineralized N can be maximum during this period. The in-situ technique adapted in this study provided a convenient method to measure the N mineralization by maintaining the soil moisture and temperature conditions in the incubation columns nearly similar to those in the bulk soil.

Name of Scientist Involved: Dr. Rick Boydston

End User of Information/Technology: Potato, pea, sweet corn, carrot, and mint growers, processors, crop consultants, farm managers, extension and research faculty/scientists, and seed growers.

Technology Description: Improved management of volunteer potatoes and other weeds affecting irrigated annual crops.

Means: Presentations at 1) Mint Growers Field Day, Prosser, WA on June 5, 2003; 2) Potato Field Day, Paterson, WA July 16, 2003; 3) Potato Association of America, Spokane, WA, on August 11, 2003; 4) Pacific NW Vegetable Association Conference., Pasco, WA on November 20, 2003; 5) Tri-State Mint Meetings, Boise, ID on January 5, 2004; 6) Mint Industry Research Council, Las Vegas, NV on January 15, 2004; 7) Wash, State Vegetable Seed Growers Association, Moses Lake, WA on January 20, 2004; 8) Idaho Potato School, Pocatello, ID on January 22, 2004; 9) Washington State Potato Convention, Moses Lake, WA on February 4, 2004; 10) Weed Science Society of America, Kansas City, MO on February 10, 2004; 11) Organic Ag Principles Workshop, Wilsonville, OR on February 24, 2004; 12) Western Society of Weed Science, Colorado Springs, CO on March 10, 2004; and 13) International Biofumigation Conference, Florence, Italy on March 31, 2004.

Description: Improved volunteer potato management practices have been developed in field corn and sweet corn that reduce volunteer potato populations in succeeding crops and reduce sources of disease, insect, and nematode problems in potato crops. Weed hosts of corky ringspot disease have been identified that perpetuate the disease in problem fields when not controlled in crop rotations. Control of these identified weeds in rotation crops could lead to improved control of corky ringspot while reducing use of costly soil fumigants. Dr. Boydston has measured impact of several cover crops on weed incidence in the following crops, which can help growers select cover crops that suppress weeds in succeeding crops. New weed management methods have been developed in peppermint, spearmint, and carrot seed crops that have reduced problem weeds, such as, common groundsel, prickly lettuce, and annual grasses and increased the quality of harvest crops.

2003

Name of Scientist Involved: Dr. Niklaus Grünwald

End User of Information/Technology: Legume breeders and growers; legume seed industry; farm managers; plant pathology extension and research faculty/scientists

Technology description: Improved management of root rot diseases affecting legumes and vegetables

