Message from the Director

I am pleased to present the 2018 annual report for the Washington State University Irrigated Agriculture Research and Extension Center (IAREC) in the College of Agricultural, Human, and Natural Resource Sciences (CAHNRS). This report highlights IAREC contributions to research, extension & outreach, teaching, and service to the community. As a leader in irrigated agriculture research and development, IAREC is strategically located in south-central Washington to advance the land-grant mission of WSU.

The IAREC team welcomed Dr. Faith Critzer, Dr. Per McCord, Dr. David Brown, and USDA-ARS scientist Dr. Max Feldman in 2018. IAREC hosts faculty from Biological Systems Engineering, Crop & Soil Sciences, Entomology, Food Science, Horticulture, Plant Pathology, and the Agricultural and Natural Resources Extension Program as well as USDA-ARS scientists and a coordinator of the tree fruit certification program of the Washington State Department of Agriculture. Three subject-matter centers (AWN, CPAAS, CPCNW, see opposite page) also operate from IAREC.

IAREC faculty generate research-based knowledge on a wide range of issues directly affecting agricultural production. They collaborate with growers and stakeholders to develop practical solutions that advance the economic sustainability and global competitiveness of crops grown in Washington State, promoting national and worldwide food security. IAREC faculty have made significant contributions to undergraduate and graduate education and training to prepare a new generation of diverse and competent scientific professionals capable of navigating complex agricultural challenges.

Leadership of IAREC and AWN transitioned in 2018. I sincerely thank Drs. Gary Grove, Director, and Doug Walsh, Associate Director, for their guidance to IAREC through May 2018 and Dr. Grove for his guidance to AWN until October 2018. I am also grateful for the guidance and support received from the WSU and CAHNRS Leadership. I am looking forward to strengthening our collaborations and partnerships and exploring new opportunities with WSU colleagues, commodity commissions and growers, state and federal agencies, and research and educational institutions for advancing the mission and strategic goals of IAREC, benefiting agriculture nationally and globally.
**AWN**

AgWeatherNet (AWN) provides access to current and historical weather data from WSU’s automated weather station network along with a range of models and decision aids. The weather data, advisories, and decision support systems provided by AgWeatherNet can help improve production and product quality, optimize resource use, and reduce environmental impact. AWN has 170+ automated weather stations located primarily in the irrigated regions of eastern Washington. The first station was installed in 1988. Standard AWN weather variables include air temperature, relative humidity, dew point temperature, soil temperature at 8 inches, rainfall, wind speed, wind direction, solar radiation, and leaf wetness. Some stations also measure atmospheric pressure. These variables are recorded every 5 seconds and summarized every 15 minutes by a data logger. The monitoring stations are Campbell Scientific CR-1000 data loggers combined with a range of sensors powered by a battery that is recharged through a solar panel. Communications are handled through cell phone data telemetry and the Internet. Following processing, weather data are disseminated via http://weather.wsu.edu. The weather data and associated tools that are provided on the website are updated continuously.

Contact Dave Brown, AWN Director, dave.brown@wsu.edu

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**CPAAS**

The Center for Precision & Automated Agricultural Systems (CPAAS) offers a framework for automated and precision agriculture at Washington State University. We develop solutions for more effective growing, harvesting, and processing of crops that will improve the quantity, quality, and safety of food production in the state of Washington, the Pacific Northwest, and worldwide.

Technologies developed at CPAAS, such as an automated labor management system, a hand-held mechanical blossom thinner, a high-trellis hop-twining robot, and smart targeted sprayer have been either commercialized by local manufacturers or adopted by individual growers. CPAAS research facilities and transdisciplinary team also support postdoctoral research associates, graduate students, and visiting scholars from around the world who perform research and/or education activities at CPAAS.

