Cervantes:
Hello everyone! Welcome to today's episode of Potato-cast. A Potatoes USA podcast, full of all your favorite potato industry content.
I'm Natalia Cervantes, Potatoes USA Conversation Architect, and your host.

Today, I have a special episode.
At the Potato Expo in Anaheim, California, I had the pleasure of interviewing Carl Rosen. Carl is the Head of the Department of Soil, Water, and Climate at the University of Minnesota. Carl joined me for a discussion on soil health. A project that was brought to the Potato Research Advisory Committee back in 2018.

But why listen to me when we could be hearing directly from Carl.

Cervantes:
Carl, welcome to Season 2 of Potato-Cast.

Rosen:
Thank you, Natalia. It's a pleasure to be here today, with you, in person.

Cervantes:
Yes, I'm so grateful that the Potato Expo is happening this year. I'm really looking forward to walking the Expo today and mingling with industry members at the Potatoes USA booth. If you don't mind Carl, can you tell our listeners a little bit about yourself?

Rosen:
I'm happy to do that Natalia.
For those who don't know me, my name is Carl Rosen. I'm a Professor and Extension Soil Scientist in the Department of Soil, Water, & Climate at the University of Minnesota and have served as Department Head for the past 12 years. I have an MS degree in Horticulture from Penn State University and a Ph.D. degree in Soil Science from UC Davis. For the past 35 years, my research and extension programs in Minnesota have focused on optimizing nutrient management for a variety of crops with particular emphasis on irrigated cropping systems especially those that include potatoes. In recent years my research has also focused on water quality issues related to fertilizer use as well as ways to improve soil health. I also co-teach and undergraduate class on soil fertility and that is also an enjoyable part of my job.

Cervantes:
That is an impressive background. As Department Head for 12 years, what's been your favorite part of that journey so far?

Rosen:
Well, the favorite part is that I get to help other people advance and succeed in their careers. It is really gratifying to see how faculty and students contribute to advancing science through their teaching, research, outreach, and service. When they succeed, I feel like I am succeeding as well. I also enjoy teaching students and conducting field research, so when I eventually step down as department head, I will be able to continue in those areas.

Cervantes:
And how long have you been involved with Potatoes USA?

Rosen:
My first contact with Potatoes USA was back in about 2017 when I was asked if I would lead the Potato Soil Health Project. I had been working with various aspects of soil-related problems in potato production for the past 30 years and was a co-investigator on a previous specialty crop research initiative proposal on potato soil health that was not funded, so it seemed like a good opportunity. We submitted a proposal to the USDA - Specialty Crop Research Initiative in early 2018 entitled “Enhancing Soil Health in US Potato Cropping Systems” and we found out that we were selected for funding a few months later. The project officially started in September 2018. Ryan Krabill who was with Potatoes USA at the time along with John Keeling at the National Potato Council were instrumental in communicating with growers and industry partners about our intent of submitting a Soil Health proposal. I think we received over 100 letters of support which may have been a record for this kind of a project. Those letters certainly helped us receive favorable reviews. Since then, I have been involved with Potatoes USA to provide project updates and to participate in brainstorming sessions on research topics relevant to the potato industry.

Cervantes:
I’ve heard the term Lead Project Investigator get used a couple times, is that your title on this Soil Health proposal as well?

Rosen:
Technically I am the Project Director.

Cervantes:
And what is your role as Project Director?

Rosen:
As Project Director, I oversee all aspects of the project starting with the science and ensures that the work get done. I also get to delegate, so my experience as department head comes in handy sometimes.

Cervantes:
Forgive me for this question Carl, I know that soil health is important but what makes this particular project special?

Rosen:
This is a special project because potatoes are such a challenging crop to work with when it comes to soil health. Soil health is vital for all crops to protect our soils from degradation and sustain yields for future generations. According to the NRCS, soil health refers to the condition of a soil to function as a vital living ecosystem that sustains plants, animals, and humans. This is a holistic view of soils that considers the physical, chemical, and biological properties of soils and how they all interact to help us produce crops in a sustainable manner. We do a pretty good job with the chemical aspects of soil – for example, fertilizer inputs, but we have often neglected the biological or living aspects of the soil which are also important for nutrient cycling and improved soil structure.

Cervantes:
What are some of the key principles of soil health?

Rosen:

Some of the key principles of soil health are to keep the soil covered. One way of doing that is to leave residue on the surface. Leaving on residue will help to reduce soil erosion. A second principle to minimize soil disturbance or in other words reduce tillage. This is important because excessive tillage leads to compaction, can disrupt microbial communities, and tends to reduce soil organic matter. A third principle is increasing crop diversity, rotating with different crops will help to break disease cycles which is especially important for potatoes because they are susceptible to various soil borne diseases. A fourth principle is to keep living roots in the soil. This helps to hold the soil in place and provide a favorable environment for the microbial community. A fifth and final principle is to integrate livestock when possible. One of the benefits of livestock is that when manure is used properly is not only recycles nutrients but provides an important source of carbon for soil microbes.

Cervantes:
What is most important? What do you keep the focus on?

