Evaluation of Corn Varieties for Certified Organic Production—Crawfordsville Trial, 1998

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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. In Iowa alone, organic acreage for all crops has increased from 13,000 in 1995 to 120,000 in 1998. Organic corn production in 1997 was reported at 9,920 acres. International demand for organic products, particularly 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 the best management practices for these systems. Once the transition is complete, comparable yields to conventional systems can be obtained. In addition, organic products garner a 20-300% premium price in the marketplace, with organic corn, for example, averaging a 200% premium price over conventional corn in 1998. Soil health, maintained through crop rotations, organic matter additions (manure/compost), and cover crops, has been the basis of successful organic farming. In the first year trials growing corn under organic conditions, we examined the performance of four varieties, using a locally produced, inexpensive, renewable resource (hog manure) for fertilization, and mechanical methods for weed control (as required for certified organic production).

Materials and Methods

Plots previously planted to soybeans at the Southeast Research and Demonstration Farm (SERF) were identified for this study. Soil sampling in the fall of 1997 characterized the soil as shown in Table 1.

Table 1. Pre-plant soil characteristics at the SERF Organic Corn Trial, 1998.

Soil Characteristic	Amount
Organic Matter	4.4%
pH	6.0
Buffer pH	6.45
P	20 ppm
K	184 ppm
Soybean cyst nematode eggs	50 eggs/100 cc soil

Plots were field cultivated for seedbed preparation on May 13 and again on May 21, 1998. Untreated corn seed was planted at a 1.75 in. depth on May 21 in 30-in. rows. Four replications of four varieties were planted at a population of 27,700 plants/acre in 20 x 60 ft. plots. Varieties included the following Pioneer hybrids: 34K77, 34G81, 3489, and 33G26. The following information is excerpted from Pioneer literature:

Pioneer hybrid 34K77
A 107-day hybrid with very good ear mold resistance, brittle stalk resistance, and drought tolerance with moderate tolerance to gray leaf spot. This hybrid should provide excellent silage yields, energy, and digestibility. This variety is also available as a high oil hybrid in 1999. One drawback to this hybrid is its susceptibility to anthracnose stalk rot.

Pioneer hybrid 34G81
An exceptionally high yielding 107-day hybrid with strong stalks, superior staygreen, outstanding drought tolerance, and moderate gray leaf spot resistance. This variety responds well to higher planting populations.

Pioneer hybrid 3489
A very high yielding 108-day hybrid that is widely adapted and stable. This variety has strong drought tolerance, exceptional drydown, and is an excellent choice for silage. Some concerns with this hybrid are its susceptibility to anthracnose stalk rot and its slightly lower rate of emergence.

Pioneer hybrid 33G26
A 112-day hybrid with exceptional yield potential. Its strong gray leaf spot resistance, excellent stalk quality, exceptional staygreen, superior test weight, and dependable early growth makes it an excellent choice for gray leaf spot challenged areas. This hybrid also demonstrates exceptional silage yield potential with excellent readily available energy and digestibility.

Fertilization was provided through liquid hog manure that was broadcast at a rate of 3,500 gal/acre and incorporated on May 13, 1998. This application period corresponded with the requirement for raw manure to be applied at least four months prior to harvest for agronomic crops. Analysis of this manure included 39 pounds of nitrogen per 1,000 gallons of manure to supply approximately 136 pounds of N/A. No insecticides, fungicides or herbicides were applied in keeping with organic standards. Weeds were managed through two rotary-hoeings (May 27 and June 4) and one row cultivation on June 25.

A core set of measurements was taken on 10 plants per plot (total of 40 plants per variety) for crop stand counts (July 1), insect damage (July 1), nutrient uptake (ear-leaf tissue content (July 20) and stalk nitrate content (October 5). The middle three rows (7.5 x 60 ft.) were harvested on October 9, 1998, with a combine equipped with a scale to quantify yields. All measurements were subjected to analysis of variance and Fisher's PLSD test.

Results and Discussion

Corn performed very well under organic conditions, with yields ranging from 124.1-174.0 bushels/acre. Average production for each variety is presented in Figure 1. There were no significant differences among the four varieties (ANOVA, P=.05), although 3489 produced the greatest yields (158.9 ± 9.6 bushels/acre).

There were no significant differences among varieties in stand counts at 45 days after planting (Figure 2). Stand counts averaged 25,000 plants/acre after three tillage operations. Any negative effect from untreated seed was not evident in this trial.