We are committed to developing “World Preeminent and Washington Relevant” research, education, and extension programs in the areas of agricultural automation and precision farming, and to providing a venue for:

- High impact research outcomes for our stakeholders
- True trans-disciplinary collaboration within WSU and worldwide
- High quality educational and research experiences for our students
- Incubation and development of new ideas relevant in an entrepreneurial climate

Contact Director Qin Zhang, qinzhang@wsu.edu

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**CPCNW**

The Clean Plant Center Northwest (CPCNW) offers clean plant services for the fruit tree, grapevine and hops industries. Our clean plant services include virus- and virus-like pathogen detection and treatment, and the production, distribution and retention of virus-tested plant material to ensure the productivity and competitiveness of U.S. agriculture. In addition to our clean plant services, we conduct targeted research to find more effective ways to diagnose and eliminate viruses.

Contact Director Scott Harper, scott.harper@wsu.edu or Coordinator Tanner Hunt, cpcnw@wsu.edu
David Brown
Associate Professor, Crop & Soil Sciences • AgWeatherNet Director • WSU since 2007 • PhD from University of Wisconsin-Madison • Focus on precision agriculture, environmental sensors, and spatio-temporal data science

Faith Critzer
Associate Professor, Food Science • Statewide Produce Safety Extension Specialist • WSU since 2018 • PhD from University of Tennessee • Focus on providing science-based recommendations and training to farms and packinghouses so they can develop robust food safety programs

Manoj Karkee
Associate Professor, Biological Systems Engineering • CPAAS faculty • WSU since 2010 • PhD from Iowa State University • Focus on crop sensing, machine vision and control for agricultural automation and robotics including tree fruit harvesting and pruning, and crop-load estimation

Markus Keller
Professor, Horticulture • Chateau Ste. Michelle Distinguished Professor of Viticulture • WSU since 2001 • PhD from Swiss Federal Institute of Technology, Zürich • Focus on environmental factors and management practices influencing wine and juice grape production

Melba Salazar-Gutierrez
Research Assistant Professor, Biological Systems Engineering • CPAAS faculty • WSU since 2010 • PhD from Universidad Nacional de Colombia • Focus on crop modeling, impact of climate variability, cold hardiness of tree fruit and grapes, and use of statistics in agricultural systems

Bernardita Sallato
Regional Tree Fruit Extension Specialist • Manager, Cherry Breeding Program • WSU since 2016 • MS from Pontificia Universidad Catolica de Chile, Santiago • Focus on applied research and extension of soils and plant nutrition for tree fruit production

Doug Walsh
Professor, Entomology • Extension IPM Coordinator for Washington State • WSU since 1998 • PhD from University of California, Davis • Focus on integrated pest management in hops, grapes, alfalfa, mint, and seed crops

Joan Davenport
Professor, Crop & Soil Sciences • WSU since 1997 • PhD from University of Guelph, Ontario, Canada • Focus on understanding soil variability and management of water and nutrients, primarily in perennial fruit crops • Leader in Global Campus (online) teaching

Lav Khot
Assistant Professor, Biological Systems Engineering • CPAAS faculty • WSU since 2013 • PhD from North Dakota State University • Focus on sensing and automation technologies for site-specific, precision management of production agriculture

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Qin Zhang  
Professor, Biological Systems Engineering • CPAAS Director • WSU since 2009 • PhD from University of Illinois, Urbana Champaign • Focus on agricultural automation and smart agriculture

Matthew Whiting  
Professor, Horticulture • Tree Fruit Extension Specialist • WSU since 2002 • PhD from WSU • Focus on horticultural and physiological issues facing tree fruit growers, including mechanization and automation in orchard systems

Steve Fransen  
Associate Professor, Crop & Soil Sciences • Agronomist • WSU since 1983 • PhD from South Dakota State University • Focus on varieties, harvest management, and cultural management in irrigated perennial warm-season grasses grown for biofuels and forage

Gary Grove  
Professor, Plant Pathology • WSU since 1986 • PhD from The Ohio State University • Focus on epidemiology and management of aerial diseases of crops including grapes, hops, and stone fruit

