Name

Jose G. Franco

Co-Advisor Information

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Research Description

Title: Functional diversity and its effects on water-use efficiency in an organic intercropping system

This study will evaluate how an incremental increase in functional crop diversity in an organic intercropping system will enhance ecosystem functioning and crop water-use efficiency while improving or sustaining crop yields. For the purpose of this study, each component crop will add an architectural layer, adding complexity to the canopy similar to natural ecosystems. By maximizing the use of space and selecting nitrogen-fixing plants, yield per unit area can potentially be increased. Additionally, by selecting crops that have a low vertically spreading growth form, soil temperature and moisture loss can be reduced. A reduction in soil moisture loss and an increase in crop water use efficiency could help remediate water shortage problems in a drought-prone area such as Texas.

Intercropping is an agricultural practice that promotes biological interactions and diversifies crop production in order to introduce biodiversity into agroecosystems (Mohler and Stoner 2009). Some researchers have emphasized the importance of functional differences between species and the relationship between species in space and time rather than species richness *per se* on improving ecosystem functioning (Landis et al. 2000). Thus, we propose to choose crop species that add a specific function to the community, such as nitrogen fixation, pollinator attractant, herbivore repellant etc. to improve yields while increasing resource use efficiency.

Small farmers in tropical forest areas have long utilized intercropping systems and have incorporated a variety of crops with different growth forms, which creates a complex multi-layered habitat that closely mimics nature (Denevan 1995). In agroforestry systems of the tropics, it has been observed that deep-rooted trees bring nutrients and water up from deeper soil layers, thereby increasing nutrient and water use efficiency and reducing leachate (van Noordwijk et al. 1996). The “three sisters” intercropping system of squash, bean and corn practiced by the Native Americans is another well documented example of a multi-layered agroecosystem (Mohler and Stoner 2009). In these types of systems, each crop occupies a functional group niche and contributes in a different way to the overall functioning of the ecosystem (Vitousek and Hooper 1993). In the case of the “three sisters”, squash suppresses weed growth (smother crop) and reduces soil temperatures and soil moisture loss, bean is the nitrogen-fixer, and corn acts as structural support (Mohler and Stoner 2009).

Despite the rising popularity of intercropping in developed countries (Kahn 2010), multi-layer architecturally complex intercropping systems have not been studied extensively in the Southern United States. There are few studies that have quantitatively evaluated the role of functional diversity on ecosystem functioning, water use efficiency, and yields in intercropping systems. We propose to quantify and mechanistically explain the effects of a functionally diverse crop community on regulating soil health, water use efficiency and plant productivity. The results from this study could help small-acreage vegetable producers in Texas reduce irrigation inputs while improving yields and increasing profits.

References:

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Landis, D. A., S. D. Wratten, and G. M. Gurr. 2000. Habitat management to conserve natural enemies of arthropod pests in agriculture. Annu. Rev. Entomol. **45**:26.

Mohler, C. L. and K. A. Stoner. 2009. Guidelines for intercropping. Pages 95-100 Crop rotation on organic farms: A planning manual. NRAES-177.

van Noordwijk, M., G. Lawson, A. Soumare, J. J. R. Groot, and K. Hairiah. 1996. Root distribution of trees and crops: competition or complementary. Pages 319-364 *in* C. K. Ong and P. Huxley, editors. Tree-crop interactions: A physiological approach. CAB International, Wallingford, UK.

Vitousek, P. M. and D. U. Hooper. 1993. Biological diversity and terrestrial ecosystem biogeochemistry. Pages 3-14 *in* E. D. Schulze and H. A. Mooney, editors. Biodiversity and Ecosystem Function. Springer-Verlag Berlin, Berlin 33.

Academic Qualifications

Education		Course	Grade
Ph.D.	WMHS/Ecosystem Science & Management Texas A&M University 2009 - Present	Vegetable Crop Production Plant Physiology Plant Pathology Land Use & Water Quality Geographic Information Systems Small Watershed Hydrology Statistical Hydrology	
		GPR:	
M.S.	Range Science New Mexico State University 2005-2007	Herbicides in the Range Environment Soil Morphology Rangeland Ecology Statistics I & II	
		GPR:	
B.S.	Biological Science/Geology minor University of Texas at El Paso 2002-2004	Ecology Plant Morphology Plant Form & Function	
		GPR:	
		GRE:	

Proposed Use of Funds

If awarded, the Mills Scholarship funding will be used for soil fertility analyses and soil moisture monitoring equipment. Any remaining funds will be used to attend academic conferences in order to present research.

Intended Career Path

Upon completion of my dissertation, I would like to work for Texas AgriLife Extension, focusing on sustainable agriculture and water resources education and producer outreach, while also lecturing at a Texas college or university.