Summer interns add fresh perspectives to REACCH research teams

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REACCH provides the hands-on, real-life experience that undergraduate students need to become confident, knowledgeable, and impactful scientists. Since 2012, REACCH has trained a total of 41 undergraduate student interns. These students each spent a nine-week period doing independent research with REACCH faculty. In addition to research, students participated in seminars and workshops that targeted specific skills such as interdisciplinary collaboration, research and communication, and how to apply to and succeed in graduate school. As part of their experience, students were asked to write blogs to be shared with project participants and stakeholders. Here we highlight the experiences and work of the 2014 interns. Their full research blogs can be found on the REACCH website.

IMPACT

REACCH invests in training interdisciplinary scientists so that future generations can make informed decisions regarding climate and management and maintain resilient, sustainable, and profitable agricultural systems.

REACCH Undergraduate interns work at research sites all over the PNW including the OSU's Columbia Basin Agricultural Research Center. Photo by Rebecca Graham.

2014 interns take time for a final photo following their presentations describing their summer research experiences. Pictured: left to right back row: Zach Millang, Christian McGillen, Brita Olsen, Jacob Cohen, Rich Manuli; front row: Caitie Mack, Jenna Way, Savannah Sheehy, Rebecca Graham, Jashvina Devadoss, Carolyn McCotter, Allison Buiser. Photo by Marika Haverhals.

Cereal pests, like aphids pictured here, were the focus of several REACCH undergraduate intern projects. Over nine weeks, students develop the skills to produce scientific results for the project. Photo by Brad Stokes.

Allison May Buiser (Knox College), Kristy Borrelli UI, Chad Kruger WSU, and Georgine Yorgey WSU

Precision agriculture resources for farmers

We studied current precision agriculture (PA) technologies and practices in PNW wheat production through interviews and literature review. PA allows farmers to address the variability in nutrient availability and yields across fields. It may save farmers money and reduce environmental issues through the management of zones instead of uniform field management. We identified useful information about adopting PA practices through interviews with researchers and will make it available to farmers through extension materials.

Jacob Cohen (Pennsylvania State University), Ivan Milosavljevic WSU, and David Crowder WSU

Role of climate change in plant-insect interactions

Climate change projections for the PNW suggest that drought stress will increase for most crops in the next 50 to 100 years. Yet there is almost no information about how drought stress might interact with biological stressors to affect crop yields and quality. Our research addressed this knowledge gap by exploring interactions between drought stress, insect pests, and a viral plant pathogen. Specifically, we exposed plants to different combinations of virus (*Barley yellow dwarf virus*), insects (wireworms), and drought. This research is ongoing, but preliminary results suggest that feeding by wireworms significantly decreased plant quality and made plants more susceptible to other stressors. Our results suggest that biotic and abiotic stress may act additively to decrease plant yields. Future research should include such interactions to better understand how climate change will affect crop production.

Future climate scenarios could increase the likelihood that drought can impact wheat and associated organisms like insects and pathogens. Photo by Seth Davis.

Jashvina Devadoss (University of California, Berkeley), Erin Brooks UI, and Nicole Ward UI

Exploring field-scale variability with remote sensing and EMI sensors

To identify improvements in precision agriculture technology, I focused on two information technologies that address the definition of management zones and rates: remote sensing and electromagnetic induction (EMI) sensors. I looked at field variability, specifically at the relationship between changes in electrical conductivity and soil moisture, and the potential of bulk electrical conductivity to delineate management zones for precision agriculture. We generated preliminary results by comparing EMI data to soil properties, water content, topographic properties, Normalized Difference Red-Edge Index, and crop yield data. At this point, both the EMI and remote sensing maps must be used in conjunction with other tools to delineate precision agriculture management zones, and eventually producers will be able to map their own fields with these tools.