Scott Harper  
Assistant Professor, Plant Pathology • Director, Clean Plant Center Northwest • WSU since 2017 • PhD from University of Auckland, New Zealand • Focus on transmission and expression of viruses and other systemic pathogens in fruit trees, grapevines, hops, and other crops

Per McCord  
Associate Professor, Horticulture • WSU since 2018 • Stone Fruit Breeding and Genetics • PhD from North Carolina State University, Focus on developing superior sweet cherry varieties for the Pacific Northwest, and research to enhance stone fruit breeding

Michelle Moyer  
Associate Professor, Horticulture • Statewide Viticulture Extension Specialist • WSU since 2011 • PhD from Cornell University • Focus on vineyard production research and developing educational programs for industry

Troy Peters  
Professor, Biological Systems Engineering • Extension Irrigation Specialist • WSU since 2006 • PhD from Utah State University • Focus on increasing irrigation efficiency through improved scheduling and adoption of precision technologies

Naidu Rayapati  
Professor, Plant Pathology • IAREC Director • WSU since 2004 • PhD from Sir Venkateswara University, Tirupati, India • Focus on virus diseases of horticultural, vegetable, and fruit crops, including characterization, diagnosis, and development of integrated management strategies

David James  
Associate Professor, Entomology • WSU since 1999. PhD from Macquarie University, Sydney, Australia • Focus on sustainability of IPM and conservation biological control in viticulture, insect conservation, and community research and education projects

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Department/Unit

- Biological Systems Engineering
- Crop & Soil Sciences
- Entomology
- Food Science
- Horticulture
- Plant Pathology
- Agriculture & Natural Resources
Having scientists from the U.S. Department of Agriculture Agricultural Research Service (USDA-ARS) and the Washington State Department of Agriculture (WSDA) co-located at IAREC helps facilitate collaboration.

**AFFILIATIONS**

**Brian Irish**

USDA-ARS

Geneticist/Curator • Adjunct faculty • Plant Germplasm Introduction & Testing Unit • PhD from University of Arkansas (Plant Pathology) • At Prosser since 2016 • Focus on forage legume (alfalfa, clover, trefoil) germplasm accessions

**Phil Miklas**

USDA-ARS

Research Geneticist • Adjunct faculty • PhD from North Dakota State University (Plant Breeding & Genetics) • With USDA-ARS since 1992 • Focus on identification and development of traits for disease and stress tolerance in dry edible beans

**Roy Navarre**

USDA-ARS

Research Geneticist • Adjunct faculty, Plant Pathology and Horticulture & Landscape Architecture • PhD from Oregon State University • With USDA-ARS since 2001 • Focus on food security, nutrition, and disease resistance of potatoes

**Lyndon Porter**

USDA-ARS

Research Plant Pathologist • Adjunct faculty • PhD from Washington State University (Plant Pathology) • With USDA-ARS since 2005 • Focus on integrated management of foliar and root diseases in peas, chickpeas, lentils, and beans

**Kylie Swisher Grimm**

USDA-ARS

Research Plant Pathologist • Adjunct faculty • PhD from University of Arizona (Molecular & Cellular Biology) • At Prosser since 2016 • Focus on new and emerging diseases and pests of potato in the laboratory, field, and greenhouse

**Max Feldman**

USDA-ARS

Research Geneticist • Adjunct faculty • PhD from Washington State University (Molecular Plant Sciences) • Focus on germplasm development in potato using quantitative genetics and high-throughput phenotyping

**Lauri Guerra**

WSDA

Coordinator, Tree Fruit Certification Program • Supervisor, Nematode Diagnostics Laboratory • WSDA since 1999 • PhD from University of California, Davis • Focus on providing plants with minimal risks of virus or nematode presence

**Long-Xi Yu**

USDA-ARS

Research Geneticist • Adjunct faculty, Plant Pathology and Crop & Soil Science • PhD from University of Orleans, France (Plant Molecular Biology) • Focus on enhancing resistance to biotic and abiotic stresses in forage crops
The administrative, research, facilities, and technical support staff are truly the lifeblood of WSU IAREC. Without their knowledge, dedication, and support, our faculty could not carry out their research, extension, and teaching projects. We honor the IAREC staff and the many roles they play in moving our mission forward.

