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Measuring and Communicating the Benefits of Organic Foods

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Introduction

The growth of the organic industry is no longer confined to the East and West Coasts, as organic production and processing is booming in the Midwest as well. In Iowa alone, for example, there are over 100,000 acres in organic production farmed by over 500 producers (13). In 1997, the increasing organic trend was brought to the attention of Iowa State University by Dr. Jerry DeWitt and a group of stakeholders who approached the Dean of the College of Agriculture and proposed to create the first Land Grant University tenure-track position with a specialty in organic production (10). Over the past eight years since the inception of the position, the growth in the organic industry has averaged in excess of 20% annually (19,26). As the market has grown, so have consumers' expectations of quality organic products that are healthy and produced in an ecologically sound manner. In return for fulfilling these expectations, the organic consumer is willing to pay a premium. In addition to consumers, chefs, in many ways, have been leading the way in promoting organic foods. Several organizations, including the Chefs' Collaborative, the Slow Foods Convivium, and individual restauranteurs are advancing the notion that customers are willing to pay a premium for local and organic foods on the menu.

One of the challenges for the organic producer, processor, and marketer is to differentiate their products in the crowded food marketplace. Not only must the organic industry be concerned with competing with conventional products, they must also compete against a range of products that are advertised as "natural," "farm fresh," "raised locally," and a host of other Eco-Labels, attesting to some form of production standards. However, despite the plethora of production claims and labels, the market for USDA Certified Organic products continues to exhibit robust year-to-year growth. Among other reasons, perhaps paramount is that the term "organic" has legal standing and an internationally recognized label conveying the message that the production system that created the product was governed by a set of well-developed rules regardless of the country of origin (25). As a result of the requirements of labeling and the national regulation of the term "organic," when consumers purchase organic products they enjoy a level of confidence that the supply chain involved in creating the product has been thoroughly vetted and monitored over time.

While the evolving organic production systems in the US and the world are often viewed as a relatively small market, there are profound implications for the larger food system, especially in the area of food security.

In a survey conducted by scientists at North Carolina State University (17), most respondents preferred US rather than foreign-sourced food, and local, family-farmed products rather than those produced by large corporate entities. While identifying the reasons for this preference is difficult, a likely factor is the notion that if the product on the retail shelf is locally produced, the consumer can find the producer should the need arise. This notion is reinforced in the case of organic products, as all ingredients and processing aids must, as a matter of law, be identified, reported, and approved by an independent agency whose charge is assuring compliance with USDA standards (25). Applying the implications of the North Carolina findings to the US organic market, it is easy to conclude from a food security perspective that organic products would have a competitive advantage in the market if the product was locally produced. Applying the established audit trail protocols developed for the organic marketplace with the North Carolina findings to the larger food market would yield a safer, more secure food system in the US.

Transgenic crops, also referred to as genetically modified organisms ("GMOs") in popular literature, are an evolving issue in organic and conventional markets worldwide. Across the globe, most participants in the organic industry eschew GMOs as a matter of course. The basis for the GMO prohibition in organic production is environmental and philosophical and it is unlikely that the prohibition will be lifted anytime in the foreseeable future. Driven by the fear of losing market share due to consumers' resistance to purchasing and consuming foods that include GMO ingredients, many US, Japanese, and European Union (EU) conventional processors require the use of non-GMO ingredients in their products. Often the product will be differentiated in the market by noting this fact somewhere on the label. Consumer resistance to GMO ingredients is higher in the EU and Japan than the US; however, US consumers, like their Japanese and E.U. counterparts, desire a labeling scheme indicating whether a product contains GMO ingredients. Absent a label, the only way for a consumer to be confident a product does not have GMO ingredients is to purchase products for which there are no GMO ingredients possible or purchase certified organic products. Communicating all aspects of the fast-changing GMO dynamic is critical to consumers' understanding of how the GMO prohibition dovetails with the organic system approach to production and concomitant environmental concerns.

As organic production has increased, several limiting assumptions have been raised to the level of fact supported by little, if any, direct evidence. These include: (i) inherent lower yields; (ii) higher production costs; (iii) limitations on the number of acres that can be effectively managed in accordance with the organic rules; (iv) manure applications lead to soil and water and contamination; (v) organic foods are not as safe as those produced in a conventional system; and (vi) organic production degrades soil quality. However, a review of some of the existing literature (5,15,21) reveals that much of the evidence supporting these assumptions can be traced to a lack of effective management practices, rather than a function of an organic system. These details on organic management should be part of the message communicated to the public.

