Muscatine Pepper Trial, 1998
Evaluation of Soil Amendments for Certified Organic Vegetable Production

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Introduction

Organic farming has increased to a $4.2 billion industry in the U.S. and continues to expand approximately 20% annually (14). In Iowa alone, organic acreage for all crops has increased from 13,000 in 1995 to 100,000 in 1998 (9). International demand for organic products, especially from the Japanese and European markets, is also on the rise. Farmers interested in transitioning some or all of their land into organic production require information on best management practices for these systems. Once the transition is complete, comparable yields to conventional systems can be obtained (1,12,19). In addition, organic products garner a 20-300% premium price in the marketplace, with organic soybeans, for example, currently averaging a 250% premium price over conventional soybeans (9).

Intensive horticultural systems must rely on additional sources of N-P-K for proper growth and yields (1). There has been an increasing interest among organic farmers in Iowa for an unbiased analysis of the many natural soil amendment/fertilizer and compost products on the market for vegetable and herb crop production. These products are reported to help preserve soil structure and quality, and protect groundwater from toxic runoff/infiltration (2,4,5,10,13,15,16, 17,20). In addition, soil amendments consisting of green and livestock waste products have been reported to mitigate vegetable disease (3,7,8,21) and insect problems (6,11). Organic producers in Iowa have requested studies from Iowa State University staff on soil amendments that meet organic certification requirements (18) and provide an economic benefit in terms of improved plant growth and yields. First year preliminary results from trials conducted at the ISU Muscatine Island Research Farm (MIRF) are presented below.

Materials and Methods

Plots previously planted to rye at the MIRF were roto-tilled on April 6, and disked on May 19, 1998. 'Hungarian wax' pepper plants were seeded in trays on April 16 and transplanted into rows (at 12" x 42" spacing) in 27' x 8' plots on May 19. Four replications of seven treatments were planted within the field. Treatments included the following: Treatment 1 = Organic Control (no fertilization); Treatment 2 = Organic Bio-Cal® (900 lb/A with a 50 lb N/A side-dress of compost); Treatment 3 = Organic Compost (100 lb N/A at planting); Treatment 4 = Organic Bio-Cal® (900 lb/A) plus compost (100 lb N/A at planting); Treatment 5 = Conventional Control (no fertilization); Treatment 6 = Conventional Fertilizer (conventional rates); and Treatment 7 = Conventional Fertilizer (conventional rates) and Lime (hydrated lime at 500 lb/A). Forty plants were planted in each replicated plot for a total of 1,120 plants in the experiment.

The conventional fertilizer rates consisted of 14-14-14 (N-P-K) at 400 lb/A and 0-0-60 at 200 lb/A, which provided 56 lb N, 56 lb P and 176 lb of K four days before planting. A side-dress of 34-0-0 at 129 lb/A provided an additional 44-lb N/A on June 11.

The goal of the fertilization program was to obtain similar rates of nutrients in the organic and conventional system (•100 lb N/A and equivalent calcium rates). Treflan® was applied at 1 pt/A on May 19, in the conventional plots. No insecticide was applied in any treatments because of low insect pressure.

An Iowa-produced compost (emphasizing the tenet of sustainable agriculture: use of locally produced inputs) was obtained for this study (Ultra-Gro®, a turkey litter product from Circle Hill Organics, Ellsworth, IA). Composition of the compost includes 2.2-2.8-1.5 N-P-K and other minor elements. The compost selected for this study had been stored for at least one year as required for certified organic production (manure must be composted for six weeks, or applied four months before harvest). The compost in Treatments 3 and 4 were applied four days before planting, and the side-dress application in Treatment 2 was applied on June 11. Bio-Cal® is a locally produced bi-product of the kiln industry, consisting of 35% of various forms of calcium and the remainder in sulfur, boron and phosphorous.

Weeds were machine- or hand-cultivated throughout the season. Irrigation was applied as needed through overhead risers. A core set of measurements was taken on 10 plants per plot (total of 40 plants per treatment) for crop plant productivity (biomass) and plant health on a bi-monthly basis. Height of plants and leaf number were monitored, along with numbers of harmful and beneficial insects. Peppers were harvested according to schedule on July 7, July 27, August 14, August 28, and September 11. Counts were also made of culled peppers at harvest (peppers showing damage from insects or diseases). Peppers were transferred to chambers in the Horticulture Department in Ames and held at 50 degrees F in order to conduct postharvest storage-life studies. Fresh weights were taken immediately after harvest and at weekly intervals following harvest (currently in progress). All measurements were subjected to analysis of variance and Fisher's PLSD test ($P = 0.05$).