Rebecca Graham (Cal Poly San Luis Obispo), Stephen Machado OSU, Rajan Ghimire OSU, and Larry Pritchett OSU
Management effects on soil organic carbon pools

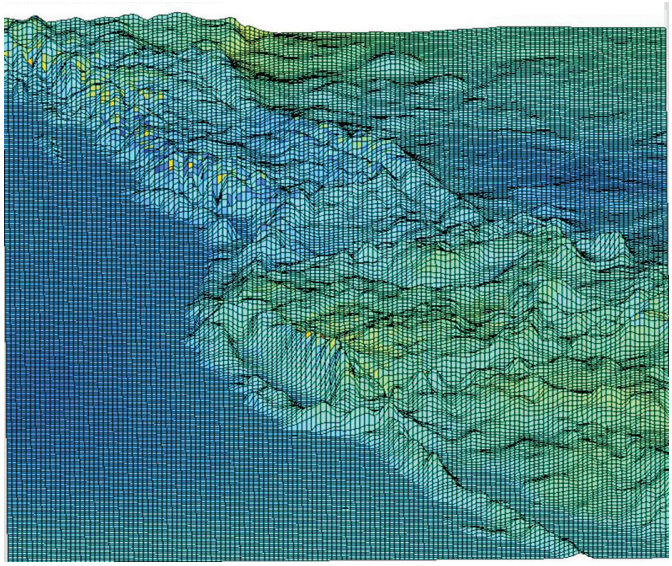
More than half of the stored soil organic carbon (SOC) has been lost in the last century due to soil disturbance. Understanding the factors that regulate SOC loss can help predict ecosystem responses to climate change. We measured potentially mineralizable carbon (PMC) in the winter wheat–summer fallow tillage fertility long-term plots at Columbia Basin Agricultural Research Center to determine how SOC and PMC contents change with tillage and soil fertility management practices. Results show that nitrogen application did not significantly affect SOC pools. With respect to tillage, plowing resulted in the lowest mineralizable carbon content. The PMC content under grass pasture was approximately 2.5 times more than PMC content under sweep tillage and about 8 times more than under plow tillage. This research indicates that reducing or eliminating tillage has the potential to increase SOC accumulation under dryland wheat-based cropping systems of eastern OR. More research will expand our understanding of how SOC pools respond to management and climate change.

Caitie Mack (Paul Smith's College), John Antle OSU, Susan Capalbo OSU, and Laurie Houston OSU
Strengths, weaknesses, opportunities, and threats analysis of California's Low Carbon Fuel Standard

The Low Carbon Fuel Standard is a "first-of-its-kind" regulation that has the ability to increase the use of renewable fuels. In order for this regulation to work properly, a cost containment strategy should be implemented. My internship with REACCH has led me to explore the history and future of renewable fuel standards and markets, with the hope of decreasing fossil fuel use. Price ceilings and floors will provide low-carbon fuel investors with a more precise projection of what the low price may be in the future, thus reducing the chance that they will lose money on their investment if prices suddenly drop dramatically. This will strengthen the incentives to invest in a low-carbon fuel.

Rich Manuli OSU, John Antle OSU, Susan Capalbo OSU, and Laurie Houston OSU
Obstacles in the oilseed biofuel market

Biofuels are a broad topic and have many variations in production and recycling resources. To get a better understanding of the oilseed market, I used AgProfit™ software to find the differences in the annual crop budgets of a model farm near Pendleton, OR, in a precipitation zone of 18 to 24 inches. I compared a winter wheat-pea rotation to one incorporating camelina. Selling camelina was not profitable without the tax credit, but when the producer processes the oil on site, it doubles the unit price (excluding the added cost of production). The evidence is clear that these oilseeds can be very profitable with the use of the tax incentives and the additional benefits of co-products, oilfuels, or an additional crop that helps wheat yields.



When global climate models are downscaled to regional climates, topography increases the validity of results. Image by Christian McGillen.

