Safeguarding Potato Cropping Systems in the Pacific Northwest Through Improved Soil Health

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Summary

Consumer preferences are driving interest in improving soil health in potato production systems in the U.S. Pacific Northwest (PNW) and beyond. Potato production poses a particular challenge in terms of soil health due to intensive tillage, minimal residue left on fields, short rotations, and the importance of managing soilborne pathogens. We present strategies that improve soil health and their effects on soilborne pathogens, the yield and quality of potatoes, and net returns in potato production systems. These practices include reducing tillage; adjusting crop rotation length and species composition; reducing fumigation; and using cover crops, green manures, and organic amendments. Selected results from studies conducted in the PNW over the last 25 years are presented.

Strategies for Improving Soil Health

Cover Crops/ Green Manures

Figure 1. Mustard green manure being incorporated into soil prior to potato planting. Photo credit: Andy McGuire

Green manures of specific cultivars of Brassica species incorporated prior to potato production can suppress Verticillium wilt, in some cases. Variability is likely due to differences in the length of time using green manures; differences in green manure crop management can affect the quantity or quality of the incorporated biomass; site variability; and differences in potato management (McGuire 2012).

Nematode suppression by Brassica green manures has been reported, including Columbia root knot nematode (Al-Rehiayani et al. 1999; Mojtahedi et al. 1991; O'Neill 2016; Riga 2011), root lesion nematode (Hafez and Palisamy, 2003), and stubby root nematode (Charlton et al. 2011),

Soil Fumigant Reduction

- Interest exists in alternatives to chemical fumigation because of fumigation costs; pressures from consumers and regulators; and effects of fumigants on non-target soil organisms, such as free-living nematodes, bacteria, and fungi that play a role in nutrient cycling (Collins et al. 2006; Hamm et al. 2003).
- Site specific fumigation with 1,3-dicholoropropene for Columbia root knot nematode may offer opportunities to reduce fumigant use (King and Taberna 2013), but the cost of soil sampling may be prohibitive.
- In a comparison of in-row to broadcast fumigation, Hansen et al. (2018) reported broadcast fumigation resulted in greater total and marketable yields and greater net return for 'Russet Burbank.' Where, yield and quality of 'Norkotah' were similar for both methods.

Crop Rotation

- Potato rotations vary widely across the PNW and may include alfalfa, canola, dry beans, field corn, grasses, green manures, peas, small grains, sugar beets, sweet corn, and vegetable crops.
- Including minimal tillage and crops that produce residue left in the field, or crops with different root architectures than potato offer opportunities for soil health improvement during the non-potato portions of the rotation.
- Pathogen host status of cash and cover crops are important considerations for each pest or disease species of concern.

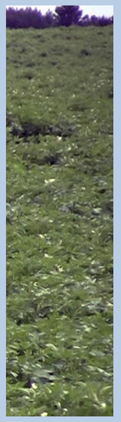

Photo credit: Sylvia Kantor

Animal Manures/Compost

Fig 2. Dairy manure offers an opportunity for improving soil health in some areas. Photo credit: Darrell Kilgore, CAHNRS Communications

In potato production regions in close proximity to livestock agriculture, opportunities exist for using animal manures and composts in potato rotations. Moore et al. (2016) reported that soil health indicators can be improved with manure use. However, there may be issues with salinity, sugar ends and an increase in small potatoes due to late season nitrogen availability.

Reduced Tillage

Tillage reduction may offer an opportunity for improving soil health in potato production, however there is little published research from potato production systems in the PNW. Collins et al. found that conventional and reduced tillage treatments did not differ in yield or quality and crop residues protected against wind erosion (Fig. 3).

Fig. 3. Conventional and reduced tillage treatments in a 3-year sweet corn-sweet corn-potato rotation under center pivot irrigation in Paterson, Washington. (Photo source: Collins et al. 2010)

Research Recommendations

Based on the review of the literature, the following recommendations were made:

1. Determine the relationship between practices that improve soil health and soil health indicators, soilborne pathogens, and potato yield and quality in PNW potato systems.
2. Develop a soil health assessment approach or calibrate an existing assessment method for use in PNW potato systems and establish a baseline understanding of soil health in PNW potato systems.
3. Gather additional information to characterize distinct potato cropping systems in the PNW and identify specific soil health challenges and opportunities unique to each system.
4. Develop a better understanding of the barriers that currently prevent adoption of practices known to improve soil health and address these barriers. Quantify the tradeoffs that exist for particular practices, or suites of practices, in order to provide PNW potato growers with important decision-making tools for optimizing tradeoffs.
5. Establish long-term research and demonstration sites in the various potato cropping regions in the PNW to provide information on both economic and agronomic changes resulting from these approaches.

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The full report can be downloaded at the CSANR Publications website.

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