Soil and Weed Management Tactics Have Differential Effects on Tomato, Cabbage and Weed Growth, Disease, Yield and Quality Variables in a Midwest Transitional-Organic System

Annette Wszelaki[1], Karen Amisi[1], Sally Miller[2], Brian McSpadden Gardener[2], Doug Doohan[1], and Matt Kleinhenz[1]
Departments of [1]Horticulture and Crop Science and [2]Plant Pathology
The Ohio State University - OARDC
1680 Madison Avenue, Wooster, OH 44691-4096

The design and use of production systems that optimize crop yield and quality within commercial, agroecological contexts is a major focus for many. Organic farming is an increasingly significant part of the U.S. and world landscapes and its prominence continues to derive in part from its ability to provide an abundant supply of high quality food within ecological principles.

Various effects of climatic conditions and major aspects of in-field management on vegetable crop yield and quality, weed abundance and diversity and disease pressure are well documented, although the best collective understanding of these effects derives principally from studies in conventional systems. However, information from conventional systems cannot be applied directly to transitional- or certified-organic systems because they differ in key aspects that may alter plant biochemistry and physiology. For example, imbalances between crop nutrient demand and soil supply affect crop status, perhaps manifesting themselves as shifts in crop yield, quality and/or marketability. Low N levels may favor the production of C-containing compounds (e.g., starch, cellulose, phenolics, terpenoids) over that of N-containing compounds, such as proteins and alkaloids. Plant protein levels may increase with N uptake, with sugar levels rising where soil P levels are low relative to other elements. Likewise, carotenoid levels tend to be highest when conditions favor plant growth. Plant levels of ascorbic acid (Vitamin C) and β-carotene (Vitamin A precursor) may increase and decrease, respectively, when N availability is low.

Reports from Pennsylvania, Ohio, New York and elsewhere notwithstanding, more is known regarding vegetable crop management-yield and quality relationships in arid, semi-arid or tropical areas than in other areas. More needs to be known about structure-function relationships within intact, temperate-zone organic vegetable systems, in part to help design systems that meet farmer, consumer and societal expectations. Known as major challenges in organic production, fertility and weed management are particularly difficult in regions with variable weather. Therefore, we set out to document soil amendment (unamended control, composted dairy manure, or raw dairy manure) and weed management (critical period or no seed threshold) treatment effects on crop and weed growth, disease, yield and quality variables over 3 years in an Ohio transitional-organic rotation of processing tomato, processing cabbage, clover and wheat.

Differences among amendment treatments were larger in cabbage than tomato, a trend possibly driven by genotypic-specific nutrient requirements and, in years 2 and 3, cabbage being planted into plots receiving amendments in the previous one or two seasons. Indeed, amendment application influenced cabbage yield yearly, with treatment effects on postharvest quality variables increasing annually. In contrast, weed

management treatments had relatively little effect on crop variables, although the size of cabbage heads was greater in the no seed threshold (NST) versus critical period (CP) plots in 2001. Similar results were found for tomato fruit size in 2003. Also, the Area Under the Disease Progress Curve value for tomato was greater in CP versus NST plots in 2003. Overall, disease pressure was highest in tomato in 2001, although soil amendment treatments had minor effects on disease within a given year. In cabbage, disease was more prevalent in 2002 than in 2003, but in 2003 the compost treatment had significantly more rotten heads than the manure or control treatments. These results underscore soil management-crop yield and quality relationships, the potential for cumulative, crop-specific responses to organic soil and weed management tactics, and the need for additional research designed to help synchronize nutrient supplies with crop demand in temperate, organic vegetable systems, so that they are better equipped to meet grower and market expectations.

Publications Resulting From This Work

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