



**AgEcon** SEARCH  
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

*The World's Largest Open Access Agricultural & Applied Economics Digital Library*

**This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.**

**Help ensure our sustainability.**

Give to AgEcon Search

AgEcon Search  
<http://ageconsearch.umn.edu>  
[aesearch@umn.edu](mailto:aesearch@umn.edu)

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

# **Pesticide Use and Produce Quality**

**Proceedings of a Workshop  
Sponsored by**

**Agricultural  
and  
Food Marketing Consortium**

**Farm Foundation**



## PESTICIDE USE AND PRODUCE QUALITY: EVALUATING THE ROLE OF PRIVATE SECTOR INSTITUTIONS

Enrique E. Figueroa  
Cornell University

*The consumer seeks more fresh or fresh-like product of good visual quality that is full-flavored, nutritious, convenient to prepare and serve, pesticide-free, and available year round at a reasonable price. At the current state of the art, some of these goals are mutually exclusive, and the marketplace will decide which goals will predominate (Shewfelt, p. 105).*

The above quote appeared in 1990 and has particular relevance to the development of this paper. It identifies produce attributes upon which consumers base their purchasing decisions and postulates the "mutually exclusive" nature of some attributes. Are the attributes mutually exclusive? Will the marketplace decide which attributes predominate? Can/should government intervention play a role or should the "weeding" of the incompatible attributes be left entirely to the private sector? This paper will put forth a framework by which public and private sector individuals can evaluate the attribute-culling process, if a culling process is warranted.

Before proceeding, it is important to identify a term frequently used when discussing the issue of produce quality and pesticide use. The term is "cosmetic" and is usually used in the context of cosmetic defects on produce. The term gained prominence because the 1990 farm bill passed by Congress specifically uses it in directing the U.S. Department of Agriculture (USDA) to investigate the above-mentioned relationship. However, there appears to be no consensus on what cosmetic means—i.e., at what point does a "blemish" cease to be a blemish and become a "rot"? Can USDA condition grade standards be evaluated to ascertain which are cosmetically based? Should USDA grade standards be the vehicles for evaluating cosmetic standards in produce? How does the produce industry—from producer to consumer—arrive at a consensus of what is meant by cosmetic standards? The definition of cosmetic standards needs to be clarified, particularly how the definition will serve to answer the preceding questions. So far, no consensus has emerged to define cosmetic standards and a number of professionals now argue that the term is inappropriate and should not be used.

Historically, the quality of produce has been ascertained by members of the trade through the use of USDA grade standards, label identification and personal contacts and/or reputation. Consumers principally judge quality through appearance, the reputation of a particular store or the type of shopping experience they encounter at a particular store. For the most part, both trade personnel and consumers have a consistent set of produce attributes that constitute quality. However, the use or non-use of pesticides in the production and distribution of produce is an area in which trade personnel and consumers diverge in their relative assessments of quality. Those consumers that discount produce quality because it has or was produced with the use of pesticides generally are at odds with trade personnel who generally do not discount quality because of pesticide use. It is perhaps this divergence of quality assessment by these two market participants that is at the crux of the issue of produce quality and pesticide use.

### Dimensions of the Issue

The role private institutions play in determining a consensus on produce quality and pesticide use needs to be incorporated into, and thereafter evaluated from, a multi-dimensional perspective. The dimensions and key questions include:

- How do regulatory dimensions affect pesticide use and produce quality?
- What is the appropriate framework for economic analysis of the issue?
- What role do consumer preferences play?
- What role does information transmitted by the market play?
- What are the social welfare gains?

The following brief discussion addresses possible answer(s), but, more importantly, attempts to frame the entire issue of pesticide use and produce quality from the perspective of the private sector.