Productivity of Organic Systems

Our research at the Iowa State University Neely-Kinyon farm in southwest Iowa has shown that, from a business planning standpoint, one should assume that yield will be lower in an organic grain system during the transition phase. However, we discovered that careful execution of good management protocols, based on local practices, produced no significant differences between organic and convention yields of the primary cash crops,

yellow dent corn, and food-grade soybeans (8). Researchers at the University of California at Davis (22), The Rodale Institute (20), and in Europe (16) have gathered similar results.

Profitability of Organic Systems and Limitations in Growth

Production costs were also compiled and compared for the certified organic and the conventional systems. The most notable discovery was that while labor costs were greater in the organic system, material costs were significantly lower. Moreover, the most significant accounting notation was that the organic system was more profitable (11).

Without information about the limitations of land, labor, capital, and production involved, the absolute number of certified organic acres that can be effectively managed is unknowable. Once budgets that include these four items are compiled, a determination can be made regarding the potential dimension for organic operations (18).

Food Safety Concerns

The fertilization regimen of most organic crop production relies heavily on the application of manure and composted manure. It has been observed in many contexts that continuous application of manure, as well as any other fertilizer, can lead to polluting run-off. This fact has often been extrapolated to the point of concluding that, since organic producers use manure, they are adding to the water pollution load. Scant evidence exists showing any facts behind this claim, whereas overwhelming evidence suggests that excess applications of any fertilizer can result in some form of water pollution. In addition, the application of raw manure is regulated in organic production where raw manure must be applied during a period of active up-take by the plant (for horticultural crops – 120 days before harvest) (25), thus mitigating pollution due to agricultural run-off.

The suggestion that organic food is less safe than conventional food generally surfaces when a case of food-borne illness has been traced to an organic product, usually produce. As in most cases of such illnesses, the cause is not the production system per se, but the post-harvest handling of the product during which time some pathogen is allowed to remain on, or comes in contact with, the product at some point in the journey from the field to the table. This problem of sanitation is shared across all levels of the food system and can only be addressed by adherence to effective food sanitation protocols.

One of the most apparent benefits from consuming organic food is lower pesticides in foods. The Consumers Union began a study in 1998 determining that organic fruits and vegetables in US groceries had significantly lower pesticide residues compared to conventional produce, which was substantiated four years later in a similar study (2). The University of Washington measured pesticide metabolites in pre-school children over a three-day period and found concentrations of pesticides metabolites six times lower when children were fed organic over conventional food (7). The Organic Center for Education and Promotion has also compiled peer-reviewed information finding lower pesticide levels in organic food (3), which has led to increasing consumer confidence with organic food consumption.

Concern over mycotoxins in food is also driving consumer interest in organic foods. Studies in Europe have consistently reported 50% more mycotoxins in conventional food and livestock feed than in organic counterparts (3). In a comparison of organic and conventional corn grain quality at Iowa State University, we found no mycotoxins in the organic corn. Scientists have speculated that fungal infections may arise due to the lack of diversity and heavy use of fertilizer coupled with fungicide applications.

In terms of *E. coli*, this pathogen was the target of our comparison of organic versus conventional apple cider in Iowa (12). We did not find *E. coli* in either system and no statistical difference in yeast and mold populations in conventional versus organic apple cider.

Food Quality Comparisons

In comparing organic and conventional food quality, identical conditions — soil, weather, varieties — as the conventional system must occur when producing the organic crop. In addition, the organic crop should be *certified* organic to assure that only NOP-compliant practices are involved. Several studies have followed these two criteria and are reported here. At the Citrus Research Institute in Acireale, Sicily, researchers found higher concentrations of Vitamin C in the organic versus conventional citrus fruits (23). At the University of California-Davis, after 10 years of organic management, organic tomato fruits had higher calcium (Ca) and phosphorus (P), which corresponded to greater levels of Ca and P in the organic system's soils (6). In Denmark, Brandt and others (4) have focused on phenolic compounds, which are the plants' natural defense chemicals that act as cancer-fighting compounds in humans. She found that plant disease incidence was not higher in organic compared to conventional (sprayed) crops, suggesting higher intrinsic resistance and phenolic composition in organic plants. In a similar organic fruit comparison study at UC Davis, organic and sustainably-grown fruits were also found to contain higher phenolics than conventional produce (1). Another nutraceutical of interest to consumers is lycopene, which assists in mitigating damage; Ishida and Chapman (14) found that organic catsup had 50% more lycopene than conventional brands. Benbrook's study of the literature (3) found that organic food, on average, contained 30% higher levels of beneficial antioxidants than conventional food. Taste is more of an illusive issue, but seminal work by Reganold and others (24) at Washington State University confirmed through lab analysis and taste tests that organic apples were less acidic and firmer than conventional apples.

