Research Report
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Effect of Gypsum Applications on Organic Crop Production and Postharvest Quality

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Introduction

With a 20% growth rate in 2001, organic agriculture continues to expand in the U.S. and the world (OTA, 2002). After the release of consistent federal standards for products marketed as "organic" in October 2002 (USDA/AMS, 2002), organic production and consumption was expected to increase beyond current organic sales of $10 billion in 2001 (OTA, 2002). In 1999, Iowa farmers reported 150,000 acres of organic production to the Iowa Department of Agriculture and Land Stewardship survey (IDALS, 2000a), although statistics for organic horticultural crops remain underreported.

Most organic producers rely on manure or manure-based composts and nitrogen-fixing cover crops to supply their soil fertility needs (Kelly, 1990). Several research projects comparing productivity and yield for compost-fertilized and synthetic-fertilized crops have shown generally favorable results for the organic treatments. Cover crops can also be used successfully for nutrient and weed management in organic systems. In order to meet certified organic requirements in the state of Iowa (IDALS, 2000b), a soil-building cover crop is required for at least one out of every five years of horticulture production. In a national survey (Walz, 1999) and through statewide focus groups (Delate, 2002), organic farmers identified pest management and soil fertility as their most critical vegetable research needs.

Our research focuses on best management practices for enhancing soil quality and pest management for transitioning and certified organic farmers. Many organic farmers have observed an increase in pest resistance and improvements in plant health through the application of soil amendments. There has been much interest among organic farmers for an unbiased analysis of the many naturally based soil amendments on the market for organic production. Because synthetic inputs, including petroleum-based products used in processing some calcium amendments, are disallowed in organic production, we have focused on organically approved soil amendments. Through crop rotations and compost applications, we have demonstrated comparable organic corn, soybean, oat, alfalfa, pepper, broccoli, and medicinal herb yields compared to conventional crops (Delate, 1998–2002).

In 2002, we examined the effect of gypsum as a soil amendment to enhance crop production and postharvest quality. This research was conducted in the on-going LTAR (Long-Term Agroecological Research) experiment, established as an organic site in 1998 at the Iowa State University Muscatine Research Farm, and at an on- farm site (Abbe Hills Farm, Mt. Vernon, Iowa) where organic practices were used. Research on the effects of compost and calcium products, routinely applied by organic vegetable farmers, has been limited. Calcium, supplied through composted manure and cover crops on organic farms (Chaney et al., 1992), is required for plant growth and can also aid in improving soil aggregation (Magdoff & van Es, 2000). Many organic farmers report yield benefits from additional calcium amendments (Parnes, 1986). Other benefits from pre- or post-harvest calcium applications include improved postharvest storage (Fallahi et al., 1997) and mitigation of diseases in storage (Conway et al., 1994) resulting from cell wall enhancement.

The objectives of the research included the following:

- Establish research station and on-farm plots to study the effect of calcium amendments on organic pepper and corn;
- Determine plant performance and yield under each management system;
- Conduct postharvest quality studies on organic peppers at the Iowa State University Horticulture Department; and
- Evaluate outcomes of research and, with Soil Solutions, determine strategies for 2003 research.

Materials and Methods

Pepper Production Study

Four replications of nine treatments were assigned to the Muscatine Island Research Farm LTAR plots in a randomized complete block design on June 8, 2002.

Treatments included the following:

- Treatment 1: Organic control (no fertilization/no pesticides);
- Treatment 2: Organic fertilizer (100 lb N/A, preplant incorporated);
- Treatment 3: Organic fertilizer (50 lb N/A + gypsum 500 lb /A, preplant incorporated);
- Treatment 4: Organic fertilizer (100 lb N/A + gypsum 500 lb /A, preplant incorporated); Treatment 5: Hairy vetch cover crop tilled completely into field before planting;
- Treatment 6: Hairy vetch cover crop strip-tilled in field with an organic fertilizer side-dress application (50 lb N/A);
- Treatment 7: Conventional Control (no fertilizer or lime/recommended pesticides);
- Treatment 8: Conventional fertilizer (conventional rates); and
- Treatment 9: Conventional fertilizer (conventional rates), lime (hydrated lime at 357 lb/A and elemental sulfur 993 lb/A).