### Regulatory Environment

The regulatory environment for producing and marketing produce is primarily governed under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA); the Federal Food, Drug, and Cosmetic Act (FFDCA); the Agricultural Marketing Agreement of 1937; and the Pesticide Monitoring Improvements Act of 1988 (U.S. General Accounting Office). In addition, various states and/or market orders have other regulations specific to their jurisdictions. For example, Maine has pesticide labeling requirements for produce containers. California has very restrictive statutes governing pesticide use

(Greene and Zepp, p. 15). Given the multitude of current legislation on pesticide use, new legislation needs to be introduced to clarify how pesticide use will be incorporated into the definition of produce quality. Compounding the legislative debate will be issues raised by Dr. Bruce Ames at the University of California and his development of the "index for possible hazard" or HERP (human exposure/rodent potency) index (Carter and Nuckton, p. 25). In short, Dr. Ames argues that commonly consumed items such as peanut butter and beer and wine pose more of a cancer threat than, say, DDT. Therefore, judgments about regulating pesticides need to have a balanced perspective that recognizes life's everyday hazards. To what extent private sector institutions are effective in informing the debate concerning regulatory issues affecting produce quality will be a function of how the industry and environmental groups can define risk and risk assessment of pesticides on produce. Indeed, agreeing on the appropriate risk assessment methodology for evaluating produce quality and pesticide use will be difficult since environmental groups and produce industry groups have very different positions on what the appropriate methodology should be.

### Framework For Economic Analysis

As just mentioned, the evaluation of risk and risk assessment is a key parameter in formulating pesticide use policy. Incorporating risk into an economic analysis framework is just as important, but, unfortunately, the current body of literature does not provide a rich foundation for conducting sound economic analyses. Research is particularly lacking in the area of how firms and/or industry can make a determination of their optimal allocation of resources in a risky environment. On the demand side, more literature supports the incorporation of, for example, "pesticide-residue-free" as a produce attribute.

The analytical methodologies that have been (can be) used to evaluate pesticides in/on produce are:

1. The Houthakker-Thiel Model
2. The Lancaster Model
3. The Consumer Goods Characteristic Model
4. The Willingness-To-Pay Approach
5. The Reputation Setting Model
6. Conjoint Analysis
7. Consumer and Producer Surplus Modeling

The Houthakker-Thiel Model incorporates both quantities and qualities—i.e., pesticide-residue-free as an attribute—of goods in a utility function. The Lancaster Model defines goods in a utility function as a bundle of characteristics—one characteristic would be the level of pesticide residues on particular tomatoes. The Consumer Goods Characteristic Model is a variant of the Lancaster Model and

defines goods as having both common and unique characteristics—no pesticide residues in a particular brand/label of lettuce, for example (Morse and Eastwood). Some form of the preceding three models can yield a hedonic price function and such a function can directly estimate the implicit price(s) of attributes—i.e., pesticide-residue-free. An application of the Lancaster Model to evaluate the effect of the “Alar scare” on apple sales in Metropolitan New York City found that information about the scare had a significant impact (van Ravenswaay and Hoehn). An application of a hedonic price equation to estimate implicit prices for selected quality attributes of tomatoes found differences across months of the year and across tomato attributes. Of the four attributes estimated—color, damage, firmness and size—damage was the only attribute significant in all three time periods evaluated (Jordan, et al).

The above-mentioned models are applicable to varying degrees. However, if data could be obtained on quantities and prices of produce with varying levels of pesticide-related attributes, then the hedonic price equation model can yield sound and possibly robust results. For private firms, this approach would yield estimates of price, income and cross-price elasticities of demand and therefore allow firms to make better decisions concerning pricing and item availability.

### Consumer Preferences

Of the six dimensions listed, the consumer preference dimension is the most researched. Though most work falls under the general category of “food safety,” a good amount of work has been conducted to ascertain consumer preferences for produce quality and its relationship to pesticide use. The statistic that the United States uses 45 percent of all pesticide production on only 7 percent of the cultivated land in the world may be at the root of consumer concerns about pesticides in food (U.S. Environmental Protection Agency, p. 12). Also, there is evidence that the level of concern about pesticide use on produce has changed over time. In 1965, 41.5 percent of surveyed consumers indicated that a danger existed in eating fruits and vegetables that had been sprayed or dusted with pesticides. By 1984, the comparable percentage had changed to 71.1 percent (Sachs, et al., p. 103). Conversely, a study of male and female African-American and non-African-American consumers indicates males think today’s food is safer. However, the majority of females believe today’s food is less safe (Jordan and Elnagheeb, p. 20).

