Title Optimizing the use of cover crops, compost, and sustainable production techniques to enhance productivity and quality of organic cucumber and tomato

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Abstract

The overall objective of this study is to focus on key aspects of organic production such as transplant production, cover cropping, biodiversity, and compost management in order to address some important and critical issues stymying the growth of this industry. In this research we hypothesize that higher level of plant biodiversity, through intercropping, along with the use of cover crops and organic amendments increases crop growth, yield, and productivity.

Healthy transplants are a key to successful organic production. Therefore, greenhouse studies were initiated to test an alfalfa-based organic amendment for tomato transplant production. A factorial experimental design with five concentrations (0.0%, 0.6%, 1.2%, 1.8%, and 2.4%) and five incubation periods (0, 1, 2, 3, and 4 weeks) was set up. We demonstrated that addition of adequate amounts of the alfalfa-based amendment could help produce healthy and vigorous tomato transplants that meet commercial standards. Large-scale field experiments were conducted from 2005 to 2009 to address a wide gamut of issues. One of the studies investigated the impact of tomato-cucumber intercropping on tomato growth and development, and soil physical and chemical properties. Effects of intercropping on tomato growth and yield characteristics were less evident; however, it significantly influenced cucumber yield and reduced cucumber beetle and bacterial wilt damage. In tomato, regardless of cropping system, compost application significantly increased plant height, stem diameter and dry weight clearly indicating a positive effect on plant growth. Repeated use of compost increased soil EC and NO_3-N concentrations, except in 2009 which received higher than normal rainfall. There were no differences in soil Ca, Mg and K levels due to intercropping or compost application. Multivariate analysis, based on variables such as soil chemical properties, crop growth and yield characteristics, separated compost and no-compost treatments, however, cropping system treatment (monocrop or intercrop) could not be clearly differentiated.

Soil respiration, microbial biomass and diversity were affected by cover crop (rye or rye-vetch mixture) and compost treatments with significantly higher response in soils receiving compost

applications. Highest microbial biomass (195-210 μg g^{-1} dry soil) was found in soils amended with rye + compost. Soil nematode populations showed a significant increase for bacterial feeding nematodes in the rye-vetch compost treatment in one of the years. Community level physiological profile based on C substrate utilization revealed higher microbial functional diversity in rye and compost amended soils. The impact of cover crops and compost on postharvest tomato fruit quality and functional food qualities was also investigated. There was minimal effect of cover crops, but, compost addition significantly increased marketable fruit quality (proportion of marketable fruit and average fruit weight). Other fruit quality aspects such as density, firmness, and total soluble solids did not differ among treatments. Percentage antioxidant activity and the functional food quality of the tomato extracts, with respect to inhibition of cyclooxygenase enzyme activity was highest in tomatoes grown on soils amended with rye-vetch and compost. A subset of the field study investigated the effect of two row covers (60% and 85% light transmission) on crop microclimate and cucumber growth. Use of row covers increased vine length, flower count, leaf area, leaf count, plant biomass, and total marketable yield. When row covers were used in conjunction with compost, no differences in plant growth and yield characteristics were observed between row covers.