Fifty-two plants were planted in each replicated plot for a total of 1,872 plants in the experiment. A cover crop of hairy vetch (*Vicia villosa*) (60 lb/A) and rye (*Secale cereale*) (90 lb/A) was seeded in selected plots on September 21, 2001, and after germination, remained dormant throughout the winter. Soil samples (a composite of 5 6-in. cores) were taken in vetch incorporated, vetch strips, and organic control plots at pre-season (May 28) and at the last harvest (September 19). All other plots were planted to rye in the previous year, and were roto-tilled to kill the rye on June 8, 2002. Vetch plots (Treatment 5) were mowed on June 1 and roto-tilled to completely incorporate the residue on June 8. The vetch in the zone-tilled vetch plots was killed with a cultipak, followed by a disc coulter and chisel sweep acting as an undercutter, sweeping 8-10 in. under the vetch to cut roots and loosen the soil under the mulch without disturbing the soil surface. Passage of the disc coulter and chisel sweep left a 1-3 in. strip down the center of the row into which the peppers were transplanted.

'Red Knight' bell pepper plants were seeded in trays on April 15 and mechanically transplanted into rows (at 18" x 42" spacing) in 15' x 20' plots on June 12, 2002. 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 and sulfur rates). 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 on May 30. A side-dress of 34-0-0 at 143 lb/A provided an additional 44 lb N/A at first flower. The organic fertilizer (Midwestern Bio-Ag®, Blue Mounds, Wisconsin) was a blend of blood meal, feather meal, composted poultry litter, bone meal, sulfate of potash, borate, copper sulfate, manganese sulfate and zinc sulfate and consisted of 6-3-5 N-P-K. Organic fertilizer was applied as a 50 or 100 lb. N/A treatment prior to planting, or as a side-dress application (50 lb. N/A) after plants were established within tilled vetch strips on June 25. The gypsum (Soil Solutions, Inc., Holstein, IA) contained 21% calcium and 17% sulfur. Treflan® was applied at 1 pt/A on June 8 in the conventional plots. No insecticides were applied in any treatments based on low pest loads from monitoring reports.

Weeds were machine or hand cultivated throughout the season in organic plots, except in vetch strip-tilled plots, where the cover crop was left as a mulch between plant rows. As a result of inadequate growth of the vetch cover, rye straw was applied as a mulch (3 in. deep) on July 11, 2002. 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 June 25, July 11, July 24, and

August 6, 2002. Height of plants, number of leaves, and number of pepper fruit were monitored, along with numbers of harmful and beneficial insects.

In order to determine nutrient uptake in leaves and fruits, ten newly mature pepper leaves (• 4 inches) and 3 mature pepper fruit were collected from the middle portion of plants from Treatments 1, 3, 4, and 8, and placed in a cooler for transport to Horticulture Hall, Iowa State University, Ames, IA, on September 19, 2002. Leaves and fruit were dried at 152.6°F for 48 and 120 hours, respectively. The Iowa State University Soil and Plant Testing Laboratory, Agronomy Hall, analyzed leaf samples for calcium, phosphorus, magnesium and potassium. Fruit tissue was also analyzed at the Soil and Plant Testing Laboratory for nitrogen, potassium, phosphorus, calcium and magnesium, following standard procedures.

Peppers were harvested according to schedule on August 15, August 28, and September 12, 2002. The number of pepper plants showing disease symptoms and removed from plots was determined at final harvest. Fresh weights were taken immediately after harvest. All measurements were subjected to analysis of variance and Fisher's PLSD test (P•0.05) (SAS Institute, 1988).

<u>Postharvest Study</u>

Water Loss in Normal Storage

After harvest, peppers and other vegetables may encounter chilling temperatures in transit or in storage that enhance water loss and/or decay. Because of the reported beneficial effects of calcium on cell wall structure, a study was conducted to determine if calcium amendments (gypsum) enhanced plant/fruit ability to retain water in normal storage and to recover from chilling temperatures.

After initial weighing at harvest, 24 unblemished peppers per treatment per harvest were transferred to 50° F chambers in the Iowa State University Horticulture Department for postharvest storage-life studies. Fresh weights and visual quality of stored peppers were recorded every two weeks for six weeks. Evaluations were terminated when peppers were unmarketable.

Electrolyte Leakage following Chilling Injury Temperatures

Chilling injury was measured by the amount of electrolyte leakage (ion leakage from cell walls) in pepper fruits following treatment. Twelve mature peppers, of uniform size and color, were harvested on 12 September 2002 from each of the following previously described 2002 Muscatine LTAR treatments:

- Treatment 1: Organic control (no fertilization/no pesticides);
- Treatment 3: Organic fertilizer (50 lb N/A + gypsum 500 lb /A, preplant incorporated);
- Treatment 4: Organic fertilizer (100 lb N/A + gypsum 500 lb /A, preplant incorporated); and
- Treatment 8: Conventional fertilizer (conventional rates).