Results and Discussion

At maximum growing point (July 7), leaf height was not significantly different in plants fertilized with organic compost compared with conventional fertilizers (Figure 1). All organic and conventional treatments had greater biomass than the organic and conventional controls, respectively (ANOVA, $P = 0.05$). At the first harvest on July 7 (Figure 2), pepper fresh weights from the organic treatments were greater than the conventional treatments, with the greatest number of peppers (170) and greatest average weight (20.5 ± 0.57 g) harvested from Treatment 4 plots (compost plus Bio-Cal®). Because of the variability among peppers, however, significantly greater yields were obtained only for Treatments 4, 6 and 7 (ANOVA, $P = 0.05$).

Total pepper fresh weight over the five harvest periods (Figure 3) was not significantly different among treatments (ANOVA, $P = 0.05$). It is apparent from the fresh weights, however, that the pepper plants produced the greatest yields when provided additional nitrogen fertilization. This is demonstrated by the weights from Treatment 2 plants (receiving 50 lb N/A) where the average total weight per harvest was

5.70 kg, compared with peppers from Treatments 4 and 5 (receiving 100 lb N/A) where average total weight was 7.15 and 7.07 kg, respectively.

We were particularly interested in the number of culled peppers in each harvest as a measure of pepper health. Although numbers of culled peppers were not statistically different (ANOVA, P = 0.05), greater numbers of peppers were culled due to insect or disease in the conventional plots compared with the organic peppers (Figure 4). We are continuing this analysis through a postharvest study to determine the effect of soil amendment treatment on storage duration and pathogen development in storage.

Although the conventionally fertilized plants produced greater pepper weights over five harvest periods, overall differences with organic plots were not statistically different. On July 7, yields were greater in the organic plots, suggesting an advantage at early harvests. The greater premium obtained with organic peppers (average of 50%) should offset any reduction in yields with organic systems. Assuming a 50% increase in price, and the average yield in the organic system (excluding the control plots) 19.4% lower than the conventional plots over the five harvest periods, the premium would become approximately 30% over the conventional returns.

Numbers of harmful and beneficial insects; incidence of diseased peppers in storage; and postharvest storage life comparisons between the organic and conventional peppers are currently undergoing analysis. This experiment will be repeated at the Muscatine Island Research Farm in 1999 and 2000.

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Figure 1. Pepper Plant Height at Maximum (7/7/98)

