Center for Precision & Automated Agricultural Systems CPAAS 2011

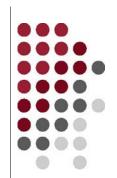










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WSU Center for Precision & Automated Agricultural Systems

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Message from the Director

The WSU Center for Precision and Automated Agricultural Systems (CPAAS) has continuously been striving for preeminence in 2011 by promoting creative research and extension activities for production agriculture. The top priorities of CPAAS for 2011are (1) to develop a more intimate management structure which encourages faculty to engage in interdisciplinary research, and (2) to create a critical mass of expertise in the subject area. We have focused on increasing the center impact by creating a more collaborative environment which attracts faculty to join us in pursuit of a common value. Using the approach of promoting the center's mission and encouraging faculty to apply for an affiliation with the center to pursue common goals, CPAAS has officially appointed 8 faculty members from Departments (Schools) of BSE, EEC, ES, HLA, and WSU Extension as affiliated members in 2011. All those faculty members, supported by CPAAS staff, have actively participated in various CPAAS functions, and contributed greatly to the center's accomplishments.

We have also put forth great effort to create an effective management structure, including establishing an External Advisory Committee (EAC) and an Internal Executive Committee (IEC). Both the six-member EAC formed by delegates from our stakeholders and the three-member IEC formed by Center faculty provided leaderships in development strategy and in major decision-making. Suggested by both committees, our faculty has created a mission statement for the Center, as stated at the first ever faculty retreat held in October 2011.

"To develop a world preeminent and Washington relevant research and educational program in the areas of agricultural automation and precision farming, our mission is to provide a venue for: (1) High impact research outcomes for our stakeholders; (2) True trans-disciplinary collaboration within WSU and World-wide; (3) High quality educational and research experiences for our students; and (4) Incubation and development of new ideas relevant in an entrepreneurial climate",.

The critical mass for conducting productive research relies strongly on recruiting qualified graduate students and research associates. Our international collaboration has continuously attracted students, scholars and scientists from different parts of the World. In 2011, CPAAS recruited five graduate students and three post-doctoral research associates which brought the total number of Ph.D. students to 8 and post-docs to 5. In addition, CPAAS hosted exchange students from China and Malaysia. The CPAAS research team supported multiple research projects, including five multi-institutional, trans-disciplinary SCRI projects (our faculty lead two of those projects) and several industry funded projects.

Working as a team, we are committed to developing a "World preeminent and Washington relevant" research and education program and to create solutions with precision agriculture and agricultural automation.









Qin Zhang Professor- Biological Systems Engineering Director- Ctr for Precision & Automated Agricultural Systems

Dr. Qin Zhang is the Director of CPAAS, and a Professor of the Biological Systems Engineering Department. He received his Ph.D. degree from the University of Illinois at Urbana-

Champaign in 1991, his M.S. degree from the University of Idaho in 1987, and his B.S. degree in from Zhejiang Agricultural University in China in 1982. Prior to his arrival at WSU, Dr. Zhang was a professor at the University of Illinois at Urbana-Champaign, and before joining the faculty at UIUC in 1997, he worked in Caterpillar Inc. as a Senior Engineer. Dr. Zhang has focused his teaching and research activities on agricultural mechanization, agriculture automation, and intelligent machinery. Based on his research outcomes, he has written two textbooks, published over 100 peer reviewed journal articles, presented over 200 papers at conferences, and has awarded nine U.S. patents. He is currently serves as the Editor-in-Chief for *Computers and Electronics in Agriculture*.



Paul G. Carter Associate Professor WSU Extension and Columbia County Director

Carter joined WSU Extension in 2005 serving Columbia County Extension Office as Director and Educator. In 2011 he completed affiliate status with CPAAS as a remote sensing and dryland

precision agriculture specialist. From Purdue University, he earned his B.S. (1974) in Agriculture Mechanization, M.S. (1999) in Agronomy Soil Science, and completed Ph.D. (2005, all but dissertation) Agronomy Remote Sensing. While completing degrees at Purdue University, he worked as a staff member with the Laboratory for the Applications of Remote Sensing (LARS). Paul's Extension programs in agriculture include precision technology applications, soil nutrition, and weed management. He participates in many of the state's agriculture organizations including Sec/Treas of the Washington State Crop Improvement Association. Internationally, he serves on the editorial board of the Journal of Precision Agriculture and presents at international conferences. Paul has initiated local Precision Farming seminars in Columbia County, presented at Lincoln-Adams, Garfield, and Walla Walla counties in Washington and Morrow county in Oregon. His leadership has impacted the adoption of precision technologies in the dryland wheat production area of Washington State.







Karina Gallardo Assistant Professor/ Extension Economist WSU Wenatchee TFREC School of Economic Sciences

Dr. R. Karina Gallardo is an Assistant Professor Extension Specialist in the School of Economic Sciences, stationed at the Tree Fruit Research and Extension Center of Washington State

University in Wenatchee. She holds a BS in Food Science from the Universidad Nacional Agraria La Molina (Lima, Peru), a Master in Science in Agricultural Economics from Mississippi State University and a PhD in Agricultural Economics from Oklahoma State University. Gallardo's primary research and outreach program goal is to enhance value-added agribusiness opportunities for specialty crops in the state of Washington. As such, her areas of research are focused on consumer demand analysis and economics of technological change. More specifically, Gallardo is conducting research assessing consumers' preferences for fresh fruit quality, and understanding the profitability and various other factors affecting growers' adoption of new technologies, such as new cultivars, improved pest management systems, and labor enhancing mechanisms.



Gwen-Alyn Hoheisel Area Extension Educator WSU County Extension Prosser

Gwen-Alyn Hoheisel started in 2006 as a faculty member with WSU Extension working in commercial tree fruit and grapes. She received her Master's degree in entomology from Pennsylvania

State University in 2002, and her B.S. degree in zoology from University of Maryland in 1998. Hoheisel has focused her work on sustainable pest management and application technologies. Her has resulted in 14 journal, extension, and trade journal publication; 40+ presentations at grower and scientific meetings; 1 computer database for growers; 30+ informational videos for growers; and 40+ in-depth educational workshops. Hoheisel also sits as an ex-officio board member to 5 Washington tree fruit and grape commodity organizations.







Manoj Karkee Assistant Professor Biological Systems Engineering

Dr. Manoj Karkee is an affiliated faculty member to the center and is an assistant professor in the Biological Systems Engineering Department. Dr. Karkee was born in Nepal where he received his

undergraduate degree in Computer Engineering. He went to Asian Institute of Technology, Bangkok, Thailand in 2003 for his Master's Degree in Remote Sensing and GIS. He received his PhD in Agricultural Engineering and Human Computer Interaction from Iowa State university in 2009 and joined WSU in 2010. Dr. Karkee has established a strong research program in agricultural automation and mechanization area with particular emphasis on machine vision systems. Some of his sponsored projects include *crop load estimation, fruit tree pruning, plant stress monitoring,* and *solid set canopy delivery*. He has been publishing actively in journals such as 'Computers and Electronics in Agriculture', and 'The Transactions of ASABE' and has been presenting frequently in national and international conferences.