Two peppers from each production treatment were then subjected to each of the following postharvest treatments in refrigerated (Bally Case and Cooler Company, Bally, PA) or controlled storage (Sherer Environmental Chamber –Model cel36-10 , Sherer-

Gillet Co., Marshall, MI) at the Horticulture Department, Iowa State University, Ames, IA:

- Postharvest Treatment 1 (CI-1): Chilling injury (C.I.) temperatures of 2°C (34°F) for 4 days;

- Postharvest Treatment 2 (CI-2): Chilling injury temperatures of 2°C (34°F) for 7 days;

- Postharvest Treatment 3: Normal pepper storage (NS-1) temperatures of 10°C (50°F) for 4 days;

- Postharvest Treatment 4: Normal storage (NS-2) temperatures of 10°C (50°F) for 7 days; and

- Controls: 2 peppers from each plot of each treatment kept at room temperature of 20°C (68°F).

After each chilling injury regime (CI-1 and CI-2), peppers were moved to 20°C (68°F) storage for 2 days to simulate recovery from chilling injury conditions. Razorblades were used to cut 2-1cm^2 samples of uniform pepper tissue from each treatment prior to electrolyte leakage measurement. Tissue samples were placed in 20 ml deionized water and positioned in a vacuum chamber (Nalgene Co., Rochester, NY) for 3 min. for extraction of ions. Vacuum extraction was then repeated for another 3 minutes. Samples were then placed in an Innova 2300 platform shaker (New Brunswick Scientific, Edison, NJ) at 120 rpm for 1 hr. Initial electrolyte leakage (Concentration 1) was measured with a YSI conductivity meter (YSI Model 35, Yellow Springs Instruments, Yellow Springs, OH). Samples were autoclaved (Amsco General, American Bio-Medical Service Corporation, West Hills, CA) at 121 psi for 20 minutes to kill cells and release remaining ions. Samples were re-measured for final leakage (Concentration 2) and percent leakage was calculated by the formula: $\%L = C_1/C_2 \times 100$. All measurements were subjected to analysis of variance and Fisher's PLSD test (P•0.05) (SAS Institute, 1988).

Results: Pepper Production Study

At maximum growing point (August 6), mean leaf height and fruit number were significantly different among treatments (Table 1). The tallest plants were found in the organic fertilizer (100 lb N/A), the conventional fertilizer, and conventional fertilizer plus lime treatments. Plant height in the organic fertilizer (100 lb N/A) plus gypsum treatment , however, was statistically equivalent to the conventional fertilizer treatments. Leaf number was similar in the organic fertilizer treatment (100 lb N/A), alone or with gypsum, the hairy vetch strip-tilled plus organic fertilizer (50 lb. N/A) treatment, and in the synthetically fertilized plots. Increasing N from 50 to 100 lb N/A in the gypsum treatments did not result in an increase in plant growth, contrary to previous years' results. Plant growth was also not increased by adding lime to the fertilizer treatment.

Plant height and leaf number in the strip-tilled vetch treatment plus 50 lb. N/A side-dress application was greater than in the completely incorporated (tilled) vetch treatment. This result contrasts with previous years where the strip-tilled treatment plants without the additional 50 lb N/A was significantly smaller than the other organic treatments. Fruit number was similar between the two vetch treatments in 2002, however. The greatest mean number of fruits per plant was produced in the organic fertilizer treatments of 100 lb N/A alone and with gypsum. There was no difference in fruit number between the conventional fertilizer treatments and the organic fertilizer at 50 lb N/A plus gypsum treatment.

Table 1. Pepper plant growth and insect parameters, MIRDF, 8 August 2002.

