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Developing a Vegetable Fertility Program Using Organic Amendments and Inorganic Fertilizers

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Summary. This review integrates information from common organic amendments used in conventional vegetable production, including 1) cover crops (legumes and nonlegumes), 2) compost generated from yard wastes, biosolids, municipal solid waste (MSW), animal manures, and other biodegradable waste by-products, and 3) raw animal manure (with and without bedding). Environmental monitoring has shown elevated nitrate concentration to be widespread in both surface and groundwater, often occurring in regions with concentrated horticultural production. Therefore, the objective of this review was to calculate the nutrient content from organic amendments, since these are not considered nutrient sources. Common organic amendments affect soil bulk density, water-holding capacity, soil structure, soil carbon content, macro- and micronutrients, pH, soluble salts, cation exchange capacity (CEC), and biological properties (microbial biomass). The first step in building a conventional tomato (*Solanum lycopersicum*) fertility program will be to take a soil sample and send it to a soil laboratory for a nutrient analysis. These results should be compared with the local crop recommendations. Second, select the organic amendments based on local cover crop suitability and availability of compost, raw animal manure, or both. Then, determine the nutrients available from cover crops and other applied organic amendments and use inorganic fertilizer sources to satisfy the crop nutrient requirements not supplied from these other sources.

Vegetable production systems in the United States include plasticulture and open bed. These production systems have been effective for commercial production with resulting economic return. Plasticulture generally includes raised beds, fumigation, polyethylene mulch, irrigation, and soluble fertilizer application; open bed production includes herbicides, irrigation, and soluble fertilizer application. However, conventional vegetable growers rarely add organic amendments because the use of concentrated, relatively inexpensive (compared with the value of the crop), and readily available synthetic fertilizers results in high yields with maximum short-term profits (Kelly, 1990). The most common organic amendments that conventional vegetables growers can use are cover crops, compost, and raw manures (Ozores-Hampton et al., 2012).

Incorporating cover crops into vegetable production may enhance the sustainability of the system by recycling unused nutrients from previous vegetable crops, improve soil structure, increase soil organic matter (SOM) and fertility, retain moisture, prevent leaching of nutrients, decrease soil density, suppress weeds, increase population of beneficial insects, control erosion, manage plant-parasitic nematodes, increase soil biological activity, and increase yields (Abdul-Baki et al., 1997a, 1997b; McSorley, 1998; Sainju and Singh, 1997; Stivers-Young, 1998; Sullivan, 2003; Treadwell et al., 2008a). Some benefits may occur during the cover crop life cycle, while other benefits may take effect after the cover crop is incorporated (Treadwell et al., 2008b). Disadvantages of growing cover crops within a vegetable production system include additional production cost, delayed vegetable planting, increased pest pressure, immobilization of fertilizer nitrogen (N), and difficult to control ratoon vegetable crop (Treadwell et al., 2008c).

Compost can be defined as “the product of a managed process through which microorganisms break down plant and animal materials into more available forms suitable for application to the soil” (Florida Department of Environmental Protection, 1989). The technological and scientific advances in compost production (DeBertodi et al., 1987; Epstein, 1997), utilization (Stoffella and Kahn, 2001), microbiology (Insam, et al., 2010), and engineering (Haug, 1993), which has occurred during the past two decades, and implications that compost is environmental “friendly” and sustainable have been the reasons for the tremendous increase in worldwide compost usage. In areas of high population, there are a variety of nonhazardous wastes suitable for composting and land application that can provide an economically sound and environmentally acceptable option for utilization, but the majority of these wastes are currently landfilled or burned (Ozores-Hampton et al., 1998). Organic amendments composed of wastes produced by urban populations include MSW; yard trimming; food wastes from restaurants, grocery stores, and institutions; wood wastes from construction, demolition, or both; wastewater (from water treatment plants); and biosolids (sewage sludge). Agriculture produces other organic wastes that can be composted: poultry, dairy, horse, feedlot, and swine manures; wastes from food-processing plants; spoiled feeds; and harvest wastes (Ozores-Hampton et al., 1998, 2005; Ozores-Hampton, 2006). The use of organic amendments may improve soil quality and enhance the utilization of fertilizer, thus improving the performance of vegetable crops (Ozores-Hampton et al., 1998, 2011; Ozores-Hampton and Peach, 2002). In addition, compost application may control weeds (Ozores-Hampton et al., 2001a, 2001b), suppress plant diseases (Hoitink and Fachy, 1986; Hoitink et al., 2001), increase SOM, decrease erosion by water and wind (Tyler, 2001), and reduce nutrient leaching (Jaber et al., 2005; Yang et al., 2007).

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4536	lb	kg	2.2046
1.1209	lb/acre	$kg \cdot ha^{-1}$	0.8922
(°F – 32) ÷ 1.8	°F	°C	(°C × 1.8) + 32