Means: Presentations at grower field day: "Resistance to white mold in chickpea, lentil, fresh pea and dry pea," Paterson Field Day, Paterson, WA, 2002. Invited talks: (1) "Aphanomyces root rot and white mold," Annual Conference, Pacific Northwest Vegetable Association, Pasco, WA, 2002; (2) "Late Blight Biology at the center of origin: Implications for US agriculture" at the Hermiston Farm Fair, Hermiston, OR, 2002; (3) "Biology of potato late blight" in Spanish, Centro for Latino Farmers, Yakima, WA, 2002; (4) "Legume pathology research" to WSU Extension Scientists, IAREC-WSU, Prosser, WA, 2002; (5) "Sampling and AFLP fingerprinting of white mold isolates from pea and lentil in the Pacific Northwest" to the USDA Sclerotinia Initiative, Minnepaolis, MN, 2003; (6) "Advances in pea root rot research" to the Green Pea Advisory Meeting, Milton Freewater, WA, 2003; (7) "New Directions for the Prosser Legume Pathology Research Program" to the Green Pea Advisory Meeting, Milton Freewater, WA, 2003; (8) "Characterization of populations of Aphanomyces euteiches on peas, lentils and alternate hosts in the Pacific Northwest" to the Pea and lentil research review, 2003; (9) "Management of white mold and Aphanomyces root rot" to the Moscow Idaho Seed Company Grower Meeting, Moscow, 2003; (10) "Biology of potato late blight at the center of origin" at the Soil Fungus conference, Sacramento, CA, March 27, 2003. Radio interview: Interviewed about ARS vegetable pathology research on radio KDNA in Spanish, Febraury, 2003. Presentations at scientific meetings: (1) Lozoya-SaldaZa, H., Grünwald, N. J., Garay-Serrano, E., Sturbaum-Abud, E., and C. R. Brown. Population substructuring of Phytophthora infestans on American potato clones in the Toluca Valley, Mexico. Am. J. Potato Res., in press. 2002; (2) Fernández-Pavía, S. P., Rodriguez-Alvarado, G., Garay-Serrano, E., Sturbaum, A. K., Grünwald, N. J., Sanchez-YaZez, J. M. and H. Lozoya-SaldaZa. Characterization of Phytophthora infestans in Michoacan, Mexico. Phytopathology, in press. 2002. (3) Grünwald, N. J., and W. E. Fry. Managing potato late blight at the center of origin: integrating durable resistance with a decision support system. Phytopathology 92: S33. 2002; (4) Fernández-Pavía, S., Grünwald, N. J., Díaz-Valasis, M., Garay-Serrano, E., Belmar-Díaz, C., Cadena-Hinojosa, M., Romero-Montes, G. and W. E. Fry. Caracterización de poblaciones de Phytophthora infestans de suelo y de follaje colectadas en el centro de Mexico. (Characterization of Phytophthora infestans populations from soil and foliage collected in central Mexico). Revista Mexicana de Fitopatología 92: S25. 2002; (5) Grunwald, N.J., Coffman, V.A., and J.M. Kraft. Sources of resistance to Fusarium root rot. Phytopathology, in press. 2003; (6) Belmar-Diaz, C.R., Grünwald, N.J.2, Fernández-Pavía, S., Garay-Serrano, E., Romero-Montes, G., Rodríguez-Alvarado, G., y Lozoya-SaldaZa, H. Survival of Phytophthora infestans Sporangia Exposed to Solar Radiation in the Toluca Valley. Phytopathology, in press. 2003; (7) Badillo-Ponce, G., S.P. Fernandez-Pavia, N.J. Grünwald, E. Garay-Serrano, G. Rodriguez-Alvarado, and H.

Lozoya-SaldaZa. Characterization of Phytophthora ipomoeae in the central highlands of Mexico. Phytopathology, in press. 2003.

Description: The USDA-ARS Legume and Vegetable Plant Pathology Project, at Prosser, WA, led by Dr. Grunwald, has developed genetic DNA markers and novel tools for characterizing populations of plant pathogens as well as improved disease management strategies. Strategies include (1) characterizing specific aspects of the epidemiology and population structure of pathogens on bean, chickpea, lentil, pea, and potato using molecular and traditional approaches to improve disease management and (2) identifying novel sources of resistance and improve resistance of vegetable germplasm to diseases. Germplasm lines with high levels of disease resistance have been characterized and improved disease management strategies have been developed that will save legume and vegetable growers considerable money by reducing chemical input requirements and yield loss caused by root rot diseases.

Name of the scientist involved: Dr. Rick Boydston

End user of information/technology: Researchers, Growers, Field staff, Consultants

Technology description: Management of volunteer potato in corn with carfentrazone and mesotrione.

Means: Presentations at (i)Washington State Potato Convention, Moses Lake, WA, Feb. 6, 2003; (ii)Western Society of Weed Science, Koloa, HA, March 13, 2003, (iii) Potato Field Day, Paterson, WA, July 8, 2002, (iv) Potato Field Day, Othello, WA, June 28, 2002, and (v) AgriNorthwest Manager Training, Pasco, WA, Feb. 11, 2003.

Description: Control of volunteer potatoes was developed using carfentrazone and mesotrion, both new herbicides available for use in sweet corn and field corn. Growers could save up to $150 - $200/acre in costs associated with volunteer potato control in sweet corn and field corn. Use of this technology could also lower potential for late blight, PLRV, and PVY in potato crops, as volunteer potatoes are usually the first hosts and sources of these diseases.

Name of the scientist involved: Dr. Rick Boydston

End user of information/technology: Growers, Field staff, Consultants, Researchers

Technology description: Nightshade and other broadleaf weed control in potato production and potato variety tolerance to sulfentrazone, flumioxazin, and dimethenamid-p.