Differences in nutrient levels in ear-leaf tissue at two months were observed only for P and K, where the silage variety 34K77 contained significantly greater levels of these nutrients (Figure 3). Stalk nitrate content (Figure 4) was less than desired for recommended nitrogen rates for complete grain fill (700 to 2,000 ppm), but grain fill did not seem to be a problem in this trial. Greater yields may be obtained with increased hog manure application rates, but pollution problems, in the form of nitrogen and phosphorus leaching, could also result.

No corn borer larvae were detected in the 160 plants sampled on July 1, although evidence of feeding was noted throughout the crop. Damage levels did not reach the economic threshold (5%) required to justify spraying with *Bacillus thuringiensis*. Gray leaf spot was also detected throughout the planting (Figure 5), but damage levels were not as apparent as those observed in the conventionally-raised Pioneer 34R06 (3489 with the *Bt* gene), planted on May 14, where 100% of leaves indicated a significant level of infection. The greatest amount of infected leaves was observed in 3489 plants, but yields were not affected significantly. There were some differences in grain analysis (Figure 6) where the silage variety 34K77 contained the least amount of protein and the greatest amount of starch. Levels were adequate for all varieties, however.

Results from this trial mimicked results obtained by organic farmers in Iowa where yields of 120-160 bushels/acres are common. While this corn would be considered "transitional" (in the three year transition between conventional and organic production), the selling price of certified organic corn in 1998 averaged $3.75/bushel. If corn is sold as organic, returns from an average organic corn acre (150 bushels/acre) would be $562.50. Cost of production studies for the Crawfordsville trial (in progress) should compare with those ascertained in the Organic Corn Trial at the ISU Neely-Kinyon Farm in 1998, where organic corn returned a 227% profit over conventional corn (see Armstrong Farm Annual Progress Report, 1999).

Acknowledgements

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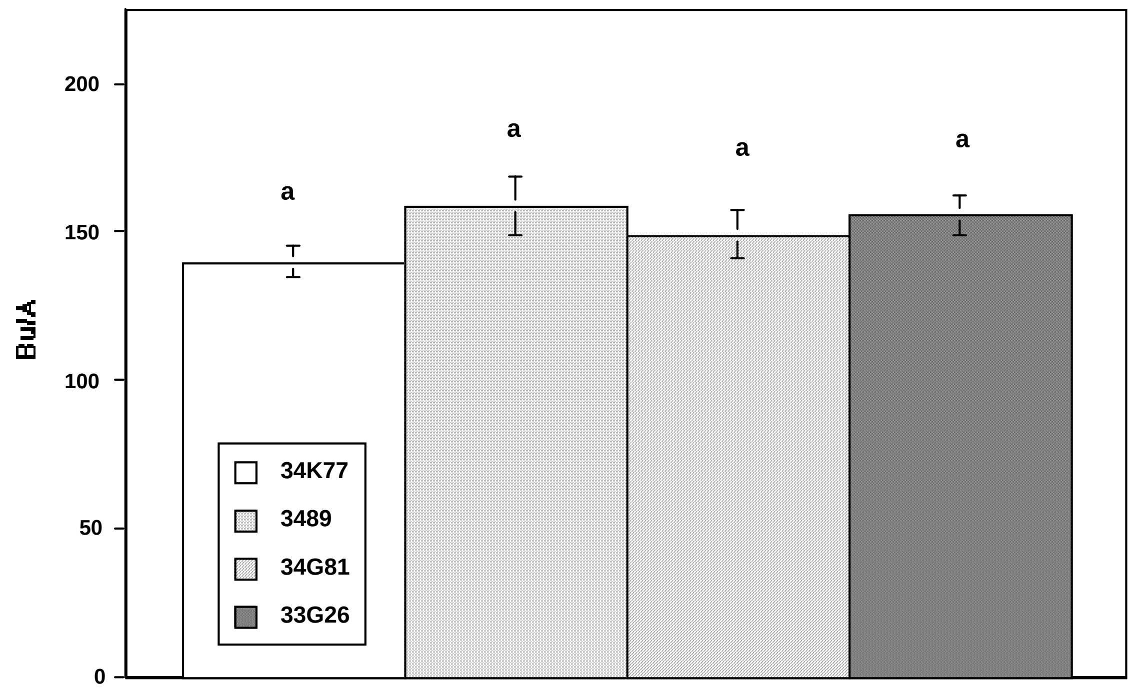

Figure 1. Yields from organic corn trial, Crawfordsville, 1998.