Treatment	Mean Plant Height (cm)	Mean Leaf No.	Mean Fruit No.	Mean No. Beneficial Insects	Mean No. Pest Insects
Organic Control	42.4 a	70.2 a	3.8 ab	10.02[z]	10.03[z]
Organic Fertilizer (100 lb N/A)	51.5 c	95.8 d	6.3 d	10.05	10.01
Organic Fertilizer (50 lb N/A) plus Gypsum (500 lb/A)	44.8 ab	76.8 abc	4.5 bc	10.02	10.01
Organic Fertilizer (100 lb N/A) plus Gypsum (500 lb/A)	47.6 b	88.1 cd	5.5 d	10.06	10.01
Hairy vetch tilled	43.6 a	72.3 ab	3.7 ab	10.12	10.02
Hairy vetch strip-tilled plus organic fertilizer (50 lb. N/A)	47.0 b	92.5 d	2.8 a	10.02	10.00
Conventional Control	41.7 a	77.7 abc	2.9 a	10.03	10.02
Conventional Fertilizer	48.8 bc	92.9 d	4.1 b	10.04	10.03
Conventional Fertilizer, Lime and Sulfur	48.3 bc	85.5 bcd	4.0 b	10.00	10.01
LSD (0.05)	3.32	13.3	0.95	N.S.	N.S.

[z] Insect numbers transformed (x+10) for ANOVA, due to low population numbers.

Table 2. Pepper yield, number of peppers, mean weight per pepper (three harvests combined), and pepper quality, MIRDF, 2002.

Treatment	Mean Yield (lb/A)	Mean No. Peppers/Acre	Mean Weight/ Pepper	Culls (%)	Blemishes/ Pepper

			(g)		
Organic Control	4043.8	14615.4	129.71	16.85	0.40
Organic Fertilizer (100 lb N/A)	5169.4	18343.2	137.40	16.71	0.46
Organic Fertilizer (50 lb N/A) plus Gypsum (500 lb/A)	3324.9	15461.5	131.43	14.37	0.35
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	4971.3	19230.8	132.33	17.24	0.46
Hairy Vetch Tilled	4289.5	15897.4	127.91	16.88	0.46
Hairy Vetch Strip-Tilled plus Fertilizer (50 lb. N)	4497.4	15256.4	134.84	8.44	1.03
Conventional Control	3543.1	15664.3	116.71	12.10	0.94
Conventional Fertilizer	4754.5	18333.3	130.46	7.56	0.64
Conventional Fertilizer, Lime and Sulfur	6287.3	20384.6	147.14	17.76	0.38
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	N.S.

Organic and conventional yields were similar in 2002 (Table 2). Although there was a trend towards greater yield, number of harvested peppers and average weight per pepper in the organic fertilizer (100 lb N/A) plus gypsum, and conventional fertilizer plus lime plots, yields were not statistically different among treatments. These results compare with previous years where conventional and organic yields were similar when 100 lb N/A was provided through fertilizer or compost. From1998 through 2000, however, organic pepper plants produced greater yields when provided with additional nitrogen (100 lb. N/A vs. 50 lb. N/A compost treatments), but in 2001 and 2002, no significant differences in yield, number of peppers and mean pepper weight were found between the 50 and 100 lb N/A organic fertilizer treatments. Enhanced pepper productivity was obtained with nitrogen additions as low as 50 lb N/A from the organic fertilizer in 2002, suggesting increased nutrition from the mineral components of the organic fertilizer and/or a more rapid N mineralization rate in the poultry litter base compared to the Ultra Gro™ compost used from 1998 to 2000.

Higher yields were obtained in the vetch treatments in 2002 compared to the previous years. In 2002, vetch treatments were equivalent to conventional fertilizer treatments, compared to 2001, where strip-tilled vetch plots contained the lowest yielding peppers, and incorporated vetch yields were statistically equivalent to the organic fertilizer treatments, but significantly lower than the conventional treatments. The addition of the 50 lb N/A side-dress application greatly enhanced plant performance in the strip-tilled plots. While not statistically different, strip-tilled pepper yields were greater than yields in the completely incorporated vetch treatment. Yields in the incorporated vetch treatment were similar to the organic fertilizer (50 lb N/A) plus gypsum treatment, suggesting an N contribution of 50 lb/A from the incorporated vetch. Biomass additions from the two vetch treatments were similar. The 2002 results are similar to research reported in Ohio, where yields were comparable between conventionally fertilized tomatoes and organic tomatoes planted into an undercut cover crop mixture of hairy vetch, rye, crimson clover (*Trifolium incarnatum* L.) and barley (*Hordeum vulgare* L) (Creamer et al., 1996).

As in 2001, there was a significantly greater number of diseased pepper plants removed from the strip-tilled vetch plots in 2002, suggesting an environment more conducive to disease development (Table 3). While not statistically significant, pepper plant removal due to disease symptoms was lowest in the gypsum plus organic fertilizer (50 lb. N/A) treatment, and the conventional fertilizer, lime and sulfur treatments.