Means: Presentations at (i) USDA-ARS Potato Field Day, Paterson, WA, July 8, 2002, (iv) Potato Field Day, Othello, WA, June 28, 2002, and (v) AgriNorthwest Manager Training, Pasco, WA, Feb. 11, 2003.

Description: Herbicides with new mode of action that control nightshade species and other small-seeded broadleaf weeds were developed and tested in potato. Tolerance of four major potato varieties were also determined. Adaption of this technology will lead to improved weed control of nightshade species tolerant to currently registered herbicides and aide in herbicide resistant weed management in potato production. Results on varietal susceptibility to these herbicides will reduce potential injury on grower fields once these products are labeled.

Name of Scientist Involved: Dr. Ashok Alva

End Users of Information/Technology: Growers, consultants, extension specialists, researchers, agribusiness.

Technology Description: Pre-plant and in-season nitrogen management for potatoes in the Pacific Northwest.

Means: (i) Potato Cropping Systems Field Day, Paterson, WA, July 8, 2002; (ii) American Society of Agronomy Annual Meeting, Indianapolis, IN, Nov. 13, 2002; and, (iii) Annual meeting of the Liaison Committee, Pasco, January 30, 2003.

Description: Efficient management of pre-plant and in-season nitrogen for potato production is important to minimize N losses and for optimal production of high quality tubers. Our studies have shown that increasing N application in excess of 336 kg/ha failed to increase the tuber yield significantly. Likewise, increasing the frequency of in-season N fertigations above 5 also failed to provide significant yield increases. Therefore, N management for optimal production of high yields of high quality potato appears to be 56 kg/ha N applied before planting and 280 kg/ha N applied in 5 weekly fertigations 3 weeks after emergence.

Name of Scientist Involved: Dr. Peter E. Thomas

End User of Information/Technology: Potato growers and research scientists working alone and in collaboration on the cause and control of the new potato yellows disease that appeared in the Columbia Basin in 2002.

Technology Description: Identification of the beet leafhopper-transmitted viresence agent as the cause of the new potato yellows disease that appeared in the Columbia Basin in 2002.

Means: (i) 2003 AgriNorthwest Winter Meetings, Pasco, WA, 2/10/03; and, (ii) Annual Meetings Potato Association of America, Spokane WA, 8/10/03.

Description: Dr. Thomas, a member to the USDA-ARS Potato Improvement and Virology Project, at Prosser, WA, has identified the cause of a an unknown, yellows disease that devastated much of the 2002 potato crop in the Columbia Basin of the Northwest USA as the beet leafhopper-transmitted viresence agent (BLTVA). This was

the first observation of BLTVA as an important disease agent of potato. His field observations during the season also provided anecdotal evidence that certain pesticide treatments applied during early stages of the beet leafhopper flight provided excellent control of the disease. This information has provided focus for an extensive, industry-sponsored research team in its quest for methods to control the disease. Since much is already known concerning the over-winter survival and dissemination of BLTVA, this information has also provided insight for pest management and control strategies recommended for growers to minimize costs of the disease in future seasons.

Name of Scientist Involved: Dr. Peter E. Thomas

End User of Information/Technology: Potato growers and research scientists working on the control of potato virus diseases.

Technology Description: Identified predominant weeds of potato as excellent hosts of the major potato viruses occurring in the US and as excellent hosts of the Green Peach Aphid, a major insect vector that disseminates these viruses.

Means: (i) XXVI International Horticultural Congress, Toronto, Ontario, Canada, 8/11-17/2002; and, (ii) Annual Meetings American Phytopathological Society, Kailua-Kona, Hawaii, 6/22/03. **Description**: Dr. Thomas, a member to the USDA-ARS Potato Improvement and Virology Project, at Prosser, WA, has identified three nightshade weed species, Hairy Nightshade (*Solanum sarachoides*), Black Nightshade (*Solanum nigrum*) and Cut Leaf Nightshade (*Solanum trifolium*) as host of potato viruses M and X, both the standard and tuber necrosis variants of the O and N strains of potato virus Y, and potato leafroll virus (PLRV). Hairy and Black, but not Cut Leaf Nightshade also host potato virus A. These are the first known weedy hosts of potato viruses A and M in the US. Furthermore, we found that Hairy Nightshade and, to a lesser extent, Black Nightshade are much better hosts than potato of the Green Peach Aphid (*Myzus persicae*), a major vector of all of these viruses except potato virus X. In addition, infected Hairy Nightshade plants accumulate much higher concentrations of PLRV and are much better sources of PLRV than potato for field transmission. The three nightshade weeds are predominant weeds of potato that are difficult to control in the crop. They markedly impact potato virus dissemination in potatoes.