Karen Lewis
WSU Regional Tree Fruit Specialist
Grant-Adams Area Extension
Executive Board Member CPAAS

Karen Lewis is a WSU Extension Regional Tree Fruit Specialist housed in the Grant-Adams Area Extension office and CPAAS. She earned her B.S. degree in Plant Science and her M.S. degree

in Horticulture at the University of Arizona. Karen's extension and applied research program has been guided by active participation and leadership in international, multi state and statewide academic teams and grower member industry organizations. Current program focus includes: development and integration of mechanized / labor assist technologies for tree fruit pruning, thinning and harvest; competitive apple and pear orchard systems; Engineering, horticultural and economic strategies for sustained production of high quality tree fruit nursery stock and light duty electric vehicles for on-farm operations.







Troy Peters
Extension Irrigation Specialist/Associate Professor
Biological Systems Engineering

Dr. Troy Peters works for Washington State University and serves as the Extension Irrigation Specialist at the Irrigated Agriculture Research and Extension Center in Prosser, WA. Troy received his

Ph.D. in irrigation engineering from Utah State University. Following graduation he worked at the USDA-Agriculture Research Service Conservation and Production Research Laboratory in Bushland, TX for three years. He has been with Washington State University for over 6 years. He is also a certified agricultural irrigation specialist and is a licensed professional agricultural engineer.



Li Tan School of Electrical Engineering and Computer Science WSU Tri Cities

Dr. Li Tan is an Assistant Professor in School of Electrical Engineering and Computer Science, and also on an affiliate assignment from CPAAS. He received his Ph.D. degree in Computer

Science from State University of New York at Stony Brook in 2002. He also have a M.S. degree in Computer Science (1999) from State University of New York Stony Brook, a M.S. degree in Computer Science (1997) and a B.S. Degree in Physics (1992) from Fudan University in China. Prior to his arrival at WSU in 2007, Dr. Li Tan was a research engineer at Mathworks, Inc. from 2004, and before that, a research associate and Postdoctoral fellow in the University of Pennsylvania. Dr. Li Tan's research interests include software testing and verification, dynamic system modeling and analysis, logistic system modeling and analysis, and decision support for precision farming. He published more than 30 articles on journals and peer-reviewed conference proceedings. He is currently directing the Center for Experimental Software Engineering at Washington State University, TriCities.







Dr. Matthew Whiting Associate Professor/Scientist and Extension Specialist Department of Horticulture and Landscape Architecture Executive Board Member CPAAS

Dr. Matthew Whiting is an Associate Professor/Scientist and Extension Specialist in the Department of Horticulture and Landscape Architecture. He received his Ph.D. degree from

Washington State University in 2001, his M.S. and B.Sc. degrees from the University of Guelph in Canada in 1998 and 1996, respectively. Dr. Whiting leads the stone fruit physiology program that addresses the key horticultural and physiological issues facing the industry. Dr. Whiting's research efforts are leading the integration of mechanization and automation in tree fruit through the development of planar orchard systems that are productive, precocious, profitable, and sustainable. Since 2002, Dr. Whiting has published over 40 peer-reviewed journal articles, garnered \$6M+ in grant funding, and given invited presentations around the globe.





CPAAS Support

Robert Dickson Information Systems Coordinator



Robert grew up in Seattle and graduated from the University of Washington with a degree in Political Science. His passion for computer technology led him to own and operate a small business in computer retail sales and service in Kennewick, WA for a number of years. Most recently Robert worked at Pacific Northwest National Laboratory in Richland, WA supporting IT in Information Management Services. Robert has a passion for technology and loves working within the research community.

Patrick Scharf Engineering Technician III



Patrick earned his B.S. in Animal Science from the University of Wisconsin-Madison in 1999. Scharf is currently working toward a Masters in Biological and Agricultural Engineering, here at WSU. Scharf's role at CPAAS includes management of facilities, research project management, project design consulting, project fabrication, safety coordination, shop manager, vehicle management, and providing assistance with administrative issues as they pertain to his activities. Scharf is also a coauthor on CPAAS publications and a listed contributor on invention disclosures to which he has made a significant contribution.

Linda Root Fiscal Specialist II



Linda came to WSU in 2006 with of seventeen years of experience in small business management. She helped facilitate the spin-off of AgWeatherNet and has been working to assist the growth of CPAAS. She has an AA degree in Business Administration from Columbia Basin College and performs functions in Center finance management, grant management, purchasing, travel, event planning as well as principal assistant to the Director.





Post-Doctoral Research Associates



Yiannis Ampatzidis



Xiaoqiang Du



Long He



Yongni Shao



Qi Wang

Graduate Students



Suraj Amatya



Mark DeKleine



Yunxiang Ye



Meng Wang



Joshua Kendall



Jingjin Zhang



Jianfeng Zhou



Bikram Adhikari





Visiting Scholars



Du Chen



Ruilong Luo



Lijuan Xie



Yong Zhao

Visiting Student Interns

Fatin Abjul Rahmen
Fatin Azizan







Project Summaries

Intelligent Agricultural Systems for Specialty Crop Production SPONSOR AGENCY: WSU ARC (Hatch)

Zhang*, Q.; Karkee, M.

The recent advancement of intelligent agricultural equipment (IAE) technology has made such equipment practical and applicable for agronomic crop production. However, there are still many special challenges to be solved before the technology can be practically applied to specialty crop production. The primary focus of this project is to remove such challenges to make IAE



technology practical and applicable for specialty crops production. Specific objectives of this project are to develop mechanization and robotic solutions for production of a wide range of specialty crops, including, but not limited to, fruits and vegetables, hops, grapes and berries, and nursery crops; to find automated solutions for disease/pest monitoring, scouting and controlling in specialty crop production; to develop core technologies for computer-aided worksite management, from data collection and analysis to decision-making support; and to create effective methods for demonstrating and delivering the research outcomes to the stakeholders.

Machine Vision System Development for Automatic Pruning of Apple Trees SPONSOR AGENCY: OFFICE OF RESEARCH-WSU

Karkee, M.

In apple production pruning is a labor intensive operation contributing significantly to total production costs. Automation of this process can significantly reduce these costs. In this research a machine vision based method was developed using a time-of-flight based 3D camera to reconstruct apple trees to identify pruning locations. From this data a skeleton of the tree was



rendered and that skeleton was simplified to mark points representing only junctions of branches and trunk. A two step pruning rule was used to identify pruning points. This method achieved an accuracy of approximaely 90% in identifying pruning locations. Further experiments are necessary for physical calibration of 3D skeletons and to develop statistical performance measures. Long term outcomes will be a decrease in manual labor, decreased affects associated with an uncertain labor force, increased profit to growers, and increased sustainability for the apple industry.





Integrated Systems Research and Development in Automation and Sensors for Sustainability of Specialty Crops SPONSOR AGENCY: USDA NIFA (REEIS)

Zhang*, Q.; Tang, J.; Pierce, F.J.; Sablani, S.S.; Lewis, K.M.; Clary, C.; Karkee, M.