Rosen:
A major focus of soil health is on maintaining or enhancing soil organic matter and a beneficial soil microbial community of bacteria and fungi. This is where it gets interesting for potatoes because soilborne diseases are a major limiting factor in potato production and therefore the common practice is to fumigate the soil to control these diseases. Now fumigation can be beneficial to plant health, but it kills not only the pathogens but also the beneficial microbes. One of the objectives of our project is to identify management practices that can promote a soil microbial community to reduce the incidence of soil-borne diseases without total reliance on fumigation. For example, are there specific microbial communities and soil health indicators associated with better potato health and yields? And what rotations and amendments benefit that microbial community also known as the soil microbiome?

Cervantes:
Does this mean that healthy soil is disease-free?

Rosen:
No, it means it's disease-resistant. Meaning that there is a diverse community of microbes in the soil that can keep the pathogenic organisms from proliferating.

Cervantes:
Are you working alone on this?

Rosen:
No, not at all. There are 24 scientists working on this project as well as graduate and undergraduate students, postdocs, and research technicians. We are assessing fields in 9 states across the country. We bring together agronomists, soil scientists, plant pathologists, economists, and extension experts. It a highly integrated project that includes basic and applied research, economics, and outreach. We also have periodic stakeholder meetings to receive input on our approach and future directions.

Cervantes:
Sounds like a very impressive group of people you have on your team. You know Carl, when I was young, I spent all my summers on a small piece of farmland on the outskirts of St. Petersburg Russia and we grew every fruit and vegetable possible. Including potatoes. I

enjoyed pulling weeds and having clean garden beds, but I didn't enjoy it enough to make it my career. Have you always been interested in soil and soil health?

Rosen:
Well not really. I did not grow up on a farm, but I always had an interest in growing plants. In fact, my father was a mathematician, and my mother was a botanist so I must have gotten that interest from my mother. After high school, I had the opportunity to work on a farm in Ireland for about 8 months. Ironically, it was a potato and dairy farm. Little did I know back then that I would be working with potatoes in my academic career. I went into horticulture as an undergraduate and master's student to learn more about plants and after taking a few soil science classes, I was hooked on learning more about soil. I then decided to pursue a Ph.D. in soil science, and I never looked back.

Cervantes:
How much soil do you really need to analyze for a project like the one you're working on right now?

Rosen:
Well, bringing about positive changes in soil health through improved management practices can take a long time. We need to monitor not just the potato crop but also the rotation crops in the years in between potatoes. In our project we are looking at the effects of two- and three-year rotations and that is just one cycle. To really get a comprehensive idea of what our practices are doing it will take several cycles to see if our treatments are having any effect on the soil microbial community, disease incidence, and potato yields. We are also looking at spatial variability in growers' fields in 7 states over three or four growing seasons. This is generating thousands of samples that being analyzed for physical, chemical, and biological properties. Once we have enough data, we also need to do an economic analysis to determine if the practices make sense for the grower to adopt. If the practices do not result in higher yields or lower inputs, then growers will not be interested.

Cervantes:
What are you hoping the soil will reveal to you?

Rosen:
The meaning of life…, which may not be too far off. One of the novel aspects of this project is that we are analyzing the soil DNA to help us characterize the soil microbiome. If we can identify practices as well as various soil health indicators that promote a soil microbiome associated with better potato yields and lower disease incidence, we may be able to provide recommendations for appropriate inputs that continue to enhance soil health. However, there is no silver bullet here. Soil is complex and what works well in one area may not work well in another. We may need to use sophisticated modeling techniques to figure this out in the end.

Cervantes:
Carl, this has been a very educating episode for me. I know our listeners learned a thing or two as well.

Rosen:
I hope so!

Cervantes:

One last thing, if I'm at a party and I want to impress my friends with my new soil knowledge, what would be something I could say?

Rosen:
Hmm… well, I am sure many listening to this podcast know that each teaspoon of healthy soil can contain more microorganisms than there are people on earth. It's quite amazing and we can manipulate those microbial populations by our management practices. Some of the microbes are beneficial, some cause disease and others we really don't know what functions they have. But, if we do things well, our hope is that we can enhance the beneficial microorganisms, maintain or increase potato yields and keep our soils healthy.

Cervantes:
I like it. That's very educational and perfect for my next fun fact at a party. But I might need to write it down. Thank you for taking the time to talk with me today. I really enjoyed our conversation.

Rosen:
Thank you for having me on Potato Cast Natalia. When will this episode air by the way?

Cervantes:
This episode will be released in February.

Rosen:
Fantastic. I'm going to head to the potato expo. I'll see you at the Potatoes USA booth Natalia.

Cervantes:
I'll see you at the booth Carl. Enjoy the walkthrough.

I hope everyone enjoyed listening and learning from Carl Rosen as much as I did. It's exciting to hear about the work that goes into managing a large multistate soil health project.
If you're looking for more information about potato research, check out the research section on potatoesusa.com I'm also including a link for resources from Carl Rosen on this episode's page.

That's all for this episode. It's time for me to go check out the Potato Expo as well.

Cervantes:
Thank you for listening to this episode of Potato-cast! Please subscribe on Spotify, Apple, or Google Podcast by searching for Potato-cast.
All supporting documents for data provided in this episode can be found on potatoesusa.com.
To see all the great information available about potatoes or new and fun ways to cook with potatoes, visit potatogoodness.com.
I am your host, Natalia Cervantes.
Until next time, take care everyone