Name of Scientist Involved: Dr. Peter E. Thomas

End User of Information/Technology: Potato growers and research scientists working on the control and elimination of potato virus diseases.

Technology Description: Lack of endemic survival of major potato viruses (potato viruses A, M, S, Y, and leafroll) in the Columbia Basin and implication for potato virus eradication in the region

Means: (i) XXVI International Horticultural Congress, Toronto, Ontario, Canada, 8/11-17/2002; and, (ii) Annual Meetings Potato Association of America, Spokane WA, 8/10/03.

Description: Dr. Thomas, a member to the USDA-ARS Potato Improvement and Virology Project, at Prosser, WA, has discovered that major potato viruses (potato viruses A, M, S, Y, and leafroll) do not survive endemically in the Columbia Basin. This is critical information for the region since new, tuber necrotic strains of potato virus Y (PVY) have been introduced that, not only eliminate affected tubers from local markets, but may exclude all fresh potatoes grown in the region from international markets. Eradication of such viruses from the region is the ideal solution but would be practically impossible if the viruses survived there. Alternatively, since the viruses do not survive endemically, their survival in the region must depend almost entirely on the vegetative seed sources of the virus. This information should focus our efforts on the elimination of viruses from seed sources, an achievable goal, by improving and utilizing new methods for pathogen-free propagation of seed stocks.

Name of Scientist Involved: Dr. Charles R. Brown

End User of Information/Technology: Potato breeding programs; potato growers, potato processing companies; the public at large.

Technology Description: Development of and description of potatoes with high levels of anthocyanins, phenolics, and carotenoids, combined with processing quality.

Means: Invited talks and keynote addresses at (i) Pacific Northwest Vegetable Association, Pasco, WA, November 14, 2002. (ii)Lamb Weston Corporation Germplasm Discussion, West Richland, WA, January 16, 2003. (iii) Potato Variety Discussion, Washington State Potato Commission, Moses Lake,WA, Feb 2, 2003. (iv) Washington State Annual Potato Conference, February, 4, 2003. (v) Western Washington Potato Conference, February 28, 2003, Mount Vernon, WA. (vi) Seminar given in the Department of Horticulture, Texas A & M, College Station, TX, March 19, 2003.

Field day exhibits: USDA/ARS Systems research field July 17, 2002; Specialty Potato Field Day, Paterson WA, September 12, 2002.

Description: The USDA-ARS Gene Transfer for Potato Variety Development Project led by Dr. Brown has developed new potato Germplasm that has high concentrations of various natural plant pigments that contribute to a higher antioxidant value of potato. The project has created new evaluation protocols to assess carotenoid concentration and antioxidant levels due to carotenoids. It has developed high carotenoid lines adapted to the long-day conditions of higher latitudes, and identified Andean native cultivars materials that can serve as sources of extremely high carotenoid levels. The project has also developed and evaluated potato clones with high levels of diverse anthocyanins and identified those with high antioxidant levels. These clones were assessed by potato processors as possible raw product in the development of innovative new products.

Unique Germplasm with high levels of carotenoids and anthocyanins have been provided to other Experiment station potato breeding programs in the US and Canada. Several of the clones with very high levels of vitamin C and certain colorless phenolics that are potent antioxidants have been identified, expanding our knowledge base of phyotnutrients naturally present in potato that will increase its nutritional value.

Name of Scientist Involved: Dr. Harold P. Collins

End User of Information/Technology: Potato producers, Crop Consultants, Agricultural Chemical Dealers and University Extension Specialists, Soil Ecologists.

Technology Description: Effects of Kpam, Vapam, and bio-nematicides on soil bacterial, fungal and nematode populations.