**Length of Service Awards**

*(faculty and staff)*

<table>
<thead>
<tr>
<th>Name</th>
<th>Years</th>
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<tbody>
<tr>
<td>Steve Fransen</td>
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<tr>
<td>Jeff Lunden</td>
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<tr>
<td>Jan Burgess</td>
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</tr>
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<td>Launa Cimrhakl</td>
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<td>Sally O’Neal</td>
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<td>Doug Walsh</td>
<td>20</td>
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<td>Clint Graf</td>
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<td>Catherine Jones</td>
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<td>Juan Magana</td>
<td>10</td>
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<td>Chon Rivera</td>
<td>10</td>
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<tr>
<td>Sam Fitch</td>
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</tr>
<tr>
<td>Francisco García Rodriguez</td>
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<tr>
<td>Amy Hill</td>
<td>5</td>
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<tr>
<td>Manuel Medina</td>
<td>5</td>
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<tr>
<td>Jason Mieirs</td>
<td>5</td>
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<tr>
<td>Adilakshmi Movva</td>
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</table>

**13 Administrative Staff**

**4 Othello Staff**

**25 Postdoctoral Researchers, Research Associates, & Research Interns**

**15 Farm & Facilities Staff**

**27 Technical Support Staff**

~50-60 hourly employees during the spring/summer season
WSU IAREC is host to graduate students from all over the world. They come to study entomology, plant pathology, horticulture, crop and soil sciences, and biological systems engineering in an environment that allows them to work directly with irrigated crops and those who farm them, while engaging with world-class faculty mentors.

The Prosser Graduate Student Association (PGSA) was formed by IAREC students in 2015. PGSA provides a platform for both academic and social engagement, encouraging students to interact outside of the classroom and the laboratory, and creating events to build camaraderie. Events hosted by PGSA include: monthly international movie nights, late night bowling, ice cream socials, trips to visit other Research & Extension Centers, lunches to welcome new students to IAREC, hiking/camping trips, and more!

WSU IAREC students are the future of agriculture.

THE STUDENT

2018 Officers
President: Nataliya Shcherbatyuk
VP: Santosh Bhusal
Treasurer: Behnaz Molaei
Secretary: Katherine East
Social Coordinators: Kapil Khanal & Margaret McCoy
Academic Coordinator: AbdelMoneim Mohamed

2018 Graduates
Raphael Adegbola, PhD (Rayapati)
Adekunle Adesanya, PhD (Walsh)
Momtanu Chakraborty, MS (Khot)
BenMin Chang, PhD (Keller)
Kapil Khanal, MS (Karkee)
Prudence Ramphisa, PhD (Davenport)
### 2018 Graduate Students, Degree Sought, Advisor

