Creme Global

Water, Fertiliser and Soil Microbiome

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As previously described, Creme Global has deep expertise in exploring the microbiome. In the case of water, fertiliser and soil understanding the factors that influence and change the microbiome and predicting how the microbiome influences its host or immediate environment relate to how water and fertiliser change the soil microbiome. Consequently how the soil microbiome influences the crops that grow. In some cases, crops such as fruit and vegetables are consumed directly and in other cases, it is consumed by animals (grass, cereals, soy, etc).

Creme Global is building partnerships with both the FDA and Teagasc. In particular, Creme Global is supporting the FDA on the objectives of developing a deeper understanding of the microbiome.

The following are examples of projects focused on expanding the understanding of the microbiome in the agri space.

FDA

https://www.fda.gov/

The Food and Drug Administration (FDA) is responsible for protecting the public health by ensuring the safety, efficacy, and security of human and veterinary drugs, biological products, and medical devices; and by ensuring the safety of our nation's food supply, cosmetics, and products that emit radiation.

One project of particular relevance is related to Salmonella contamination of raw tomatoes. This is a summary of the project.

FDA's 'Team Tomato' Fights Salmonella Contamination

https://www.infectioncontroltoday.com/food-safety/fdas-team-tomato-fights-salmonella-contamination

From 1973 to 2010, there were 15 multi-state outbreaks of illnesses attributed to Salmonella contamination of raw tomatoes, with 12 of these outbreaks taking place since 2000. They resulted in almost 2,000 confirmed illnesses and three deaths, with states in the eastern U.S. hardest hit.

"The conditions in which tomatoes thrive are also the conditions in which Salmonella thrive," says Eric Brown, PhD, director of FDA's Division of Microbiology. "But the tomato always presented an extra challenge because it is so short-lived. By the time it looked like contaminated tomatoes could be causing illnesses, the harvest would be gone."

So FDA's focus has changed over the last decade to reducing contamination early in tomato production. Says Brown, "The question was clear: What can we do to intervene and prevent this contamination from happening in the first place?"

FDA microbiologist Rebecca Bell, PhD, lead researcher on the tomato team, says the agency studies tomatoes on an experimental farm at Virginia Tech's Agriculture and Research Extension Center (AREC). This land is next to farms that have been the source of Salmonella contamination, giving the researchers access to real conditions and real threats.

The researchers collected more than a thousand bacteria in the soil and water in search of a natural enemy of Salmonella and they found one bacterium called Paenibacillus, which is benign to humans but kills Salmonella. FDA will be working with the Environmental Protection Agency (EPA) to facilitate the development of an organic treatment containing Paenibacillus that would kill Salmonella and other harmful organisms.

Bell says this will be a particularly valuable Salmonella-fighting tool in the mid-Atlantic region, where farmers often fumigate six inches down into the soil to kill harmful bacteria. Their methods for doing so may, ironically, create more opportunities for enteric pathogens (gastrointestinal organisms spread by contamination of food), such as Salmonella, to colonize in the roots of the tomato plants.

FDA researchers on this team follow parallel tracks towards the same goal of helping government and industry develop more effective and targeted agricultural practices that will improve the safety of fresh tomatoes.

Two examples of their work have been published this year in prominent professional journals.In a study published in the Journal of Applied and Environmental Microbiology, microbiologist Jie Zheng, PhD, and other FDA researchers explain how they set out to better understand how fresh tomatoes become contaminated with Salmonella. The researchers found that the quality of the water is a key factor. Tomatoes can become contaminated at specific times during the growing season, indicating the importance of using clean water to irrigate at planting or when applying pesticides.

In a study published in the journal BMC Microbiology, microbiologist Andrea Otteson, PhD, and FDA colleagues compared the tomato-growing environments of California, Virginia and Florida. The researchers are developing a baseline of microflora (including algae, fungi, and bacteria) associated with tomato crops at high or low risk of Salmonella contamination. The researchers are also considering other factors, such as the crops' proximity to poultry farms a potential source of Salmonella or certain fungi in the soil. California has not had as many Salmonella outbreaks in tomatoes, and this research may be able to pinpoint the conditions on the East Coast that would be the safest for tomato crops, Otteson says.

Findings by FDA researchers were among the building blocks of the Proposed Produce Safety Rule mandated by the FDA Food Safety Modernization Act (FSMA), Mahovic says. The proposed rule would establish science-based standards for the production and harvesting of fruits and vegetables. FSMA gave FDA a mandate to implement a system that emphasizes prevention of risks to public health.

Teagasc

https://www.teagasc.ie/

Teagasc – the Agriculture and Food Development Authority in Ireland is the national body providing integrated research, advisory and training services to the agriculture and food industry and rural communities. Their mission is to support science-based innovation in the agri-food sector and wider bio-economy that will underpin profitability, competitiveness and sustainability. This is achieved through the close coupling of research and knowledge transfer in four programme areas:

- Animal and Grassland Research and Innovation
- Crops, Environment and Land Use
- Food
- Rural Economy and Development

One project in particular that Teagasc researchers are working on understanding the diverse roles played by microorganisms in agricultural systems, and on exploring what microbiome research can offer to agriculture. This is a summary of their activity in this space.

Harnessing the power of agricultural microbiomes

https://www.teagasc.ie/media/website/publications/2018/TResearch_Winter_2018_p12-13-HarnessingAgri.pdf

Authors: Dr Fiona Brennan et al, Teagasc

Microorganisms play a critical role in agriculture, representing a key resource that underpins the agri-food sector. Soils, plants and animals all have a unique microbiome (the community of microorganisms living together in a given habitat) and these agricultural microbiomes perform an array of pivotal functions essential to system health, sustainability and productivity. Up until relatively recently, insights into these complex microbial communities have been limited. However, the advent of novel molecular technologies has transformed this field, making it possible to study microbiomes in greater depth than ever before through DNA, RNA or protein analysis. This can tell us which microorganisms are present and what they are capable of doing. Soil microorganisms are critically important to agriculture, food production, and climate regulation. Research efforts on the soil microbiome are focused on determining the impact of management, environmental and climatic factors on the soil microbiome, and informing soil management so as to promote soil health, match nutrient availability to plant requirements, and harness the soil immune response to suppress pests and diseases. Knowledge of the soil microbiome is central to the development of sustainable agricultural systems by enabling a reduction in nutrient losses to the environment, increasing carbon sequestration, reducing agricultural inputs, and increasing the resilience of crops to extreme weather events.

Using technologies that characterise a plant's microbiome it is now possible to identify individual 'crop profiles'. The research community is actively testing such profiles to identify strains that can be used by farmers to produce more from less: greater yields with better quality but with a reduced reliance on fertilisers and chemicals.

Animal microbiomes underpin livestock production. Certain microbes are capable of influencing ruminant performance by altering rumen fermentation and outcompeting harmful pathogens. Populations of rumen microbes differ between animals, providing the opportunity to breed cattle for desirable microbiome traits such as improved feed efficiency,health and reduced environmental output. Current research is focused on better understanding the role of the host animal in regulating the rumen microbiome, as well as the impact of diet and prebiotics on rumen function and animal performance.

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