Table 3. Rogued pepper plants due to disease, MIRDF, July 11, 2002.

Treatment	**Diseased plants (%)**
Organic Control	3.37 a
Organic Fertilizer (100 lb N/A)	1.44 a
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	0.96 a
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	1.44 a
Hairy Vetch Tilled	3.85 a
Hairy Vetch Strip-Tilled plus Fertilizer (50 lb. N)	14.42 b
Conventional Control	3.85 a
Conventional Fertilizer	1.92 a
Conventional Fertilizer, Lime and Sulfur	0.96 a
LSD (0.05)	3.19

No differences were found among treatments in calcium, phosphorus, potassium and magnesium concentrations in leaf tissue (Table 4). Untreated pepper fruit, however, had significantly greater levels of phosphorus, total nitrogen and calcium (Table 5). Second-year trials are required to verify this effect, which was contrary to anticipated results of greater Ca concentrations where gypsum was applied.

Table 4. Leaf tissue nutrient analysis, 2002.

Treatment	Ca (ppm)	P (ppm)	K (ppm)	Mg (ppm)
Organic Control	16537.0	4560.0	35456.3	8385.0
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	16087.0	4677.5	29612.5	4517.5
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	15137.5	4586.3	34503.8	4127.5
Conventional Fertilizer	9975.0	3762.5	31846.3	4031.3
LSD (0.05)	N.S.	N.S.	N.S.	N.S.

Table 5. Pepper fruit nutrient analysis, 2002.

Treatment	P (%)	K (%)	Total N (%)	Ca (ppm)	Mg (ppm)
Organic Control	3.30 b	2.88	2.04 c	731.3 b	1785.0
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	2.92 a	2.60	1.72 b	597.5 a	1605.0
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	2.71 a	2.90	1.47 a	591.3 a	1532.5
Conventional Fertilizer	2.96 a	2.78	1.78 b	550.0 a	1720.0
LSD (0.05)	N.S.	N.S.	N.S.	N.S.	N.S.

Results: Pepper Postharvest Study

Postharvest weight loss did not differ among treatments after 2 to 6 weeks in normal refrigerated (50° F) storage in 2002 (Table 6). These results were similar to those obtained in previous years, where storage life did not differ among organic and synthetic fertilizer treatments.

Table 6. Postharvest pepper weight loss after 2 to 6 weeks in storage, MIDRF, 2002.

Treatment	Weight loss (%)		
	2 weeks	4 weeks	6 weeks
Organic Control	3.15	8.61	11.75
Organic Fertilizer (100 lb N/A)	3.23	8.89	11.49
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	3.71	9.22	12.50
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	3.48	9.02	12.61
Hairy Vetch Tilled	3.37	8.74	11.73
Hairy Vetch Strip-Tilled plus Fertilizer (50 lb. N)	3.16	7.89	10.46
Conventional Control	4.00	9.33	12.23
Conventional Fertilizer	3.07	8.37	12.35
Conventional Fertilizer, Lime and Sulfur	3.50	8.74	11.24
LSD (0.05)	N.S.	N.S.	N.S.

In addition, there were no significant differences in electrolyte leakage among chilling injury or normal storage treatments (Table 7). The time and temperatures utilized in 2002 to simulate chilling injury may not have been severe enough to induce sufficient leakage, however. Second-year trials are needed to verify results, along with the effects from more severe treatments (e.g., 0° C for 14 days).

Table 7. Electrolyte leakage from peppers exposed to postharvest chilling injury treatments, 2002.

Treatment	Electrolyte Leakage (%)
	Chilling Injury-1: 2°C for 4 days
Organic Control	17.47
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	20.37
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	21.88
Conventional Fertilizer	20.39
	Chilling Injury-2: 2°C for 7 days
Organic Control	21.52
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	24.08
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	21.97
Conventional Fertilizer	25.94
	Normal Storage-1: 10°C for 4 days
Organic Control	23.15
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	17.91
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	19.49
Conventional Fertilizer	22.14
	Normal Storage-2: 10°C for 7 days
Organic Control	21.87
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	21.51
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	26.43
Conventional Fertilizer	24.90
	Control (Room Temperature): 4 days at 20°C
Organic Control	17.58
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	20.00
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	24.17
Conventional Fertilizer	19.90
	Control (Room Temperature): 7 days at 20°C
Organic Control	31.90
Organic Fertilizer (50 lb. N/A) plus Gypsum (500 lb/A)	21.25
Organic Fertilizer (100 lb N/A) plus Gypsum (500lb/A)	17.50
Conventional Fertilizer	22.17
LSD (0.05) among chilling treatments	N.S.
LSD (0.05) chilling treatments x fertilizer treatments	N.S.