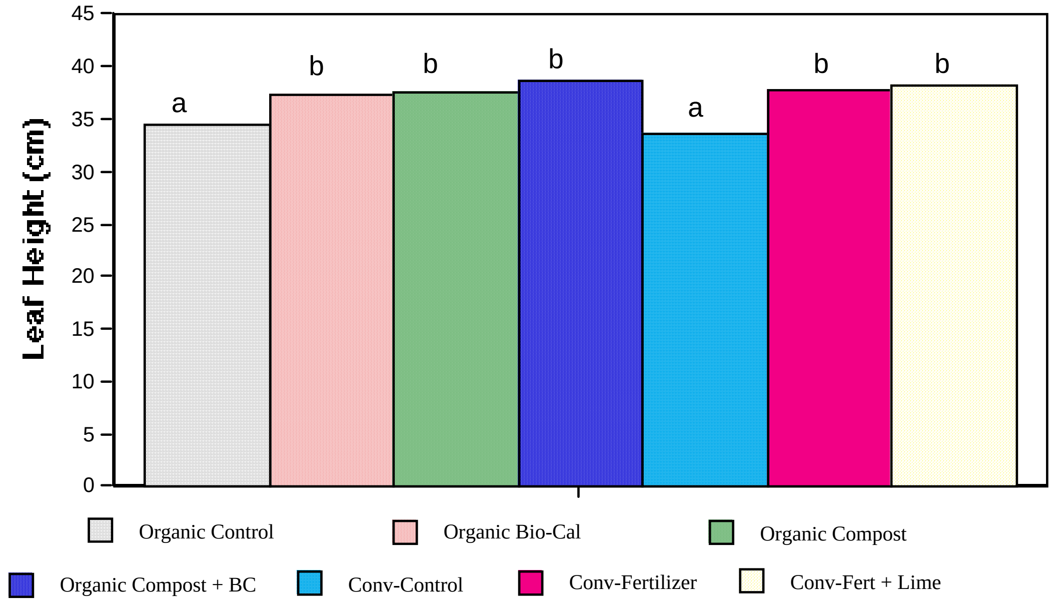


Figure 2. Muscatine-First Harvest Yields

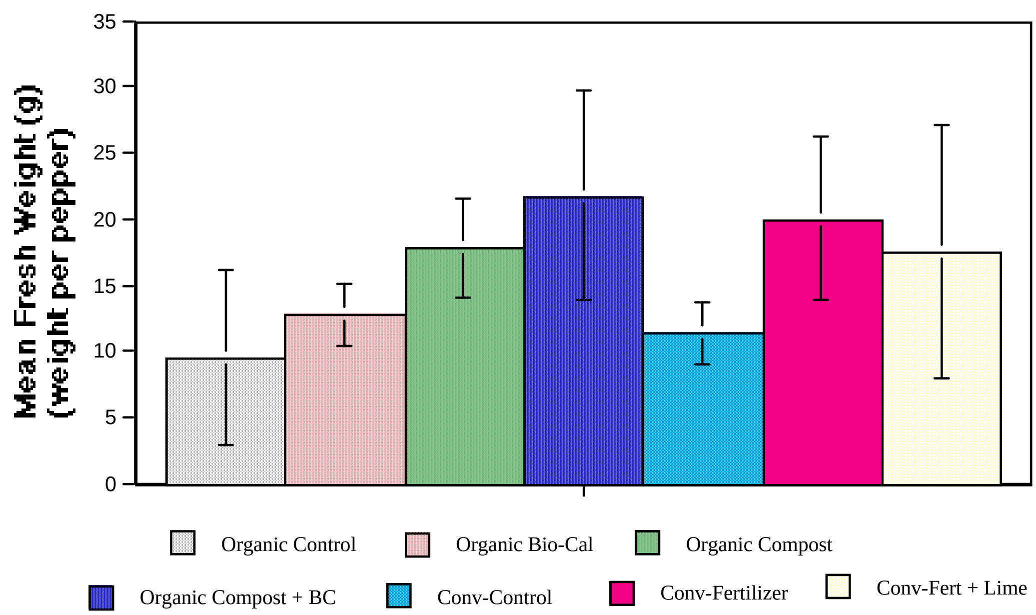
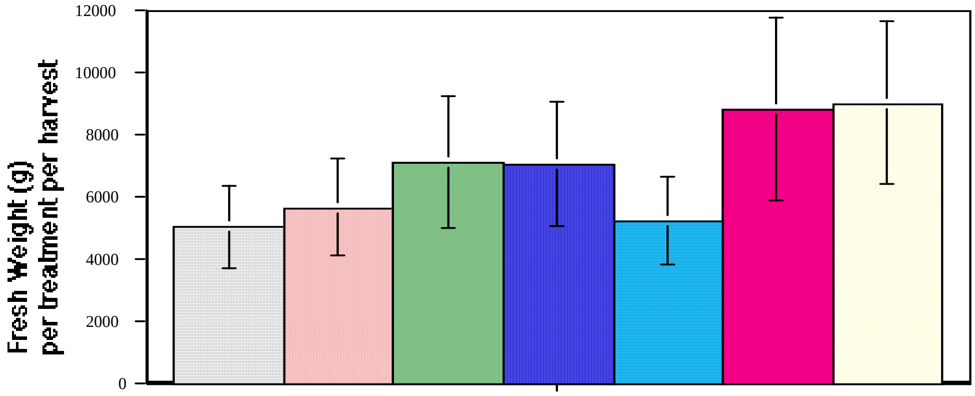


Figure 3. Total Fresh Weights



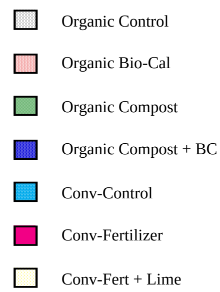


Figure 4. Culled peppers over five harvests