Means: Invited talks and presentations at: (i) USDA-ARS Paterson Field Day, Paterson, WA, July 2002 (ii) Pacific Northwest Vegetable Association's Conference Pasco, WA. , November 2002. (iii). Farm Fair, Oregon State University, Hermiston, OR., December, 2002. (iii). Columbia Basin Fieldsman and Dealers Association meeting in Kenewick, WA, January, 2003. (iv) Potato Commission Research Review, Pullman, WA. February 2003.

Description: New data were presented on the evaluation of efficacy of Kpam, Vapam and bio-nematicides on soil bacterial, fungal and nematode populations in potato production systems. Several of the bio-nematicides show promise for controlling plant-parasitic nematodes and have been found to have minimal effects on soil microbial populations or functions. The use of alternative nematode control measures in potato production systems will preserve the efficacy of several important soil fumigants.

Name of Scientist Involved: Dr. Roy Navarre

End User of Information/Technology: plant pathologists, plant molecular biologists, plant breeders, biotech industry

Technology Description: Exploiting Induced Plant Defenses for Disease Control.

Means: (i) International Horticultural Congress, Toronto, Canada, August, 2002; (ii) Moses Lake Potato Conference, Moses Lake, Washington, February 2003; and (iii) American Chemical Society, New Orleans, Louisiana, March 2003.

Description: One promising way to reduce the disease problems in potato and plants in general is to use a plant's own natural induced resistance (IR) capabilities. Plants can be treated with natural compounds that have no effect on the pathogen, but instead activate the natural disease-resisting ability of the plant, thus helping it resist the pathogen. Our discoveries about IR in potato help us understand the best way to use this technology in potato. Moreover, because these mechanisms are amongst the fundamental ways plants resist diseases. A better understanding of them will help both conventional breeding and

biotech approaches to improving potato disease resistance. Furthermore, our finding that the key plant defense molecule, salicylic acid, is present in high amounts in tubers may be a nutritionally desirable trait for potato because salicylic acid has many positive effects on human health.

2002

Name of the scientist involved: Dr. Niklaus J. Grunwald

End User of Information/Technology: Breeders, Seed industry, Consultants, Researchers.

Technology description: Durability of high levels of resistance against potato late blight and description of sources of resistance in Mexican cultivars.

Means: Presentations at (i) Crop and Soil Sciences Department, Washington State University, Pullman, WA, February 11, 2002; (ii) Washington State Potato Conference, Moses Lake, WA, February 5, 2002; (iii) Columbia Basin Crop Consultants Association, Moses Lake, January 11, 2002; (iv) Lower Columbia Basin Fieldmen Dealers Association, Pasco, WA, October 25, 2001; (v) Popular publication: Brown, C. R., Grünwald, N. J., and Lozoya-SaldaZa, H. 2002. Breeding for durable resistance to late blight: The Missing Mexican Link. Potato Newsletter, in press; and (vi) Scientific publications.

Description: The Mexican national potato program has produced several cultivars with high levels of field resistance. We evaluated durability of resistance to potato late blight of a selection of 12 such cultivars using data from 1960 to the present. Data were extracted from the field notebooks located in the archives of the Mexican National Potato Program in the John S. Niederhauser Library in Toluca, Mexico. There was a trend to indicate that field resistances to potato late blight of Mexican cultivars released between 1965-1999 were durable. At least two of the cultivars, namely Sangema and Tollocan, have been grown on at least 4-5% of the potato acreage and over long periods of time without decay in levels of field resistance. Pedigrees of the 12 cultivars indicate that most of the field resistance was introgressed from *Solanum demissum*. Field resistance might also be derived from commonly grown land-race cultivars such as "Amarilla de Puebla" and "Leona." These have been grown in Mexico since about the 1780's. They have the appearance of *S. andigena*-derived material but their genetic background is unknown.