Specialty crop producers have a need for automated production and post-harvest equipment. Aiming at filling this need by providing required research and development for such equipment, this project adapts biological concepts associated with specialty crop production, harvest, and postharvest handling into quantifiable parameters that can be sensed, develops sensors and sensing systems that can measure and interpret the parameters, and enhances the design and evaluation of



automation systems that incorporate varying degrees of mechanization and sensors to assist specialty crop industries with labor, management decisions, and reduction of production costs. The success of the project will be measured by the number of prototypes the participants develop, patents they file, and assistance they provide to industry in the process of developing commercial products.

Placing Fruit Canopy Management Automation Technology in the Field SPONSOR AGENCY: USDA NIFA (SCRI)

Zhang*, Q.; Karkee, M. Walters, T.; Whiting, M.D.

Canopy management operations are among the most expensive for specialty crop production, and the largest expense is the labor. Automated technology may replace humans, but must be tailored to the characteristics of the field, and to the size of the farm. The primary goal of this Research and Extension Planning project is to facilitate the development of a research plan for developing automated canopy management technologies suitable for Pacific Northwest cane berry production.

The specific objectives include the definition and clarification of the needs for automation in canopy management among western specialty crop producers; the development of comprehensive technical solutions to address automation issues in canopy management; and the formation of partnerships for this transdisciplinary research and development. A grower-researcher interactive workshop is designed to collect and process stakeholder input, to develop problem statements, and to form the goals of future proposed projects.







Precision Canopy and Water Management of Specialty Crops through Sensor-Based Decision Making SPONSOR AGENCY: USDA NIFA (SCRI)

Zhang*, Q; Whiting, M.D.; Tan, L.; Peters, R.T. (WSU Team)

This project is a subcontract to a SCRI project with UC Davis as the leading institute. WSU team will contribute to all 9 objectives and will take critical roles in a few: we will refine the sensor system and perform the canopy PAR/shape assessment in tree fruit orchards (Objective 1); and we will develop a research-grade sensing and mapping system to gather the data for each plant using multiple sensors to predict plant water status (Objective 2). The WSU Investigators will lead the development of visualized decision support system to meet the decision support needs of growers, university researchers (Objective 4); and will be involved in the development and implementation of site-specific application of water and fertilizer using autonomous units (Objective 5). Collaborating with external partners, we will also conduct studies on assessing social impacts of developed innovative technologies through collecting, analyzing and summarizing collect data (Objective 7).

Field Validation of DBR Harvest Assist System Under Washington Conditions

SPONSOR AGENCY: USDA NIFA (SCRI) and Washington Tree Fruit Research Commission

Lewis*, K.M., DBR Conveyor Concepts

Mechanized harvest is a documented priority for the Washington State tree fruit industry. The goal of this project is to design, build and evaluate a commercial prototype harvest assist system in Washington State apple orchards. DBR Conveyor Concepts of Conklin, MI. have recently developed vacuum tube, decelerator and dry bin filler harvest assist technologies. The technologies will be integrated on a mobile platform and will be evaluated in Washington apple orchards. Initial focus will be on the function and design of individual components and the total system. As warranted, redesign and component modifications will be made throughout field validation phase. Validation studies will include: 1) location of impacts that have potential to bruise fruit, 2) incidence and type of bruising, 3) system efficiency and individual worker productivity alone and compared to identical work conducted with ladders and bags. Identification and documentation of best management practices will be included in outreach efforts.







Innovative Technologies for Thinning Fruit SPONSOR AGENCY: USDA NIFA (SCRI) and Washington Tree Fruit Research Commission

Heineman, P., Dejong, T., Delwiche, M., Grift, T., Harper, J., Lewis, K., Liu, J., Feighard, G., Schupp, J., Slaughter, D., Tao, Y., Walsh, C.,

Blossom thinning is reported to mitigate alternate bearing in apple and increase final fruit size in both apple and stone fruit. Hand blossom thinning is expensive and requires a large workforce for a short time period. Efficacy and performance of chemical thinning is highly dependent on weather conditions, tree status and application methods. Organic producers have few products to



chemically thin fruit. Project investigators have evaluated two non-selective mechanical string thinners and technologies for selective thinning. Field studies include the evaluation of the Darwin and Unibonn string thinners in apple and stone fruit. Replicated field trials compare mechanized bloom thinning, hand bloom thinning, hand green fruit thinning and chemical thinning. To evaluate treatments, data is collected on bloom removal, fruit set, fruit quality and yield. In addition, task efficiency and individual worker productivity is measured and economic analysis is conducted for each treatment.

Development and Optimization of Solid-Set Canopy Delivery Systems for Resource-Efficient, Ecologically Sustainable Apple and Cherry Production SPONSOR AGENCY: USDA NIFA (SCRI)

Brunner*, J.; Zhang, Q.; Karkee, M.; Whiting, M.; Hanrahan, I.; Schmidt, T.; Xiao, C.-L.; Hoheisel, G.-A. (WSU Team)

This project is a subcontract to a SCRI project with Michigan State University as the leading institute, and co directed by Dr. Brunner of WSII. This project is

institute, and co-directed by Dr. Brunner of WSU. This project is performed a multidisciplinary research and extension team from three of the major fruit-producing states to develop, evaluate, and deliver resource-efficient, innovative management technologies and tactics for apple and cherry production systems. It aims to establish innovative delivery technologies for canopy and orchard floor inputs (including high efficiency irrigation systems, precision-activated micro-emitters, and reduced risk pesticides) to address critical fruit production needs as identified by commodity PMSPs and the Technology Roadmap for Tree Fruit Production. Direct outcomes of system implementation that will be analyzed include: economic and agro ecosystem impacts. Sociological research will focus on how these integrated technologies impact urban-



farm relations, barriers to grower adoption, and how these factors can inform better extension and educational programmatic efforts.





A Total Systems Approach to Developing a Sustainable Stem-Free Sweet Cherry Production, Processing, and Marketing System SPONSOR AGENCY: USDA NIFA (SCRI)

Whiting*, M.D.; Zhang, Q; Dhingra, A.; Oraguzie, N.; Pierce, F.; Ross, C.

This research is part of a large multi-state, multi-disciplinary research project funded by the USDA's Specialty Crop Research Initiative (SCRI). This four year project began in 2009. The overall research goal is to develop a highly effective sweet cherry production, processing, and marketing system with effective research and outreach programs addressing the entire production

chain. Researchers are working closely with industry to solve problems that have been identified. The rationale behind this research project is clear: to remain profitable and sustainable, the sweet cherry industry must improve harvest labor efficiency without reducing consumer appeal of fruit. Objectives are addressed in horticulture, genetics & genomics mechanical harvest technologies, packaging & consumer acceptance and economics.



Systems Approach to Superior Pear Fruit Quality SPONSOR AGENCY: NW Pear Bureau

Dhingra*, A.; Evans, K.; Sablani, S.; Zhang, Q.; Ross, C.