<table>
<thead>
<tr>
<th>Name</th>
<th>Degree</th>
<th>Advisor</th>
<th>Degree Sought</th>
<th>Advisor</th>
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<tbody>
<tr>
<td>Brent Arnoldussen</td>
<td>PhD</td>
<td>Matt Whiting</td>
<td>Margaret McCoy</td>
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<tr>
<td>Haiitham Bahlol</td>
<td>PhD</td>
<td>Lav Khot</td>
<td>Kaitlin Miller</td>
<td>MS</td>
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<tr>
<td>Noorani Barkat</td>
<td>PhD</td>
<td>Markus Keller</td>
<td>Arunabha Mitra</td>
<td>PhD</td>
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<tr>
<td>Amit Bahsin</td>
<td>MS</td>
<td>Joan Davenport</td>
<td>Abdel-Moneim Mohamed</td>
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</tr>
<tr>
<td>Uddhav Bhattachar</td>
<td>PhD</td>
<td>Manoj Karkee</td>
<td>Behnaz Molaei</td>
<td>PhD</td>
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<tr>
<td>Santosh Bhusal</td>
<td>PhD</td>
<td>Manoj Karkee</td>
<td>Johathan O’Hearn</td>
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</tr>
<tr>
<td>Abhilash Chandel</td>
<td>PhD</td>
<td>Lav Khot</td>
<td>Mohammed Rahman</td>
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<tr>
<td>Lin Chen</td>
<td>PhD</td>
<td>Qin Zhang</td>
<td>Rakesh Ranjan</td>
<td>PhD</td>
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<tr>
<td>Shimul Das</td>
<td>PhD</td>
<td>Naidu Rayapati</td>
<td>John Paulo Sacdalan</td>
<td>PhD</td>
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<tr>
<td>Greta Dupuis</td>
<td>MS</td>
<td>Doug Walsh</td>
<td>Abid Sarwar</td>
<td>PhD</td>
</tr>
<tr>
<td>Katherine East</td>
<td>PhD</td>
<td>Michelle Moyer</td>
<td>Nataliya Shcherbatyuk</td>
<td>PhD</td>
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<tr>
<td>Zongmei Gao</td>
<td>PhD</td>
<td>Qin Zhang</td>
<td>Rajeev Sinha</td>
<td>PhD</td>
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<tr>
<td>Alexis Hamilton</td>
<td>PhD</td>
<td>Faith Critzer</td>
<td>Katie Taylor</td>
<td>MS</td>
</tr>
<tr>
<td>Chenchen Kang</td>
<td>PhD</td>
<td>Qin Zhang</td>
<td>Sushma Thapa</td>
<td>MS</td>
</tr>
<tr>
<td>Ninh Khuu</td>
<td>MS</td>
<td>Scott Harper</td>
<td>Ying-Tsui “Tracy” Wang</td>
<td>PhD</td>
</tr>
<tr>
<td>Yaqoob Majeed</td>
<td>PhD</td>
<td>Qin Zhang</td>
<td>Xin Zhang</td>
<td>PhD</td>
</tr>
<tr>
<td>Joelle Martinez</td>
<td>PhD</td>
<td>Markus Keller</td>
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</tbody>
</table>

**GO COUGS!**
Grants
By the Numbers

New Grants  60  
Renewed Grants  38  
Termed Grants  59  

Grant Funds Generated
$10,407,425 total

Gifts/Private $350,594
State $1,654,755
Federal $6,698,449
Industry $1,703,627

Industry Funds
Alfalfa & Hay
Foundation for Food & Ag Research
Hops
Mint
Tree Fruit
Wine

Understanding Decline on Select Apple Scion-Rootstock Combinations

Pl: Scott Harper
WSU Co-PI: Alice Wright
Funding Agency: Washington Tree Fruit Research Commission
2018 Funding: $60,200

Dieback and decline of select apple scions on Geneva 935 rootstocks is a significant problem for introducing and expanding new variety plantings in WA. Viral pathogens including Apple chlorotic leafspot virus and Apple stem pitting virus had been suggested as the cause, but other viruses have been found on afflicted cultivars; whether these caused the decline had not been established. In short, the cause of the disease, whether a single virus or specific combination of viruses, is not known. This project takes a systematic approach to identifying the pathogens present in declining plants, toward a more complete understanding of the cause of the dieback and decline and a way forward to prevent it.
**Food Safety Modernization Act: Workshops and Extension for Washington State Tree Fruit Growers**

*PI: Faith Critzer*
*WSU Co-PIs: Girish Ganjyal, Stephanie Smith*

**Funding Agency: Washington State Department of Agriculture (WSDA)**

**2018 Funding: $451,532**

In 2011, the Food Safety Modernization Act established significant changes to our federal and state food safety regulations. FSMA required the US Food and Drug Administration to modernize the Federal Food, Drug, and Cosmetic Act by conducting rulemaking in seven areas affecting human and animal foods. This project educates produce growers and those in mixed facilities on the pertinent food safety practices related to produce growing, harvesting, holding, and processing. These efforts combined with those of the WSDA help strengthen the resiliency of Washington fruits and vegetable industry and improve the likelihood of adherence to new federal and state regulations.