Name of Scientist Involved: Dr. Charles R. Brown

End User of Information/technology: Scientists, potato growers, processing companies fresh market food distribution companies

Technology Description: Potatoes with high levels of anthocyanins and carotenoids

Means: Traditional breeding accompanied by evaluation for pigment concentrations and antioxidant values, promulgated through publication of proceedings articles in the Proceedings of the Washington State Potato Conference, presentation at the Potato Association of America Annual Meeting, talk given to the Northwest Vegetable Association (Also published as proceedings article), presentations at the annual Tri-State and Western Regional meetings, talks given to Lamb Weston scientists and executives, presentations given to numerous newspaper and magazine writers and potato growers who have come to the Station seeking information, an article in Agricultural Research, establishment of National Specialty Potato Field Trial, and a pilot collaboration with a local potato grower who will sell produce to the Farmer's Market. Genetic stock of the best clones has been given to seed growers in Idaho, Oregon, and Maine. Collaboration with a private company has resulted in the development of a commercialized snack product.

Description: Potatoes are known to be a good source of vitamin C, fiber, high quality protein in small amounts, and complex carbohydrates. They also contain flavonoids and carotenoids that are usually present at low levels. We developed potatoes that have higher levels of these compounds and also much higher antioxidant values. Potatoes with high levels of anthocyanins in the flesh contain from 6 to 34 mg per 100 grams fresh weight. The antioxidant values are two to three times higher than white flesh potato putting them in the category of Brussels sprouts. We have developed potatoes that combined carotenoids and anthocyanins, a new combination. This has created a market niche for potatoes enriched in phytonutrients for the fresh market and processing industry. Kettle Foods, an Oregon potato chip producer has developed a new market line, Garden Chips® based on one of our red fleshed breeding products, PA97B35-1. This has been given the working trade name of "Mountain Ridge Red."

Name of Scientist Involved: Dr. Charles R. Brown

End User of Information/technology: Scientists, potato growers, processing industry, fresh market packers and distributors

Technology Description: Advanced clones with resistances to Columbia root-knot nematode and corky ringspot

Means: Traditional breeding techniques, selection in growers fields and experimental plots, greenhouse screening, crossing of resistant materials, selection of initial subsequent generations in field plantings. The results of this research were presented to the Annual Meeting of the Potato Association of America, Washington State Potato Commission, and Washington State Annual Potato Conference at annual meetings

Description: Growers in the Columbia Basin of Oregon and Washington invest 20 million dollars annually in fumigation to control the nematode-incited problems of root-knot and Corky ringspot. The 350 dollars per acre that these practices cost have become prohibitively expensive with respect to the profitability of potato production. New varieties with resistance are desperately needed. We have selected clones with oblong

shape, good frying quality, russet skin, and high yield with resistance to root-knot or corky ringspot or both. We have performed virus indexing in order to build up clean seed stocks. We submitted PA95A11-14 to the Tri-State Program in 2001 where it displayed the second highest yield in the early harvest trial. Lamb Weston is now evaluating a half-acre of this clone for use as a specialized frozen skin-on wedge product.

Name of Scientist Involved: Dr. Charles R. Brown

End User of Information/technology: Scientists, potato growers, processors, fresh packers and distributors

Technology Description: Identification of potato germplasm resistant to new strains of PVY and breeding of resistant advanced material.

Means: Traditional breeding techniques were applied accompanied by graft challenge of specific clones and assessment by a serological virus assay. Results have been promulgated at annual meetings of the Potato Association of America, Washington State Annual Potato Conference and Trade Fair, Washington State Potato Commission Meetings, and Western Coordinating Committee 89 annual meetings. Other breeding programs have requested these materials for their breeding program. Several PVY immune clones are in Preliminary Yield Trials in Idaho

Description: Potato virus Y (PVY) is one of the most serious viruses afflicting potato worldwide. Recently it has become a serious problem in the US because seed programs have failed to keep high levels of it out of certified seed. Within the last year it has become evident that various forms of the "necrotic strain" are present. Some of these forms can cause necrosis in the tubers. There are two main sources of resistance *Solanum tuberosum* ssp *andigena*, and *Solanum stoloniferum*. We developed breeding materials with the *S. stoloniferum* source of resistance at Prosser. We have evaluated these and other sources for resistance to the old strain of PVY called PVY-O, and the new strain called PVY-N. We have found clones that are doubly immune to the two strains plus a third potyvirus called PVA. To do this we grafted infected scions onto test plants and test the new growth by serological technique.