This proposal is a systems approach to establishing pear-specific knowledgebase. In the past recommendations for improving pear production, processing and packaging have heavily relied on systems established for apple. However, pears are not apples, and there is an urgent need to reevaluate our approach in how to develop pear-specific solutions for production, post-harvest and processing stages. We plan to utilize this project as a platform to successfully compete for federal USDA-SCRI grant. The specific objectives of this proposal include: to evaluate and devise efficient orchard systems that are amenable to mechanized pruning and harvest using labor assist platforms; to assess the effectiveness of vigor-retarding chemicals like Apogee and Treehold by understanding the underlying gene function; to test the role of cuticle as it relates to fruit quality using microscopy; and to evaluate alternative fruit sanitization platforms like UV or gamma rays in lab settings.







3D Machine Vision for Improved Apple Crop Load Estimation SPONSOR AGENCY: WTFRC

Karkee*, M.; Zhang, Q.; Lewis, K.M.

Accurate estimation of apple cropload is essential for efficient orchard management. In this work, we designed an over the row platform to capture images from two side of apple canopies to



minimize the occlusions and improve the accuracy of cropload estimation. A color camera, a 3D camera and a orientation sensor were mounted in the sensor platform and moved along rows apples in three different commercial orchards of Allan Bros. Inc., Prosser, WA. Overall, the images of apples trees were successfully captured from both sides of the row using this platform. Taking images from dual sides showed to be fruitful as more apples were identified which were occluded when viewed from a single side. The next step of the project will be processing of images to identify apples and match it with 3D images to create 3D maps of apples. The sensorplatform system will be improved to make it lighter and easier to operate. Fruit mapping in 3D will minimize duplicated fruit counts and thus improve the accuracy of crop load estimation. Increased accuracy of crop load estimation on a block by block basis would lead to increased efficiencies, a higher level of risk management and increased profitability.

Hand-held Mechanical Thinning Devices for Cherry Production SPONSOR AGENCY: WTFRC

Zhang*, Q.; Lewis, K.M.

Industry groups have identified crop load management to be a high priority for research and technology development. Blossom thinning is a common practice for crop load management in tree fruit production. Manageable yields of high quality target fruit is the goal of bloom thinning. Mechanized thinning has shown the potential to significantly reduce the dependence on human labor in thinning operations. This research aims to create a hand-held mechanical-assist thinning device which will allow field workers



to penetrate inner layers of cherry trees to selectively thin blossoms without using a ladder, and reduce labor dependency through increased operation efficiency and worker productivity. This project will search and review previous attempts on developing such technologies, and analyze the causes of unsuccessful attempts and the key attributers to the successful systems, followed by development of a few "proof-of-concept" prototype systems and conduct field tests to verify their functionality and performance





Intelligent Bin-Dog System for Tree Fruit Production SPONSOR AGENCY: WTFRC

Zhang*, Q.; Lewis, K.M.; He, L.

The tree fruit industry needs technological innovations which can assist growers in maintaining a competitive position in the global marketplace. High labor demand, associated costs and rigorous regulations, requires the industry to adopt mechanical and/or automated approaches to solve production system challenges. As verified in the *preliminary study*, a "bin-dog" system could be used in commercial orchard environments and pickers supported by a mimicking "bin-dog" could achieve improved harvest efficiency in both cherry and apple harvests. This *second phase* project will be focused on developing a prototype of an actual "bin-dog" system capable of helping human pickers to achieve the goals of more efficient harvesting with better fruit quality, improved worksite safety and superior production and quality traceability. The core capabilities of the "bin-dog" include (1) carrying one fruit bin within the vicinity of picker harvesting zone; and (2) traveling within typical WA tree fruit orchards.

Multispectral Image Analyses of Potatoes under Different Nutrient Management with Center Pivot Irrigation

SPONSOR AGENCY: USDA ARS Prosser Vegetable and Forage Crop Research Unit

Alva*, A.; Zhang, Q.; Karkee, M.

This research project aims to investigate the feasibility of non-destructive estimation of nutritional status of potato canopy using multispectral imaging and prediction of tuber yield and quality response to variable nutrient management under pivot irrigation. Spectral characteristics of vegetation are a quantitative measure and can offer a non-destructive method to assess crop nutrition; biomass production; yield and quality of crop products. This type of sensing technology has been successfully developed for detecting nitrogen stress in agronomic crops, but little



research has been reported on effectively and accurately measuring the nutritional status of potato plants in irrigated production systems using multispectral images. This project will modify the technology to potato production under center pivot irrigation. Furthermore, multispectral image sensing can be an efficient tool of non-destructive evaluation of potential non-uniformity in water distribution in center pivot irrigation system.



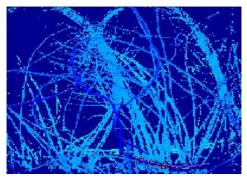


Student Projects

3D Machine Vision System Development for Red-raspberry Pruning

Adhikari, B.; and Karkee, M.

Pruning is a labor intensive operation in red raspberry production. Mechanization can reduce labor demand from such labor intensive tasks. This project focused on development of a 3D machine vision system to map red raspberry bushes for automatic pruning. A sensor platform consisting of a time-of-flight-of-light-based 3D camera and a color vision camera was developed to move these sensors along a raspberry row. A set of 3D and color images were collected in the experimental red raspberry plots in Northwest Research and Extension Center



of Washington State University. These 3D images were processed to remove noise and plants that did not belong to the rows adjacent to the sensors. A 3D skeletonization algorithm was used to obtain the 3D structure of these bushes.

A Thermal Weed Control Technique in Agriculture

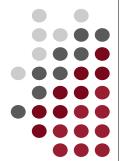
Mark De Kleine, Yongqian Ding, Manoj Karkee, Qin Zhang

Weed competition can reduce the growth of young crops and ultimately reduce produce quality and yield. Growers currently rely on costly chemical and/or manual weed control practices to reduce the weed competition with their crops. Soil-pasteurization could be an innovative weed control practice to reduce the cost and environmental effects of manual and/or chemical weed control techniques. In this work, thermal water treatments using variations of temperature and time were applied to two types of grass seeds to evaluate the effects on seed germination in a laboratory environment. Seeds were wrapped in brown paper towels during the thermal treatments and then kept in a plastic dome, at 23°C, for 14 days. A germination rate of 81% was measured at 23°C water treatments, whereas no grass seed was germinated when 80°C water was applied for





30s. These results show that a thermal water soil-pasteurization technique has a potential to effectively control weed seed germination in agricultural fields.