<u>Corn Production On-Farm Study</u>

Methods

An on-farm site for this project was established at Laura Krouse's Abbe Hills Farm in Mt. Vernon, Iowa. 'Abbe Hills Open Pollinated' corn was planted on May 22, 2002, at a rate of 27,000 plants per acre. Immediately before planting, 0, 500 or 900 lb/acre of gypsum were incorporated into plots (12.7 x 50 ft), established as four replications of three treatments, in a randomized complete block design.

Corn was harvested on October 4, 2002, and yields determined on a bushel/acre basis. Grain quality was determined by the Iowa State University Grain Quality Laboratory, Ames, IA.

Results

Corn yields were not statistically greater in the gypsum treatments (Table 8), but an increase of 18 bushels/acre was obtained in the900 lb/acre gypsum treatment compared to the control. There were also no significant differences for moisture, protein, oil or starch in the grain quality (Table 8).

Table 8. Yield and grain quality of “Abbe Hills Open Pollinated” corn, 2002.

Treatments	**Yield (Bu/acre ± SE)**	**Moisture (% ± SE)**	**Protein (% ± SE)**	**Oil (% ± SE)**	**Starch (% ± SE)**
500 lb/acre gypsum	83.1 ± 10.7	25.0 ± 0.4	7.75 ± 0.25	4.0 ± 0	58.5 ± 0.3
900 lb/acre gypsum	90.4 ± 7.0	26.3 ± 0.9	7.67 ± 0.3	4.0 ± 0	58.0 ± 0.0
Control (no gypsum)	72.1 ± 7.4	25.0 ± 0.6	8.0 ± 0.0	4.0 ± 0	58.3 ± 0.3
LSD 0.05	N.S.	N.S.	N.S.	N.S.	N.S.

Technology Transfer

A Field Day was held at the Muscatine Farm on July 16, 2002, where Dr. Delate discussed this project’s results. The Abbe Hills Field Day was cancelled due to inclement weather in August, but Laura Krouse held information sessions for her CSA (Community Supported Agriculture) customers and representatives from Gerber Baby Foods on this research. In addition, research information was presented at conferences (Iowa Organic Conference, November 21, 2002, and Upper Midwest Organic Conference, March 2002) and numerous Extension meetings in 2002.

Discussion and Suggestions for 2003 Research

With the continued 20% annual industry growth rate, organic agriculture holds much promise for vegetable producers (Clark et al., 1999). Lower yields in the transition from conventional to organic production are expected due to slower N-release from organic materials compared to synthetic fertilizers (MacRae et al., 1993). Calcium-containing amendments will continue to be used by organic farmers who report significant soil changes and plant responses. Results from our 2002 research did not demonstrate any statistically significant effects from gypsum applications on pepper yield and postharvest quality, but some trends are worth noting. Similar growth, yield and postharvest quality to conventional crops (fertilized with synthetic N-P-K) is the minimum standard for all organically produced crops. In our research, pepper plant height in the organic fertilizer (100 lb N/A) plus gypsum treatment was statistically equivalent to the conventional fertilizer treatments. The greatest mean number of fruits per plant was produced in the organic fertilizer treatments of 100 lb N/A alone and with gypsum. There was no difference in fruit number between the conventional fertilizer treatments and the organic fertilizer at 50 lb N/A plus gypsum treatment. There was a trend towards greater yield, number of harvested peppers and average weight per pepper in the organic fertilizer (100 lb N/A) plus gypsum, despite non-statistical differences. Corn yields increased 11 to 18 bushels/acre when gypsum was applied at 500 and 900 lb/acre, respectively. Despite the lack of statistical differences with the control plots, the farmer at this site intends to apply gypsum to her other corn fields, based on results of this experiment.

For 2003, we propose to repeat the above experiments, in order to verify 2002 results, and examine reasons behind unexpected results (i.e., the lower Ca content in gypsum-treated leaves and fruit). Additional chilling injury treatments will be added, including 0° C for 14 days, in anticipation of greater differences in recovery when pepper fruits are subjected to more damaging treatments. Two Field Days (one at each site) will be held in 2003, with the goal of reaching 200 people.

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