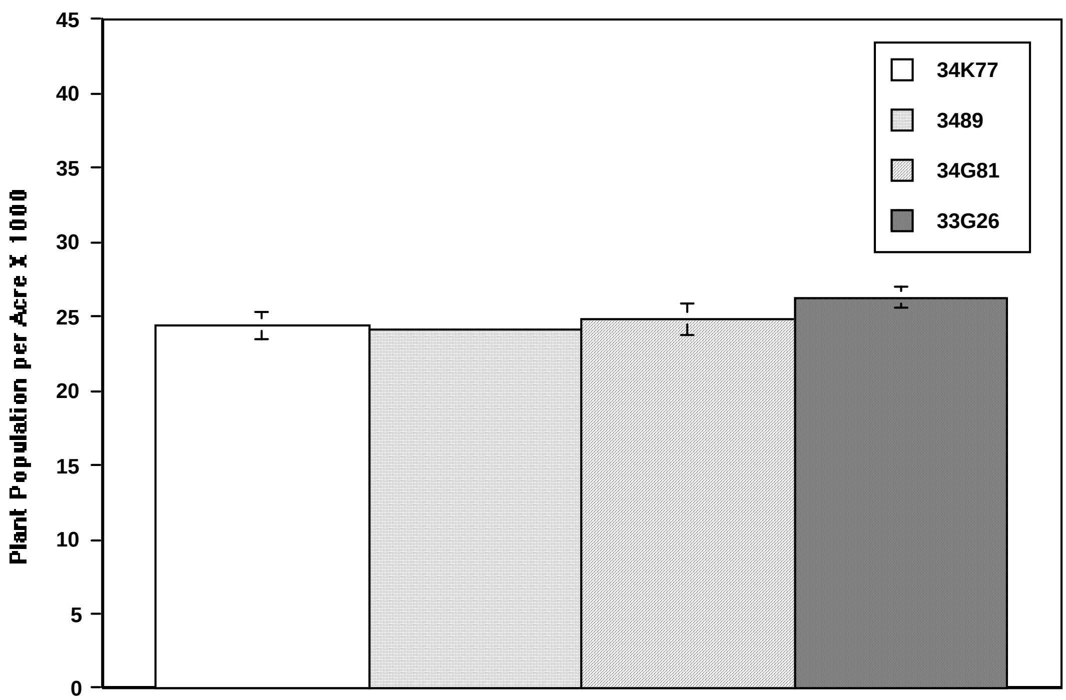

Figure 2. Corn stand counts in organic trial, Crawfordsville, 1998.