Soil Quality Under Organic Conditions

Weed control in organic systems often requires tillage operations. For cash grain crops, this usually involves multiple passes over the field. This observation has lead to the conclusion that organic grain production degrades the soil by compaction. Our observations at the Neely-Kinyon research site have cast considerable doubt on this conclusion (9). One of the reasons for the doubt is that the average number of field operations we conduct over the course of a 4-year rotation (corn-soybean-oats/alfalfa) has been similar to that of a conventional corn-soybean-corn-soybean no-till operation. In addition, the compost, oats, and alfalfa contribute significant organic matter to the organic system. Thus, by measures analyzed by soil scientists at the USDA National Soil Tilth Lab, soil quality in our certified organic system has improved over time.

The Role of Extension

Communicating the proven benefits of a certified organic production system to a larger audience is a key factor in sustaining growth of the overall organic industry. At a Land Grant institution, such as Iowa State University, this communication is accomplished by employing the well-structured Extension Service. In any given year, Iowa State's Extension Organic Program holds about ten workshops and field days throughout the state. Over the course of the school year, we train about 100 elementary students at the Neely-Kinyon farm site on organic principles and practices. Of equal importance is the publication of organic research results in peer-reviewed

journals. Over the past year, the *Agronomy Journal*, *Crop Management*, *HortScience*, and *Renewable Agriculture and Food Systems* have published some of our organic research.

We also have worked with the writers at The Rodale Institute's online publication "New Farm" to provide research-based organic information to a larger audience. Additional on-line sources can be found at the organic webpage at Iowa State which is linked to many other information sources, the Organic AgInfo website which is housed at North Carolina State University and is a product of the Organic Agriculture Consortium between ISU, Ohio State University, Tufts University, NC State, and the Organic Framing Research Foundation. Another established source for researchers, producers, and the public is the USDA-SARE (Sustainable Agriculture Research and Education) Program Sustainable Agriculture Network (SAN) and the Appropriate Technology Transfer for Rural Areas (ATTRA) program. Reflecting the robust growth of the organic industry, an increasingly effective way to communicate the benefits of organic production are mainstream groceries. In Iowa, we have been approached by Hy-Vee Supermarkets to provide accurate information regarding the benefits of consuming organic foods.

In conclusion, I think the most apparent benefit of organic production that can be communicated to consumers is preservation of our environment. With less pesticides used in organic production, organic produce has clearly been shown to contain lower pesticide residue. Other food quality studies have shown organic foods with lower nitrates, higher soluble solids, higher antioxidants, and higher phenolic compounds. Whether these additional claims will induce consumers to increase organic food purchases or not, the current practices and philosophies embodied in organic production (i.e., protection of the environment and support for family farms) will most likely provide incentive enough to continue organic purchases.

Literature Cited

1. Asami, D., Hong, Y. J., Barret, D. M., and Mitchell, A. E. 2003. Comparison of the total phenolic and ascorbic acid content of freeze-dried and air-dried marionberry, strawberry and corn grown using conventional, organic, and sustainable agricultural practices. J. Agric. Food Chem. 51:1237-1241.

2. Baker, B., Benbrook, C. M., Groth, E., III, and. Lutz Benbrook, K. 2002. Pesticide residues in conventional, IPM-grown and organic foods: Insights from three U.S. data sets. Food Addit. Contam. 19:427-446.

3. Benbrook, C. 2005. Organic food comparisons–State of science reviews. Organic Center for Education and Promotion. Online. Available at: www.organic-center.org (accessed 10 September 2005). Organic Trade Association, Greenfield, MA.

4. Brandt, K., and Mølgaard, J. P. 2001. Organic agriculture: Does it enhance or reduce the nutritional value of plant foods? J. Sci. Food Agric. 81:924-931.

5. Clark, M. S., Horwath, W. R., Shennan, C., Scow, K. M., Lanini, W. T., and Ferris, H. 1999. Nitrogen, weeds and water as yield-limiting factors in conventional, low-input, and organic tomato systems. Agric. Ecosys. Environ. 73:257-70.

6. Colla, G., Mitchell, J. P., Poudel, D. D., and Temple, S. R. 2002. Changes of tomato yield and fruit elemental composition in conventional, low input, and organic systems. J. Sustain. Agric. 20:53-67.