Publications

Peer Reviewed Journal Articles

- 1. Chen, D., X. Du, S. Wang and Q. Zhang, 2011. Mechanism of vibratory fruit harvest and review of current advance. Transactions of the CSAE, 27(8): 195-200.
- 2. Gallardo, R.K. 2011. Choice Experiments' Findings: A Tool for Fruit Agribusiness Managers Decision Making. International Food and Agribusiness Management Review, 14: 95-110.
- 3. Gallardo, R.K., E. Kupferman, and A. Colonna. 2011. Willingness-to-pay for Optimal Anjou Pear Quality. HortScience, 46: 452-456.
- 4. Gallardo, R.K., E. Kupferman, R. Beaudry, S. Blankenship, E. Mitcham and C. Watkins. 2011. Market Quality of Pacific Northwest Pears. Journal of Food Distribution Research, 42: 89-99.
- Hehnen, D., I. Hanrahan, K.M. Lewis, J. McFerson and M.M. Blanke. 2012. Mechanical thinning improves fruit quality and provides consistent bearing in apple. Scientia Horticulturae, 134(1) 241-244
- 6. Iezzoni, A.F., J.W. Olmstead, and M.D. Whiting. 2011. Selecting and fingerprinting the next generation of size-controlling rootstocks for sweet cherry. Acta Hortic. 903:235-240.
- 7. Kang, F., F.J. Pierce, D.B. Walsh, Q. Zhang and S. Wang, 2011. An automated trailer sprayer system for targeted control of cutworm in vineyards. Transactions of the ASABE, 54(4): 1-9.
- 8. Olmstead J.W., M.D. Whiting, G.A. Lang, D. Ophardt and Oraguzie N.C. 2011. 'PC7146-8' (Benton®) Sweet Cherry. HortScience 46(1): 121-122.
- 9. Olmstead J.W., M.D. Whiting, G.A. Lang, D. Ophardt and Oraguzie N.C. 2011. 'PC7064' (Selah®) Sweet Cherry. HortScience 46(1): 123-124.
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- 12. Seavert, C. and M.D. Whiting. 2011. Comparing the economics of mechanical vs. hand harvest of sweet cherry. Acta Hortic. 903:725-730.
- 13. Smith, E.D. and M.D. Whiting. 2011. The pedicel's role in postharvest weight loss of two sweet cherry cultivars. Acta Hortic. 903: 935-939.
- Wang, Q., Q. Zhang, F. Rovira-Más and L. Tian, 2011. Stereovision-based lateral offset measurement for vehicle navigation in cultivated stubble fields. Biosystems Engineering, 109: 258-265
- 15. Zhang, C. and M.D. Whiting. 2011. Improving 'Bing' sweet cherry fruit quality with plant growth regulators. Scientia Hortic. 127:341-346. (IF 1.20)
- Zhang, C. and M.D. Whiting. 2011. Pre-harvest foliar application of Prohexadione-Ca and gibberellins improve sweet cherry fruit quality and storability. Plant Growth Regulat. 65:156-165 (IF – 1.33)



Extension Publications

- 1. Galinato, S. and R. K. Gallardo. 2010 Cost Estimates of Producing Pears in North Central Washington. Washington State University Extension Factsheet FS031E, July, 2011.
- Galinato, S. and R.K. Gallardo. Cost Estimates of Producing Bartlett Pears in Yakima Valley, Washington. Washington State University Extension Factsheet FS034E, July, 2011.
- 3. Galinato, S. and R.K. Gallardo. Forthcoming. 2011 Cost Estimates of Establishing and Producing Honeycrisp Apples in Washington. Washington State University Extension Factsheet.
- 4. Gallardo, R.K. 2010 Cost of Producing Native and Scotch Spearmint under Rill and Center Pivot Irrigation in Washington. Washington State University Extension Factsheet FS026E, April, 2011.
- 5. Moyer, M.M., Mills, L., Hoheisel, G., & Keller, M. 2011. Assessing and Managing Cold Damage in Washington Vineyards. EM042E Washington State University.
- 6. Peters, R.T. 2011. Managing Wheel-Lines and Hand-Lines for High Profitability. WSU Peer Reviewed Extension Publication. Accepted and In Press. Publication # FS044
- 7. Peters, R.T. Practical Use of Soil Moisture Sensors for Irrigation Scheduling. Under review.
- 8. Peters, R.T. Using the Atmometer for Irrigation Scheduling in Washington. Under review.
- 9. Peters, R.T., 2011. Lawn Watering: Tips to Save Water, Save Money, and Have a Healthy Green Lawn. WSU Extension Fact Sheet. Accepted for Publication.
- Peters, R.T., 2011. El Manejo de Líneas de Riego de alas Móviles-Rodantes (wheel-lines) y Líneas de alas Móviles-a-Mano (hand-lines) para Incrementar la Rentabilidad. WSU Extension Publication # FS044ES
- 11. Peters, R.T., and J.R. Davenport. 2011. Managing Irrigation Water on Different Soils in the Same Field. WSU Extension Publication. Under Review.







Conferences/Proceedings and Abstracts

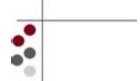
- 1. Ampatzidis, Y. and M. Whiting. 2011. Modeling Activities During Manual Fruit Harvesting. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 2. Ampatzidis, Y. and M. Whiting. 2011. Simulation of Bin Loading Process During Manual Harvest of Specialty Crops Using the Machine Repair Model. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 3. Ampatzidis, Y. and M. Whiting. 2011. Training System Affects Sweet Cherry Harvest Efficiency. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 4. Ampatzidis, Y., B. Adhikari, M. Whiting, and Q. Zhang. 2011. System for Monitoring Picker Efficiency During Harvest of Specialty Crops. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 5. Ampatzidis, Y., M.D. Whiting, X. Du, and Q. Zhang. 2011. UML modeling of mechanical harvester work flow. HortScience. 46:S211. (abstract)
- Ampatzidis, Y., S. Vougioukas, and M.D. Whiting. 2011. Modeling activities during manual fruit harvesting: A comparison of processes in the U.S. and Greece. HortScience. 46:S159. (abstract)
- 7. Ampatzidis. Y., F.J. Pierce, and M.D. Whiting. 2011. Portable weighing system for determining harvest efficiency. HortScience. 46:S161. (abstract)
- 8. Athanson, B., A. Young, C. Peace, D. Main, A. Dhingra, M. Whiting, T. Einhorn, L. Long, I. Hanrahan, T. Auvil, J. McFerson, and N. Oraguzie. 2011. Advances in PNW Sweet cherry breeding and genetics program. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 9. Chen D., X. Du, Q. Zhang, M. D. Whiting, and S. Wang. 2011. Performance evaluation of two mechanical harvesters in removing cherry fruits for fresh market. ASABE Paper No. 1110524. St. Joseph, Mich.: ASABE.
- 10. Du, X., D. Chen, Q. Zhang, P. Scharf, and M. Whiting. 2011. Mechanical harvesting of UFO cherry: investigation of tree plant dynamics. ASABE Paper No. 1110523. St. Joseph, Mich.: ASABE,
- 11. Gibeault, D., R. Contreras, T. Einhorn, and M. Whiting. 2011. The influence of crop load on sweet cherry fruit size and quality. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 12. Kilian, B., T. Koepke, C. Hendrickson, E. Smith, M. Whiting, N. Oraguzie, and A. Dhingra. 2011. Sweet Cherry Research: Examining the gene expression of fruit-pedicel abscission. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 13. Koepke, T., R. Sharpe, A. Harper, J. Grimes, S. Schaeffer, V. Krishnan, D. Jiwan, M. Whiting, N. Oraguzie, and A. Dhingra. 2011. CisSERS and SNPs. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- Peters, R.T. 2011. Kansched for Potato Irrigation Scheduling. Proceedings of the 2011 WA/OR Potato Irrigation Conference. Kennewick, Washington. Jan. 27, 2011
- 15. Sanchez-Labbe, A. and M. Whiting. 2011. Pruning strategies for renewing uprights and managing tree height in the UFO system. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 16. Sanchez-Labbe, A. and M. Whiting. 2011. Targeted treatment with Prohexadione-CA can control vigor in sweet cherry. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.