**Root Growth Management to Reduce Ca Deficiency Disorders in Apples and Cherries**

*PI: Bernardita Sallato-Carmona*
*WSU Co-PIs: Matt Whiting, Lee Kalcsits*

**Funding Agency: Washington State Department of Agriculture**

**2018 Funding: $152,937**

Calcium (Ca) deficiencies can lead to several disorders that reduce quality and storability in several tree fruits. Bitter pit (BP) in apples causes an estimated loss of 5%-10% each year. Honeycrisp, the most planted cultivar in WA between 2011 and 2017, is highly susceptible, with up to 50% loss each year. In cherries, Ca deficiencies have resulted in reduced fruit quality (cracking and firmness). Growers spray 6 to 20 times during the season to overcome Ca deficiency disorders, often with unsatisfactory results. This project focuses on education and outreach activities promoting production practices that lead to early root growth, which increases Ca absorption during cell division, thereby reducing Ca deficiency disorders.

**Reducing Cold Damage with Cellulose Nanocrystals**

*PI: Matt Whiting*
*WSU Co-PIs: Changki Mo, Xiao Zhang, Bernardita Sallato*

**Funding Agency: Washington Tree Fruit Research Commission**

**2018 Funding: $50,086**

Every year, tree fruit growers lose money from cold damage to reproductive buds or flowers. The U.S. Food and Agriculture Organization reports that cold damage has caused more economic losses to U.S. crops than any other weather hazard. Despite the significant perennial threat of cold damage, growers have no new, reliable means for protecting developing buds, depending largely on wind machines that are ineffective against advective freeze events. To improve yield security and profitability for WA tree fruit growers, the team of researchers is synthesizing and applying a novel dispersion of cellulose nanocrystals (CNC) intended to reduce cold damage to tree fruit reproductive buds.

**Breeding Disease Resistant Hop Cultivars**

*PI: Doug Walsh*

**Funding Agency: USDA Agricultural Research Service**

**2018 Funding: $172,062**

This is a collaborative project among WSU IAREC, the USDA Agriculture Research Service, and the Brewers Association seeking to develop new publicly available hop cultivars with excellent sensory characteristics, high yields, and good disease resistance. We are screening the joint WSU and USDA-ARS advanced-cycle hop germplasm for its performance in the Yakima Valley of Washington, the site of 73% of U.S. hop production. Hop selections are being evaluated for their yield, brewing chemistry and attributes, and tolerance to mildews, which are the primary diseases impacting hop production.
Highlighted Events in 2018

2/7 WSU President Kirk Schulz and First Lady Noel Schulz Tour IAREC Campus

2/21 SPARK (Speaking to the Potential, Ability & Resilience Inside Every Kid) Event

2/22 Columbia Tree Fruit Club Pruning Tour

2/24 REACH (Reaching Educational Achievement through Choices)

4/13 Prosser Economic Development Association Leadership Tour

5/17 Entrust Community Services Student Tour

5/17 Kiona Benton High School Tour

6/2 Winegrowers Legislative Tour

6/28 Roza Field Day

7/24 Hop Research Council Presentations and Tour

8/7 Washington State Grape and Wine Research Program Presentations

8/30 Prosser IAREC Welcomes New CAHNRS Dean, André-Denis Wright

9/11 Roza Orchard Field Day

10/1 Communication Officer of State Departments of Agriculture (COSDA) Tour
WSU’s **GRAND CHALLENGES** are a set of principles that focus the University’s research, innovation, and creativity in specific areas to achieve broad societal impact. WSU IAREC supports these overarching goals in a multitude of ways. [https://research.wsu.edu/research-initiatives/grand-challenges/](https://research.wsu.edu/research-initiatives/grand-challenges/)

**SMART SYSTEMS**
Harnessing technology to improve quality of life

- Faculty and students at IAREC have developed and deployed pilot projects utilizing unmanned aerial systems (drones) for tasks such as damage assessment in production agriculture.