7. Curl, C., Fenske, R. A., and K. Elgethun. 2003. Organophosphorus pesticide exposure of urban and suburban preschool children with organic and conventional diets. Environ. Health Perspect. 111:337-382. doi: 10.1289/ehp.5754. (accessed 10 September 2005). University of Washington, Seattle, WA.

8. Delate, K. and C. Cambardella. 2004. Agroecosystem performance during the transition to certified organic grain production. Agron. J. 96:1288-1298.

9. Delate, K., Cambardella, C., McKern, A., Burcham, R., and Rosmann, D. 2005. Comparison of conventional and organic crop and soil quality at the ISU Neely-Kinyon Farm. Iowa State Univ. Exp. Station Ann. Rep., Ames, IA.

10. Delate, K., and DeWitt, J. 2004. Building a farmer-centered land grant university organic agriculture program: A Midwestern partnership. Renewable Agric. Food Sys. 19:1–12.

11. Delate, K., Duffy, M., Chase, C., Holste, A., Friedrich, H., and Wantate, N. 2003. An economic comparison of organic and conventional grain crops in a long-term agroecological research (LTAR) site in Iowa. Am. J. Altern. Ag. 18:59–69.

12. Friedrich, H., Delate, K., Domoto, P., and Nonnecke, G. 2003. Effect of organic pest management practices on apple productivity and apple food safety. Biol. Agric. Hortic. 21:1–14.

13. IDALS. 2004. Annual survey on organic production. Iowa Dept. of Agric. and Land Stewardship. Des Moines, IA.

14. Ishida, B. K., and Chapman, M. H. 2004. A comparison of the carotenoid content and total antioxidant activity in catsup from several commercial sources in the United States. J. Agric. Food Chem. 52:8017-8020.

15. MacRae, R. J., Hill, S. B., Mehuys, G. R., and Henning, J. 1990. Farm-scale agronomic and economic conversion from conventional to sustainable agriculture. Adv. Agron. 43:155-198.

16. Mäder, P., Fließach, A., Dubois, D., Gunst, L., Fried, P., and Niggli, U. 2002. Soil fertility and biodiversity in organic farming. Science 296:1694-1697.

17. North Carolina State University. 2003. The globalization of food and how Americans feel about it. Online. N.C. State, Raleigh, NC.

18. Offermann, F. and H. Neiberg. 2000. Economic performance of organic farms in Europe. Univeritat Hohenheim, Institut fur Landwirtschaftliche Betriebslehre, Stuttgart, Germany.

19. OTA. 2005. OTA Newsletter. Organic Trade Association. Greenfield, MA.

20. Pimentel, D., Hepperly, P., Hanson, J., Seidel, R., and Douds, D. 2005. Organic and conventional farming systems: Environmental and economic issues. Ecol. Evolut. Biol. Rep. 05-1. Cornell Univ., Ithaca, NY.

21. Porter, P. 2003. Organic and other management strategies with two- and four-year crop rotations in Minnesota. Agron. J. 95:233-244.

22. Poudel, D., Ferris, H., Klonsky, K., Horwath, W. R., Scow, K. M., van Bruggen, A. H. C., Lanini, W. T., Mitchell, J. P., and Temple, S. R. 2001. The sustainable agriculture project in California's Sacramento Valley. Online. Outlook on Agric. 30:109-116.

23. Rapisarda, P., M. L. Calabretta, G. Romano, and F. Intrigliolo. 2005. A comparison of nitrogen metabolism components as a tool to discriminate between organic and conventional citrus fruits. Jour. Agri. Food Chem. 53:1-14.

24. Reganold, J. P., Glover, J. D., Andrews, P. K., and Hinman, H. R.. 2001. Sustainability of three apple production systems. Nature 410:926-929.

25. USDA-AMS. 2005. Final Rule: 7 CFR Part 205. Online. US Dept. of Agric. - Agric. Marketing Serv., Nat. Organic Prog., Washington, DC.

26. USDA-ERS. 2005. Organic production data sets. Online. US Dept. of Agric. – Econ. Res. Serv. USDA-ERS, Washington, DC.

Websites of Interest

Iowa State University Organic Ag. Program
extension.agron.iastate.edu/organicag

Organic Ag. Consortium
www.organicaginfo.org

Trade Associations

OTA — Organic Trade Association
www.ota.com

OCA — Organic Consumers Association
www.organicconsumers.org

Whole Foods Market (consumer surveys)
www.wholefoodsmarket.com