- 17. Sanchez-Labbe, A. and M. Whiting. 2011. Timing of training affects distribution of uprights in the UFO system. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 18. Sanchez-Labbe, A. and M.D. Whiting. 2011. Variability in sweet cherry flower bud distribution in the UFO system is related to genotype and shoot vigor. HortScience. 46:S124. (abstract)
- 19. Wang, M., H. Wang, Q. Zhang, K. M. Lewis, and P. Scharf. 2011. A hand-held mechanical blossom thinning device for fruit trees. ASABE Paper No. 1110525. St. Joseph, Mich.: ASABE.
- 20. Wang, Q., H. Wang, and Q. Zhang. 2011. Machine vision-based color rating of sweet cherries in an outdoor environment. ASABE Paper No. 1110521. St. Joseph, Mich.: ASABE.
- 21. Whiting, M.D. 2011. Developing planar architectures for sweet cherry. Washington State University Academic Showcase. Pullman, WA
- 22. Whiting, M.D. 2011. The UFO training system for high efficiency sweet cherry orchards. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 23. Whiting, M.D., A. Dhingra, N. Oraguzie, Q. Zhang, R. Allard, V. Bryan, E. Almenar, J. Grant, J. Harte, L. Long, F. Pierce, C. Ross, and C. Seavert. 2011. SCRI research: A total systems approach to developing a sustainable stem-free sweet cherry production, processing, and marketing system. Washington State University Academic Showcase. Pullman, WA.
- 24. Whiting, M.D., E. Smith, and Y. Yu. 2011. Variability in apple fruit quality is unrelated to fruit position and flower type. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 25. Whiting, M.D., E. Smith, S. Bound, and D. Close. 2011. The role of flowering time on sweet cherry fruit quality. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 26. Whiting. M.D. 2011. The U.F.O. architecture: A novel system for high efficiency sweet cherry orchards. HortScience. 46:S124. (abstract)
- Zhang, J.J., M. Whiting, and Q. Zhang. 2011. Light interception in two planar architectures of sweet cherry: UFO & Y Trellis. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 28. Zhang, L. and M.D. Whiting. 2011. Assessing the role of the pistil in sweet cherry fruit set. Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.
- 29. Zhang, L., B. Li, M.D. Whiting, C. Zhang, W. Xu, and S. Wang. 2011. The effect of hydrogen cyanamide on sweet cherry floral organ development in a low-chill region. HortScience 46:S123. (abstract)
- 30. Zhang, Q. 2011. Mechanization and automation for sustainable horticultural crop production. In: Proceedings of CIGR 2011 Sustainable Bioproduction Symposium.
- 31. Zhao, Y., A. Dahl O.B. Anthanson, E. Smith, M. Whiting, and N. Oraguzie. 2011. Variation in pedicel-fruit retention force in sweet cherry. HortScience. 46:S132. (abstract)
- 32. Zhao, Y., A. Dahl, B. Athanson, E. Smith, M. Whiting, and N. Oraguzie. 2011. Variation in fruit-pedicel retention force in sweet cherry (Prunus avium L.). Annual Meeting of WA Hort. Soc. 5-7 December. Wenatchee.





Grants and Awards

Current Projects/Grants

Development and Optimization of Solid-Set Delivery Systems for Resource Efficient, Ecologically Sustainable Apple and Cherry Production (USDA SCRI Project)	\$771,391
Precision Canopy and Water Management of Specialty Crops through Sensor-Based Decision Making (USDA SCRI Project)	\$666,246
Comprehensive Automation for Specialty Crops (USDA SCRI Project)	\$51,550
Placing fruit canopy management automation technology in the field (USDA SCRI Project, WSU Led)	\$49,479
A Total Systems Approach to Developing a Sustainable, Stem-free Sweet Cherry Production, Processing, and Marketing System (USDA SCRI Project, WSU Led)	\$3,891,952
Five (5) projects from Commodity Commissions of WA and Oregon	\$262,491
One (1) collaborating project with USDA ARS (Prosser, WA)	\$19,129
Total	\$4,880,847





2011 Proposals still pending as of March 2012

Advancing mechanical approaches to pollination for yield security and improved quality in fruit crops (WSU Led)	\$4,974,976
Automating Intra-Row Weed Control in Vegetable Crops (WSU Led)	\$3,960,000
Conversion of High-Yield Tropical Biomass into Sustainable Biofuels	\$709,223
Development of Jatropha Feedstock for Advanced Biofuels in the Tropics	\$765,769
Improving the profitability of blueberry production with a comprehensive precision agriculture program	\$418,351
Mitigation of Powdery Mildew Diseases on Perennial Specialty Crops	\$49,988
Adaptive Measures of Climate Change Impacts on Livestock Management in Nepal	\$79,946
Human-robot collaboration for efficient pruning of perennial fruits	\$595,084
Optimizing application technology and education to improve pesticide deposition and worker and environmental safety for orchards/vineyards(SCRI Proposal, WSU Led)	\$4,575,289
Over-the-Row Technologies for High Efficiency Orchard Systems(SCRI	\$4,692,053
Comprehensive Automation For Specialty Crops (Renew)	\$161,410
Systems Approach to Ensuring Superior Pear Fruit Quality	\$50,000
Three projects from Commodity Commissions of WA	\$152,964
<u>Total</u>	\$21,185,053





Outreach

The Center has made great efforts in outreach to promote academic collaboration between other institutions and to deliver technology to growers and stakeholders.

January

Qin Zhang presented to Washington State Cherry Institute Annual Meeting on the topic of Automation & Electrification - The Trend of Agricultural Mechanization (Yakima, WA: January 14, 2011).

Matt Whiting met with industry representatives to discuss mechanical pollination technologies. (Yakima, 3 January)

Matt Whiting gives presentation on mechanical harvest of fresh market quality sweet cherries at Cherry Institute Meeting (Yakima, WA, 14 January)

Matt Whiting gives presentation on sweet cherry SCRI research at the North Central Washington Stone Fruit Day (Wenatchee, WA: 20 January)

Gallardo, R.K. 2011. What does it Cost to Grow Cherries? A Recent Grower Based Study. Presentation given at the 2011 North Central Washington Stone Fruit Day. Wenatchee, WA. January 20.

February

Qin Zhang participated in the IFTA conference (Pasco, WA: February 27-28, 2011).

Karen Lewis and Tom Auvil conducted IFTA Intensive Workshop: Horticulture. Technology and Economics (February 5, 2011)

Karen Lewis et al. conducted IFTA Annual Conference: Sustainable Innovation (February 6-9, 2011)

Gwen Hoheisel: All industry Blueberry Meeting, 2/08/2011, 12 participants-8 hours

Gwen Hoheilsel: Vineyard Pests and Diseases at the Washington Association of Wine Grape Growers; 100 participants – 2 Hours: February 6-9, 2011).