Name of the scientist involved: Dr. Peter E. Thomas

End user of information/technology: Plant virologists, epidemiologist, etiologists, weed scientists, potato growers and consultants, and the potato seed production industry.

Technology description: Discovery of twenty-two new hosts of potato leafroll virus

Means: Presentation at the Western Vegetable Disease Conference, Portland, Oregon, January 8, 2002.

Description: Twenty-two additional host species of potato leafroll virus (PLRV) were discovered in five new families and one previously identified family: one

Chenopodiaceae, two *Compositae*, one *Cucurbitaceae*, one *Labiatae*, two *Malvaceae*, and 15 *Solanaceae*. At least two of the new hosts, S*olanum sarrachoides,* a predominant weed, and *Zinnia elegans* (Jaeq.), a common ornamental, are found naturally infected in the Pacific Northwest (PNW), USA. Four new host species were asymptomatic and 10 were infected by some virus isolates but not others. The variability in symptoms and host range indicates a considerable degree of variability in PLRV not previously recognized and may provide a much needed basis for PLRV strain separation and characterization. This work more than doubles the known host range of PLRV, provides a much expanded germplasm base for study of the virus, and provides much needed insights into the epidemiology of the virus in regions where the new host occur in nature.

Name of the scientist involved: Dr. Peter E. Thomas

End user of information/technology: Plant virus disease epidemiologists, potato growers and the potato seed production industry, consultants.

Technology description: Discovered that hairy nightshade (*Solanum sarracoides)*, perhaps the most important weed of potato, is a host of potato leafroll virus (PLRV) and plays a leading role in the epidemiology of the virus.

Means: Presentation at the Western Vegetable Disease Conference, Portland, Oregon, January 8, 2002

Description: Potato leafroll virus (PLRV) is of great economic importance in potato production. Hairy nightshade is a predominant weed in potatoes and other annual crops of the Pacific Northwest (PNW). We have discovered that this weed is an excellent host of both PLRV and of the aphid species (green peach aphid (GPA) that spreads the virus. Populations of the GPA on hairy nightshade in the field were typically 10 to 100 times higher on S. sarrachoides than on adjacent potato plants in potato fields. The incidence of PLRV infection among hairy nightshade plants in potato fields typically approached 100 % when potato infection did not exceed 20 %. We demonstrated that high levels of resistance to PLRV can overcome in potato fields when GPA are not chemically controlled on S. sarrachoides that are present in the field. Only two other summer annual weed hosts of PLRV, *Amaranthus caudatus* and *Solanum nigrum*, occur sporadically in potato fields of the PNW. These species were rarely infected by the virus. These results suggest that hairy nightshade may be the only important weed source of PLRV for transmission to the potato crop in the PNW and points out the importance of controlling this weed.

Name of the scientist involved: Dr. Peter E. Thomas

End user of information/technology: Plant virus disease epidemiologist, potato growers and the potato seed production industry, consultants.

Description: Critical aspects in the epidemiology of potato virus Y (PVY) and other major potato viruses

Means: Invitational Talks at the Montana Seed Potato Seminar. November 9, 2001; Columbia Basin Potato Consultants. October 4, 2002; Washington State Potato Commission Research Council, February 13, 2002; Popular Press coverages in Spudman-Montana Seed Potato Seminar (potato popular journal)

