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System design, surface characteristics and recirculation influence microbial communities in hydroponic leafy green production

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Abstract

Microbial communities in hydroponic systems are less studied compared to soils. In hydroponics, plant roots are suspended in a defined nutrient solution, and system complexity and microbial diversity are lower than in soil. We have established collaborations with ten commercial leafy green hydroponic producers across Ohio. These facilities range in size (from 23 to 13150 m^2) and production capacity (up to a million heads per year). In addition, we have access to research Nutrient Film Technique (NFT) and Deep-Water Culture (DWC) units. We are characterizing microbial communities from these systems using culture-based and amplicon-metabarcoding approaches. We observed that the diversity of lettuce-associated microorganisms and microorganisms in nutrient solution depends on system design (e.g., NFT vs DWC). Similarly, sampling location, within the recirculating systems (NFT) influences the diversity of recovered bacteria, with more bacterial genera isolated from nutrient solution at the end of the recirculation system compared to the water source and the nutrient solution input. For biofilms, we observed that the materials in research DWCs' pool liners result in greater biofilm buildup, based on colony forming units, than the NFTs' PVC. However, biofilm samples from NFT surfaces harbored two times more bacterial amplicon sequence variants. Our data represents an initial snapshot of the communities of microorganisms found in leafy green hydroponics. Further analysis will contribute to identifying microbial taxa of relevance for plant growth, and how microbial-microbial and plant-microbial interactions differ between bacteria in nutrient solution compared to those establishing biofilms.