Gwen Hoheisel: Pruning Strategies for Winter Damage in Grapes; 02/17/2012- Grape growers, 120 participants 8 hours

Matt Whiting holds pruning demonstration in peach orchard (Prosser, WA: 2 February)

Gallardo, R.K. 2011. Marketing. Guest Instructor at the Small Farms Cultivating Success Program – WSU Skagit County. Mount Vernon, WA. February 3.

Matt Whiting gives presentation on mechanical harvest of sweet cherries at Cherry Research Review (The Dalles, OR: 8 February)





Gallardo, R.K. 2011. What does it Cost to Grow Cherries, Gala Apples and Anjou Pears? Recent Grower Based Studies. Presentation given to Sales Personnel – Domex Superfresh Growers. Yakima, WA. February 14.

Gallardo, R.K. 2011. What does it Cost to Grow Bartlett Pears. Recent Grower Based Study. Presentation given at the Washington-Oregon Canning Pear Association Annual Meeting. Yakima, WA. February 15.

Matt Whiting demonstrates mechanical pruning of a planar sweet cherry orchard (Prosser, WA: 16 February)

Matt Whiting coordinates tour of UFO sweet cherry orchards (Buena, WA: 22 February)

Gallardo, R.K. and Taylor, M. 2011. WSU Tree Fruit Enterprise Budgets, A Powerful Tool to Track and Manage your Expenses. Presentation given at the 54th International Fruit Tree Association Pre-Conference Workshop. Pasco, WA. February 26.

Qin Zhang and Matt Whiting participated in the IFTA conference (Pasco, WA: February 27-28, 2011).

Matt Whiting coordinates tour of UFO sweet cherry orchards (Buena, WA: 28 February)

Baugher, T. A., J. Schupp, K.M. Lewis, G. Hoheisel, K. Ellis, D. Ames, J. Remcheck. 2011. Pilot orchards provide laboratories in the field to increase industry adoption of labor assist and precision technologies. Mid Atlantic Fruit and Vegetable Convention,
Hershey, PA. Poster presentation

Baugher, T. A., R. Duncan, K. Ellis, J. Harper, P. Heinemann, K. M. Lewis, G. Reighard, J. Schupp. 2011. String Blossom Thinner Designed for Variable Tree Forms Increase Crop Load Management Efficiency in Trials in Four U.S. Stone Fruit Growing Regions., Mid Atlantic Fruit and Vegetable Convention, Hershey, PA. Poster presentation

March

Qin Zhang attended Navy Green Fleet Initiative Workshop (Honolulu, HA: March 6-8, 2011).

Prof. Noboru Noguchi of Hokkaido University, Japan visited CPAAS, discussed future collaborations in agricultural field robot research and education with Dr. Zhang, and gave a seminar to Faculty, staff and graduate students at IAREC (March 12-15, 2011).

Prof. Yingjie Gao of Yanshan University, China visited CPAAS, and discussed future collaborations in intelligent off-road equipment research and education with Dr. Zhang (March 12-15, 2011).

Gwen Hoheisel: Spotted Wing Drosophila/Brown Marmorated Stinkbug Workshop 03/08 thru 04/11, 2011 20 Participants 48 hours





Gallardo, R.K. 2011. Direct Marketing Alternatives for Fruits and Vegetables, Trends and Issues. Presentation given at the Ag in Uncertain Times en Español Webinar Series. Wenatchee, WA. March 7

Gallardo, R.K. 2011. Issues in Wheat Marketing. Presentation given at the Wheat Production Growers Meeting Organized by WSU Chelan Douglas County Extension. Waterville, WA. March 2.

Gallardo, R.K. 2011. An Overview of the Webinar Series Ag In Uncertain Times En Español. Presentation given at the WSU Douglas-Chelan County Extension Seminar on Pesticide Application, Spanish Section. Wenatchee, WA. March 24.

Gallardo, R.K. 2011. Marketing. Guest Instructor at the Small Farms Cultivating Success Program – WSU Clark County. Brush Prairie, WA. March 22.

Peters, R.T. 2011. Practical Use of Soil Moisture Sensors for Irrigation Scheduling. WA Mint Drops Newsletter. Spring 2011 Issue.

April

Karen Lewis arranged to have Dr. Sanjiv Singh, Carnegie Melon University Field Robotics Institute, visit CPAAS and present BSysE Semina

Matt Whiting hosts UFO orchard plot tours (Prosser, WA: 6 April)

Matt Whiting gives presentation on modern orchard systems (Pullman, WA: 14 April)

Peters, R.T. 2011. Practical Use of Soil Moisture Sensors for Irrigation Scheduling. Good Fruit Grower. April 2011 Issue

May

Qin Zhang visited Forest Concepts LLC in Auburn, WA to discuss commercialization solutions for CPAAS research outcomes (May 10, 2011).

Qin Zhang visited Nanjing Agricultural University, China, and gave seminars in agricultural automation and horticultural mechanization (May 24-27, 2011).

Matt Whiting hosts media tour of new orchard systems (Prosser, WA: 4 May)

Gallardo, R.K. 2011. Cost of Establishing a Fruit Orchard and National Fruit Market Trends. Presentation given at the WA Chapter of the American Society of Farm Managers and Rural Appraisers. Leavenworth, WA. May 5.

Matt Whiting hosts tour of graduate students (Prosser, WA: 20 May)

Gallardo, R.K. 2011. How to Develop a Business Plan. Presentation in Spanish given to Yakima Hispanic Growers. Yakima, WA. May 19

Matt Whiting attends Cherry Institute planning meeting (Yakima, WA: 25 May)





Matt Whiting hosts visitors from New Zealand and organizes orchard tours (Yakima Valley, WA: 28 May)

June

Qin Zhang visited China Agricultural University, China to attend the final defenses of two jointly advised Ph.D. students, both conducted their Ph.D. thesis research at CPAAS (June 1-4, 2011).

Qin Zhang attended the W1009 Meeting (Honolulu, HA: June 15-17, 2011).

Matt Whiting coordinates orchard systems tour for growers from Montana (Yakima Valley, WA: 3 June)

Matt Whiting attends and presents results at Oregon State University cherry field day (The Dalles, OR: 7 June)

Matt Whiting organizes and hosts Washington State University cherry field day (Yakima Valley, WA: 8 June)

Gallardo, R.K. 2011. A Market Driven Approach to Address some of the Pacific Northwest Pear Industry Challenges. Presentation at the School of Economic Sciences. Pullman, WA, June 16.

Peters, R.T. 2011. Managing Irrigation Water in Fields with Very Different Soils. Fruit Grower News. June 2011 Issue

Matt Whiting hosts international tour group at WSU research orchards (Prosser, WA: 21 June)

Matt Whiting hosts tour group from New Zealand, providing tours of modern cherry orchard systems (Yakima Valley, WA: 28 June)

Gallardo, R.K. 2011. Production Costs for Sweetheart Cherries, Gala Apples and Anjou Pears and Platform Use Survey Results. Presentation in Spanish given to Visiting Chilean Growers, as part of the Fruit Growing Technological Tour organized by WeCu Inc. Wenatchee, WA. June 23.

