World Academy of Science, Engineering and Technology
International Journal of Agricultural and Biosystems Engineering
Vol:12, No:05, 2018

Functional Traits and Agroecosystem Multifunctionality in Summer Cover Crop Mixtures and Monocultures

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Abstract : As an economically and ecologically feasible method for farmers to introduce greater diversity into their crop rotations, cover cropping presents a valuable opportunity for improving the sustainability of food production. Planted in-between cash crop growing seasons, cover crops serve to enhance agroecosystem functioning, rather than being destined for sale or consumption. In fact, cover crops may hold the capacity to deliver multiple ecosystem functions or services simultaneously (multifunctionality). Building upon this line of research will not only benefit society at present, but also support its continued survival through its potential for restoring depleted soils and reducing the need for energy-intensive and harmful external inputs like fertilizers and pesticides. This study utilizes a trait-based approach to explore the influence of inter- and intra-specific interactions in summer cover crop mixtures and monocultures on functional trait expression and ecosystem services. Functional traits that enhance ecosystem services related to agricultural production include height, specific leaf area (SLA), root, shoot ratio, leaf C and N concentrations, and flowering phenology. Ecosystem services include biomass production, weed suppression, reduced N leaching, N recycling, and support of pollinators. Employing a trait-based approach may allow for the elucidation of mechanistic links between plant structure and resulting ecosystem service delivery. While relationships between some functional traits and the delivery of particular ecosystem services may be readily apparent through existing ecological knowledge (e.g. height positively correlating with weed suppression), this study will begin to quantify those relationships so as to gain further understanding of whether and how measurable variation in functional trait expression across cover crop mixtures and monocultures can serve as a reliable predictor of variation in the types and abundances of ecosystem services delivered. Six cover crop species, including legume, grass, and broadleaf functional types, were selected for growth in six mixtures and their component monocultures based upon the principle of trait complementarity. The tricultures (three-way mixtures) are comprised of a legume, grass, and broadleaf species, and include cowpea/sudex/buckwheat, sunnhemp/sudex/buckwheat, and chickling vetch/oat/buckwheat combinations; the dicultures contain the same legume and grass combinations as above, without the buckwheat broadleaf. By combining species with expectedly complimentary traits (for example, legumes are N suppliers and grasses are N acquirers, creating a nutrient cycling loop) the cover crop mixtures may elicit a broader range of ecosystem services than that provided by a monoculture, though trade-offs could exist. Collecting functional trait data will enable the investigation of the types of interactions driving these ecosystem service outcomes. It also allows for generalizability across a broader range of species than just those selected for this study, which may aid in informing further research efforts exploring species and ecosystem functioning, as well as on-farm management decisions.

Keywords : agroecology, cover crops, functional traits, multifunctionality, trait complementarity
Conference Title : ICARAD 2018 : International Conference on Agroecological Restoration and Agricultural Development
Conference Location : Rome, Italy
Conference Dates : May 03-04, 2018