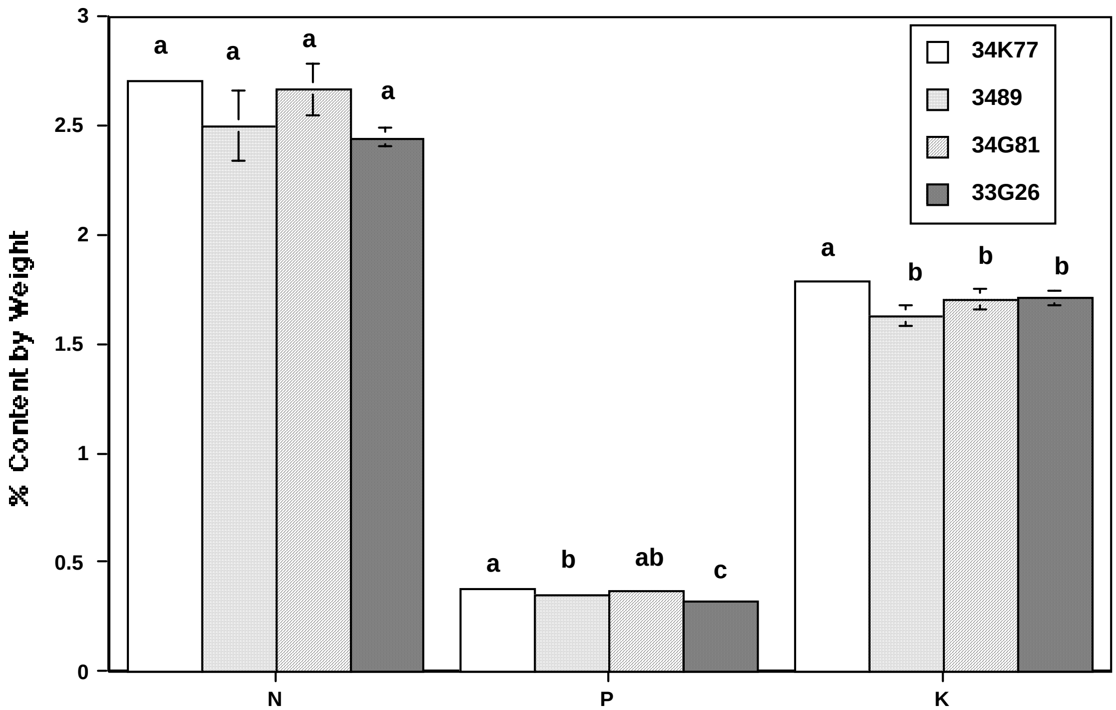

Figure 3. Organic corn trial ear-leaf tissue analysis, Crawfordsville, 1998.

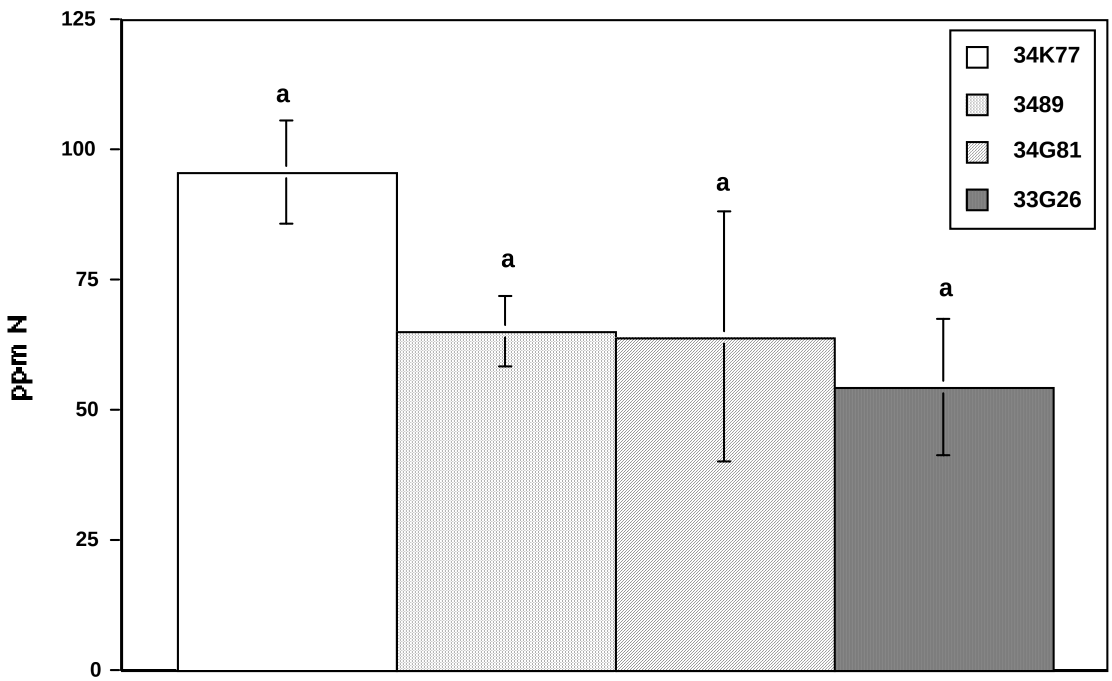

Figure 4. Stalk nitrate content in organic corn trial, Crawfordsville, 1998.

