WASHINGTON OILSEEDS COMMISSION
PROGRESS REPORT FOR 2017 PROJECTS

Project No.:
Title: Rotational benefits of canola: Can the microbiology of oilseed-cropped soils improve wheat growth?
Personnel: Catherine Reardon (PI)
Reporting Period: 2018

Accomplishments:
The objective of this research was to document benefits of oilseeds in rotation by identifying whether the growth benefit to wheat in oilseed-cropped soil is due to chemical (nutrients) or microbiological factors (root-associated communities or reduced pathogen pressure).

- The preliminary data from this proposal was presented at the Pendleton and Moro Field days by Ann Klein (post doc). The presentation introduced producers and the public to next generation sequencing technologies and the effects of oilseeds on nutrient cycling and microbial communities as compared to wheat.
- Ann Klein presented data in a poster session at the 21st Penn State Plant Symposium – Wild and Tamed Phytobiomes (poster will be distributed) on June 22, 2018.

Synopsis:
We proposed a **two-pronged approach of lab- and field-based observations** to evaluate the effects of oilseed cropping on the microbial community diversity (who is there) and activity (nutrient cycling).

- **2017 funding:** We cultivated wheat plants in a growth chamber with soils collected from the field under winter wheat, winter canola (*B. napus*), or Ethiopian mustard (*B. carinata*). Wheat plants had greater biomass when cultivated in soils from oilseed plots compared to wheat plots, but the growth benefit was confounded by differences in nitrogen.
- **2018 funding for laboratory study**: We attempted to decouple the effects of soil chemistry (nitrogen availability) from effects of microbiology on plant growth by using a "microbial transfer" approach. Rather than growing wheat in soil collected from the field, we cultivated the wheat in autoclave-killed soil that was inoculated with the microbial communities of the field soils (i.e. a small amount of "live" soil was added to the "killed" soil). Although this approach has been used in other scientific studies, the autoclaving was not sufficient in sterilizing the soil, it increased soil ammonium by an approximate factor of 10, and had a variable effect on soil enzymes (increased carbon cycling glucosidase activity, decreased phosphate cycling acid phosphatase and did not affect carbon and nitrogen cycling glucosaminidase or arylamidase activity). Due to the unintended effects of the autoclaved soils, we have not moved beyond plant biomass, soil nitrogen, and soil enzyme analyses for this laboratory-based experiment, but rather focused attention on field aspect.
- **2018 funding for field study:** Field samples of wheat root-impacted and rhizosphere soil (soil closely associated with the plant root) were collected during tillering and boot growth phases of winter wheat crops from research plots in the 11" annual

precipitation zone. The samples were collected from the wheat phase of three rotations managed with minimum tillage: winter wheat–fallow–Ethiopian mustard, winter wheat–fallow–winter canola, and winter wheat–fallow. Soil enzymes related to nutrient cycling of carbon (glucosidase, glucosaminidase), nitrogen (arylamidase, glucosaminidase), and phosphate (acid phosphatase) were similar in wheat root-impacted soil regardless of whether wheat or oilseeds preceded the fallow phase. *Preliminary data indicate that oilseeds do not provide benefit to wheat crops through increased nutrient cycling when a fallow is present in the rotation.* We are evaluating data from a separate study to determine if oilseeds impact nutrient cycling activity under spring wheat cropping when the wheat is preceded by oilseeds compared to winter wheat rather than fallow.

Progress:

- We have completed analyses of nutrient cycling enzyme activity and soil chemistry for the lab-based and field experiments.
- For the DNA analysis of the microbial communities, we have extracted the DNA and prepared it for sequencing. It will be sent to University of Idaho DNA core sequencing facility in January 2019. This analysis will help us determine whether rotational oilseeds influence the microbial (bacterial and fungal) communities of the wheat rhizosphere. We will use this information to infer whether beneficial (disease suppressive, increased nutrient availability) communities are promoted by oilseeds.
    - A portion of these samples were recently sequenced using a new technology called the MinION. This device was provided to our lab through funding from the USDA-ARS National Programs Office as a special project. The technology provides reads orders of magnitude longer than the typical next generation sequencers. We will be evaluating this data soon.

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Instructions:
1. Record information for active and pending projects.
2. All current research to which principal investigator(s) and other senior personnel have committed a portion of their time must be listed whether or not salary for the person(s) involved is included in the budgets of the various projects.
3. Provide analogous information for all proposed research which is being considered by, or which will be submitted in the near future to, other possible sponsors.

Name (List PI#1 first)	Supporting Agency and Project #	Total $ Amount	Effective and Expiration Dates	% of Time Committed	Title of Project
Current:					
Reardon, C.L., Long D.S., Williams, J.D	USDA-ARS (in house), Project Number: 2074-12210-001-00D	Salary support PI, technicians; operations, research	10/2018-10/20123	70%	Attaining high quality soft white winter wheat through optimal management of nitrogen, residue and soil microbes
Reardon, C.L.	Washington Oilseed Commission	$5000	June 1, 2018-May31, 2019	15%	Rotational benefits of canola: Can the microbiology of oilseed-cropped soils improve wheat growth?
Strauss, S.L. Inglett, P. Reardon, C.L.	NIFA-AFRI, Bioenergy, Natural Resources, and Environment	$442,102	10/2017-09/2021	15%	Impact and utilization of biological soil crusts in agroecosystems
Pending					
Klein, A.K., Reardon, C.L., Hagerty, C.H.	NIFA-AFRI, Education and Workforce Development (post doc funding)	$164,925	6/2019-6/2021	10%	Microbial dust in the wind: dispersal potential of soil microbes and plant pathogens in wind-eroded sediments
Friesen, M., (WSU) and numerous others	NIFA-AFRI	$10 million	2019-2024	10%	Managing soil microbiomes for transformational improvements in productivity, efficiency and sustainability of agricultural systems