Description: Critical Aspects in The Epidemiology of Major Potato Virus (P.E. Thomas): New questions regarding the epidemiology of potato viruses have arisen based on the fact that new strains of potato virus Y (PVY) have been found in Western United States that cause necrosis in tubers. These viruses not only eliminate affected tubers from local markets, but may exclude all fresh potatoes grown in the region from international markets. The approach toward controlling these and other potato viruses is heavily dependent on critical aspects of their epidemologies. If these viruses find suitable alternate hosts in the environment, they will become endemic, and their elimination from the region is already virtually impossible at this point. In this case, control measures will need to include, not only virus free seed production, but also the prevention of local dissemination from weeds in the environment, an approach which almost certainly will require the use of pesticides to kill vectors. Alternatively, if the new strains of PVY depend entirely vegetative propagation in potato, elimination of the viruses is theoretically possible by eliminating the virus from seed sources. Our work indicates that strains of PVY, potato virus A (PVA) potato virus S (PVS), potato latent virus (PLV) potato virus M (PVM), and potato leafroll virus (PLRV) do not survive winter in alternate hosts in the Columbia Basin. None of these viruses were found infecting overwintering weeds in the vicinities of 35 potato fields that had been identified with high incidence levels of PVY and PLRV in the previous season. Furthermore, PVA, PVY, PVM, PVS or PLV did not infect any potato plants grown in plots over a 3-year period in a region of the Yakima Valley that was once an important potato production area but is now well separated from existing potato fields. While, we could not identify an overwintering weed host for any of these viruses, all were found among three predominate summer annual potato weeds: Solanum sarachoides, Solanum trifolium, and Solanum niger. These weeds are all excellent hosts of the major insect vector of potato viruses, the green peach aphid, Myzus persicae. With the exception that S. niger was previously but incorrectly reported as a host of PLRV, none of these weeds were known to host any of the potato viruses studied here. This work represents the first identification of natural alternate hosts for PVM and PVS. The potential importance of these weeds is illustrated in our discovery that high levels of resistance to PLRV can overcome when S. sarrachoides is present in the field. We demonstrated, both in replicated field plots, and in commercial fields that populations of the green peach aphid decline precipitously when infected with the green peach aphid virus that we recently discovered.

Name of Scientist Involved: Dr. Ashok Alva

End User of Information/technology: Growers, field staff, consultants.

Technology Description: Pre-plant and in-season nitrogen management for potato.

Means: Presentations at: (i) Potato Cropping Systems Field Day, July 18, 2001; (ii) Cropping Systems Working Group Annual Meeting, January 29, 2002.

Description: Pre-plant applications of either 0, 50, or 100 lbs N/acre were evaluated on tuber yield and quality of Ranger Russet and Umatilla Russet cultivars grown on a Quincy fine sand, which contained 50 lbs N/acre of residual N at planting. The total N from all sources during the growing period was 300 lbs/acre. Additional treatment with 400 lbs/acre total N was also evaluated which received 50 lbs N/acre as pre-plant application. In all treatments, in-season N was applied in 2, 3 or 5 equal applications which began 5 weeks after emergence. The tuber yield of both cultivars showed no beneficial effects with application of 400 lbs N/acre as compared to that with 300 lbs N/acre; at the similar rate of pre-plant N application. The tuber yield of Ranger Russet was greater with either 50 or 100 lbs N/acre pre-plant application as compared to that with no pre-plant N application. However, this difference was rather marginal in Umatilla cultivar. Overall, this experiment demonstrated that frequency of in-season N application, in the range of 2 to 5, had negligible effects on the tuber yield of both cultivars.

Name of Scientist Involved: Dr. Ashok Alva

End User of Information/Technology: Growers, Field Staff, Consultants, Research and Extension Specialists

Technology Description: Nitrogen mineralization from crop residues in an irrigated potato production system.

Means: Presentations at: (i) Potato Cropping Systems Field Day, July 18, 2001; (ii) 47th Washington State Potato Conference, February 7, 2002; (iii) Washington State Potato Commission - Research Council meeting, February 13, 2002, (iv) Intl. Symposium on Soil and Plant Analysis, Edmonton, Canada, July 21-27, 2001; and, (v) Potato Progress, WSPC popular publication.

Description: The dry weight of corn, wheat, and potato residues sampled in the 0-12 inch depth soil in January 2000 (after the respective crops were harvested in the fall of 1999) were 11.8, 9.0, and 3.7 ton/acre, respectively. The total N content in the above residues were 355, 338, and 108 lbs/acre, respectively. By March 2000, the residue weights have decreased to 5.7, 3.4, and 2.1 ton/acre, respectively, along with the respective total N contents of 169, 102, and 61 lbs/acre. The residue weights further decreased to 1.1 - 1.7 ton/acre by September 2000 across all crop residues, with the total N content of 32 to 53 lbs/acre. The mineralized N, as both ammonium and nitrate forms, in the top 12 inch depth soil during January through September 2000 were 171, 129, and 72 lbs/acre from corn, wheat, and potato residue plots. The above values represented 48, 38, and 67 percentage of the total N in the respective crop residues measured in January 2000.