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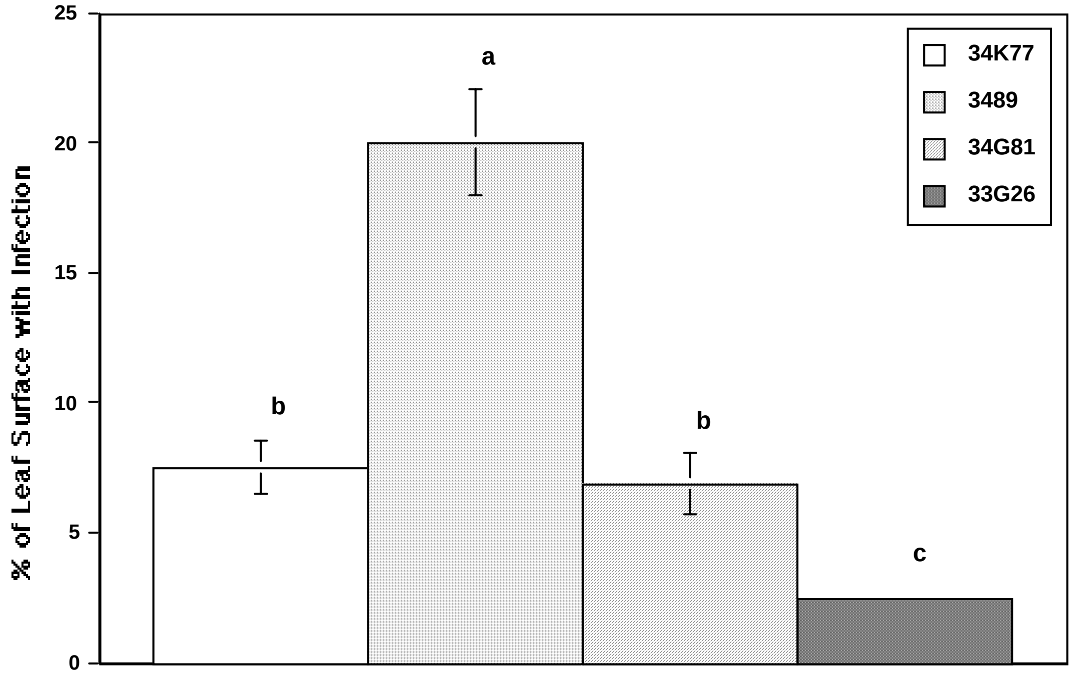

Figure 5. Gray leaf spot infection in organic corn trial, Crawfordsville, 1998.

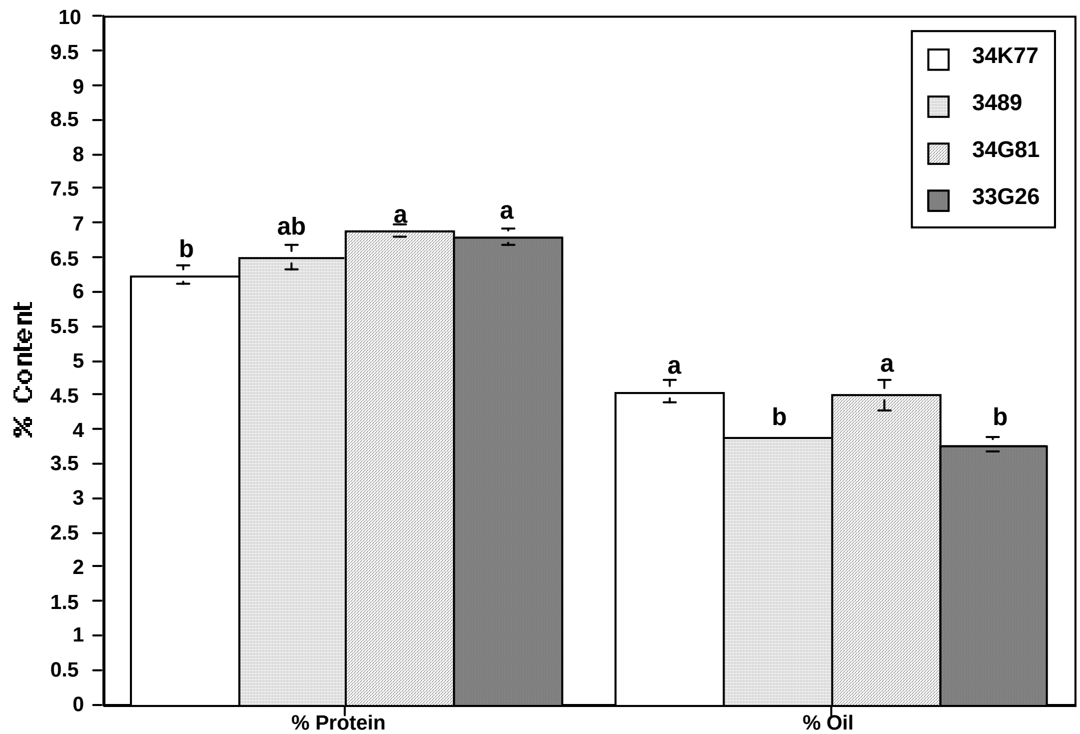

Figure 6. Grain analysis from organic corn trial, Crawfordsville, 1998.