Carolyn McCotter (University of Puget Sound), advised by Sanford Eigenbrode UI, Seth Davis UI, and Nate Foote UI
Drought and cereal pests

One of the least studied factors of climate- and drought-altered conditions is the behavioral responses among insects. I conducted a study of the behavioral responses and interspecies relations of two aphid pests that infest Palouse cereal wheat under drought conditions. Results indicate that a strong within-plant competitive interaction is occurring between aphid species. This means that multiple aphid species, when on the same plant—which could become more common with climate-driven range expansion—may compete by inhibiting reproduction of conspecifics. However, population increases in general would impose a risk of diminished agricultural production.

Zach Millang (Virginia Tech), Phil Mote OSU, and Sihan Li OSU
Analyzing regional climate models for the Pacific Northwest

The global climate model (GCM) is the most sophisticated tool we have to better our understanding of how our climate will change. GCMs are made up of three-dimensional grid cells that take into account the physical conditions of our atmosphere, ocean, sea surface, and sea ice at a given time, but lack accurate representation of topography. We use dynamic downscaling to incorporate regional topography and create regional climate models (RCMs). The development of finer resolutions would offer relevant future climate scenarios. Farmers have many options for dealing with the weather, but the precision of an RCM will help them really know which one to invest in for the future.

As Carolyn McCotter learned in her internship, aphid (pictured) and drought interact to decrease overall cereal crop productivity. Photo by Carolyn McCotter.

Brita Olson UI, Kate Painter UI

Trends in crop progress and condition

Idaho Crop Progress and Condition Reports are weekly publications from the U.S. Department of Agriculture National Agricultural Statistics Service. From the mid-1980s to the present, these reports have had a more or less standardized format, which includes quantitative survey data describing the progress and condition of wheat. We found that the condition index for both spring and winter wheat shows a strong relationship to total season precipitation (September through June) and spring precipitation (April through June). Climate projections suggest that the PNW will see decreased summer precipitation. Depending on the timing of precipitation, this decrease could negatively affect the condition of our wheat crops.

Savannah Sheehy UI, Jodi Johnson-Maynard UI, and Ian Burke WSU

Earthworm impacts on soil weed seeds

In addition to improving soil physical properties and nitrogen availability, earthworms may also ingest and digest plant seeds. Seed predation may play a role in the development of the plant community, particularly with regard to the structure of the seed bank. We incubated replicate mesocosms with soil, earthworms (either deep or shallow burrowing), and weed seeds (prickly lettuce or field bindweed). Approximately 67% of prickly lettuce and 70% of field bindweed seeds were not recovered when incubated with the deep-burrowing earthworm species. These "missing" seeds were assumed to be destroyed in the digestive process. These findings suggest that practices favoring the presence of deep-burrowing earthworm species may result in a reduction in prickly lettuce and field bindweed seeds and germination.

Jenna Way OSU, Zach Millang (Virginia Tech), Susan Capalbo OSU, and Clark Seavert OSU

Integrating environmental accounting into AgTools

The AgTools™ software uses a suite of programs to evaluate the profitability and feasibility at the individual farm level of different management decisions and cropping systems. To properly integrate environmental effects of agriculture on climate change and farm-level sustainability, we researched the most significant variables: energy use, pesticide and fertilizer use, soil erosion, water use, and greenhouse gas emissions. We used AgEnvironment™ to evaluate case study farms under climate change conditions with different crop rotations. The more diverse cropping systems have the greatest economic success (in cash flow, net farm income, and cumulative net farm income). This shows that climate change has advantages to farmers, and if they are aware of these advantages, they can plan crop rotations accordingly. As far as policy implications for climate change, AgEnvironment™ has the potential to be used as a tool that analyzes economic impacts for farmers when they adapt to meet proposed climate change regulations

Savannah Sheehy monitors mesocosms in the greenhouse as part of her study on earthworms and weed seeds. Photo by Jodi Johnson-Maynard.