Gallardo, R.K., Q. Wang, and J.F. Brunner. 2011. Great Apples at Low Pests: Growers' Valuation of Insecticide Features. Selected Paper presented at the Western Agricultural Economics Association Annual Meetings. Banff, CA. June 29-July 1

Gallardo, R.K., V. McCracken, and C. Yue. 2011. Investigating Rosaceae Breeding Programs' Priorities. Selected paper presented at the Western Agricultural Economics Association Annual Meetings. Banff, CA. June 29-July 1.

July

CPAAS faculty, staff and students participated in WSU Sweet Cherry Field Day (July 27)

Matt Whiting hosts tour group from Chile, leading a tour of new cherry orchards (Yakima Valley, WA: 1 July)

Matt Whiting hosts the Northwest Nursery Improvement Institute (Prosser, WA: 6 July)





Matt Whiting provides orchard systems tour for visitors from New Zealand (Yakima Valley, WA: 8 July)

Matt Whiting organizes tour of packing facilities for Dr. Eva Almenar (Michigan State University) (WA: 14-15 July)

Matt Whiting coordinates orchard system tours for visitors from Chile (Yakima Valley, WA: 25 July)

Gallardo, R.K. 2011. Application of Choice Experiments to Elicit Economic Values for Targeted Pear Quality Traits. Invited presentation given at the Agricultural and Applied Economic Association Annual Meetings. Pittsburg, PA, July 25.

August

Manoj Karkee, Qin Zhang, a few Post-Docs and Graduate Students participated in the ASABE International Annual Meeting and presented papers (Louisville, KY: August 8-10, 2011)

Gallardo, R.K. and Q.Wang. 2011. Growers' Willingness to Pay for Pesticides' Environmental Features: Direct VS. Indirect Valuation. Poster Presentation at the WSU Sunrise Field Day. Wenatchee, WA. August 16

Karen Lewis, Qin Zhang, a few Post-Docs and Graduate Students participated in the WSU Sunrise Field Day (Wenatchee, WA: August 16-17, 2011).

Gwen Hoheisel: WSU Viticulture and Enology Field Day: Sponsored by the Washington State Grape Society, 8/12/2011 - 120 participants - 8 hours

Matt Whiting hosts tour of peach orchard systems trials (Prosser, WA: 30 August)

September

Qin Zhang visited Deere & Company Innovation Center to discuss potential partnership in agricultural automation research (September 6-7, 2011).

Qin Zhang visited Shanghai Jiaotong University, China, and gave a seminar in horticultural mechanization (September 12-13, 2011).

Qin Zhang visited Northwest A&F University, China to chair a preliminary exam for one jointly advised Ph.D. student (September 14-18, 2011).

Qin Zhang participated in the CIGR Sustainable Bioproduction Symposium and gave an invited presentation (Tokyo, Japan: September 19-23, 2011).

Mr. Jeff Hamilton, Director of Trimble Strategic Partners visited CPAAS, and discussed potential partnership with WSU in research with Dr. Zhang (September 28, 2011).

Karen Lewis and Gwen Hoheisel conduct WSU CASC Field Day at WSU Sunrise Orchards (September 23, 2011)





Matt Whiting delivers invited presentation at Australia-New Zealand Horticulture Society Meeting (Lorne, Australia: 16 September)

Matt Whiting visited University of Tasmania to discuss collaboration on mechanical pollination research (Hobart, Australia: 22 September

Karen Lewis and Gwen Hoheisel host two week CASC field deployment in Washington State (September 12-23, 2011)

October

Qin Zhang attended Elsevier Editors' Conference (Chicago, IL: September 30 – October 3, 2011).

Gallardo, R.K. and Q. Wang. 2011. Growers' Willingness to Pay for Pesticides' Environmental Features: Direct vs. Indirect Valuation. Selected paper presented at the College of Agriculture, Human, and Natural Resources (CAHNRS - WSU) Extension Conference. Pullman Oct 4.

Gallardo, R.K., V. McCracken, and C. Yue. 2011. Investigating Rosaceae Breeding Programs' Priorities. Selected presentation at the College of Agriculture, Human, and Natural Resources (CAHNRS - WSU) Extension Conference. Pullman Oct 6.

All faculty and staff participated in CPAAS Retreat (October 13-14, 2011).

Gallardo, R.K. 2011. Sensory Testing for Horticulture. Presentation at the Food Distribution Research Society Annual Meetings. Portland, OR, October 17

Dr. Chuanguo Xu, Vice President of Changzhou Academy of Intelligent Agricultural Machinery, visited CPAAS, and discussed with Dr. Zhang in seeking for research and development collaboration opportunities (October 19-20, 2011).

Matt Whiting delivers invited presentation at Australia-New Zealand Horticulture Society Meeting (Lorne, Australia: 16 September)

Matt Whiting visited University of Tasmania to discuss collaboration on mechanical pollination research (Hobart, Australia: 22 September

November

Qin Zhang participated in the CIGR Next Leaders Study Tour in Germany (November 7-10, 2011).

Qin Zhang participated in the AgEng Conference (Hannover, Germany: November 11-12, 2011).

Qin Zhang attended the Club of Bologna Annual Meeting (Hannover, Germany: November 13-15, 2011).

Gwen Hoheisel: Washington State Grape Society Annual Meeting 11/17/2011- 85 Participants

Matt Whiting organized and hosted annual meeting for SCRI funded project (Yakima Valley, WA: 17-18 November





December

Gallardo, R. K. Poster Presentation at the WA Horticultural Association Annual Meetings, Wenatchee, WA. December 6

Manoj Karkee and Qin Zhang attended Biofuels Feedstock Production Research Planning and Field Events in Hawaii (December 11-15, 2011).

Gwen Hoheisel: Washington State Horticultural Association, 12/05 thru 12/07, 500 participants , tree fruit growers

Gwen Hoheisel: Washington Small Fruit Conference, 12/08 thru 12/09, 2011 15 participants – 8 hours, blueberry growers

Matt Whiting gave 2 presentations at the Washington State Horticultural Society Annual Meeting (Wenatchee, WA: 5-7 December)

Gallardo, R.K. and J. Brunner. 2011. Economics of Biological Control. Presentation given at the WA Horticultural Association Annual Meetings. Wenatchee, WA. December 6.

Gallardo, R.K. 2011. Economic Reality. Apples, Pears, Cherries. Are the Costs of Planting, Producing, Storing, Packing, and Shipping Being Adequately Covered by FOB Pricing? Presentation given at the WA Horticultural Association Annual Meetings. Wenatchee, WA. December 6.

HONORS AND AWARDS

- 2011 Lewis, K.M., Latino Leadership Award Washington State Horticultural Association
- 2011 Lewis, K. M., Outstanding Extension Award International Fruit Tree Association

Invention Disclosures in 2011

- 1. Zhang, Q., Du, X., Chen, D., and Scharf, P. Buffering system for improving the catching and collecting capability during fruit harvest. Filed September 9, 2011.
- 2. Ampatzidis Y., Pierce F., Whiting M. and Zhang Q. Labor Monitoring System for Specialty Crops. Filed February 2, 2012





Acknowledgement of Support

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