- The Center for Precision & Automated Agricultural Systems (CPAAS), housed at IAREC, develops mechanized and automated solutions for crop production. CPAAS innovations include development of mechanical and robotic apple and feedstock biomass harvest technology, a robotic system for fruit bin management, and mechanized weed control in vegetable crops.

- CPAAS also works with precision agriculture and decision support such as in-orchard wireless sensor networks, precision and automated irrigation systems, high-throughput phenotyping, automated labor management, and cloud-based farm management.

**SUSTAINABLE RESOURCES**
Supplying food, energy, and water for future generations

- Interdisciplinary teams (entomology, plant pathology, soil science, weed science, horticulture, biosystems engineering, food science) address key issues in hops, grapes, tree fruit, alfalfa, and other crops.

- The Washington State Integrated Pest Management Coordinator is located at IAREC.

- Tools developed at IAREC help growers know when and how to irrigate and when they can turn their water off with confidence, resulting in peak yields with water and energy savings.

- An estimated two-thirds of Washington State’s agricultural production comes from irrigated land, making IAREC’s research vital to sustainable agricultural production in the state and region.

**OPPORTUNITY AND EQUITY**
Promoting an informed and equitable society, expanding individual opportunity, advancing social justice

- IAREC faculty participated in the Leadership and Global Understanding (LGU) Columbia “Utopia” Project to deliver agricultural research results, technology, and training to farmers in remote areas.

- Researchers at IAREC have been engaged in agricultural research and development programs funded by the U.S. Agency for International Development (USAID) to tackle hunger and poverty in Africa and Asia.

- The Prosser Graduate Student Association provides opportunities for networking, professional collaboration, and social engagement.

- IAREC faculty offer hands-on research experiences to undergraduate students, especially first-generation students from low-income communities in Yakima Valley, to improve their career prospects and access to higher education.

**NATIONAL SECURITY**
Fundamental research to protect America and the world

- IAREC is strategically positioned to contribute to food security here at home and across the globe.

- IAREC faculty serve as members of USAID’s Feed the Future Innovation Labs, translating science-based knowledge in partnership with research institutions and NGOs in Asia and Africa for crop improvement and betterment of the livelihoods of smallholder farmers.

- Plant breeding and maintenance of virus- and disease-free planting materials, both of which take place at IAREC, are key components to a safe and secure global food supply.

- The engagement of university faculty and federal research scientists in addressing global dimensions of agriculture brings valuable experiences benefiting agriculture in the U.S.

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**GRAND CHALLENGES**


James D. 2018. Do some fall migrants from the Pacific Northwest augment winter breeding populations of Monarch butterflies in southern California? J Lepid Soc, 72(3), 244-247.


L. in India.

mordica charantia virus infecting bitter gourd (mordica charantia)

First report of Peanut bud necrosis virus infecting bitter gourd (Mo


Zhang X, L Ferguson, MD Whiting. 2018. Effects of temperature on pistil viability and fruit set of four sweet cherry cultivars. Scientia Horticulturae, 241, 8-17.


Zhang L, L Ferguson, MD Whiting. 2018. Effects of temperature on pistil viability and fruit set of four sweet cherry cultivars. Scientia Horticulturae, 241, 8-17.


WSU IAREC: WHERE WE ARE, WHERE WE’RE FROM, WITH WHOM WE WORK

Faculty
(country of origin, education, or major influence if outside USA)

Staff
(country of origin if not USA)

Students
(country of origin if not USA)

Active Collaborations in 2018

Visiting Scholars in 2018

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