Much of the work in the area of produce quality and pesticide use has used willingness-to-pay approaches. The prevalence of the approach emanates from the fact that many (most) consumers have not purchased produce which was produced and marketed under varying levels of pesticide use. The other factor contributing to the popularity of the approach is that researchers have been interested in de-

termining consumer trade-offs between pesticide use and the appearance of produce—i.e., surface defects and/or perceived damage. A large majority of shoppers in the Atlanta metropolitan market indicated some concern about pesticide use in produce. However, 61.5 percent of the respondents were not willing to accept cosmetic damage. Also, 88.4 percent were not willing to accept insect damage on purchased produce even though the majority were willing to pay 5 percent more for pesticide-free produce (Ott).

Another study indicated 56 percent of respondents were willing to pay 10 percent or more for pesticide-free tomatoes, but less than half were willing to purchase tomatoes with cosmetic defects. In addition, 43 percent of the respondents indicated their produce buying behavior changed due to their concern about pesticides. Of the individuals that changed their purchase behavior, 41 percent bought more organic and/or chemical-free produce, while 22 percent stopped buying produce (Weaver, et al.).

Lastly, demographic characteristics affect consumers’ willingness to pay for certified pesticide-residue-free produce. The characteristics that positively influence the willingness to pay are: if the consumer values the testing of produce, if the consumer expects to be financially better off in the future, and if the consumer is Caucasian rather than African-American. The negative influences are: if consumers are in the 36 to 60 age group category, have a college education, and have annual incomes of less than \$35,000 (Misra, et al.).

How the marketplace incorporates the above information on consumer preference for produce with varying degrees of pesticide use will determine the extent to which government intervention will be needed. If the marketplace provides a variety of produce that satisfies varying consumer needs, then the likelihood of government intervention is diminished. A key component of satisfying different consumers is the ability of the market to transmit information among all market participants.

### Information Transmitted by the Market

The most likely choice for transmitting market information about the use of pesticides in the production and distribution of produce is through brands and/or labels. However, an impediment to this approach is the perceived notion by producers and retailers that labeling a produce item as pesticide-residue-free or organic connotes that the other produce items without such labels may not be safe. Also, the ability of a producer to maintain label/brand integrity of produce as it moves along the market channel may not be very secure—once the producer sells the produce he/she has lost control of it. Moreover, consumers seem to have a relatively low level of confidence in the food industry’s supplying information on food safety (Kramer

and Penner, p. 24). Nonetheless, the marketplace has supported and continues to support various forms of branding/labeling with respect to pesticides. A key question is the extent to which labels/brands can segment or differentiate produce based on the level of pesticides used in its production and distribution.

The debate on whether USDA produce grade standards can/should be changed to incorporate information about pesticide use is perhaps a response to the inability of the current marketing system to transmit such information. The debate is useful in that various alternatives have surfaced—change standards; amend current grades; or re-define what grade standards should provide to the marketplace (Armbruster). In addition, the debate and future research need to consider:

1. Who derives information from grade standards?
2. Have grade standards adapted to increased trade?
3. What is the relationship between “information demand” and “consumer demand”?
4. Can a consensus be generated on a new set of grade standards?

The importance of the transmission of information by the market cannot be overemphasized and a number of researchers have specifically looked at this issue. One effort found very significant changes in consumers' willingness to buy oranges with thrip damage after they were told the thrip-damaged oranges were produced with half the pesticides of conventionally produced oranges (Lynch). Another study found that information plays a significant role in the outcome from the model. Consumer-stated preferences for willingness to pay and/or buy produce with labels such as organically grown, certified organically grown, pesticide-residue-tested, and Integrated Pest Management (IPM)-grown were a function of how well-informed consumers were about the meaning of such labels (Underhill and Figueroa). In fact, the role information plays in determining the outcome of a particular form of analysis is critical, particularly in willingness-to-pay approaches. An extensive survey of shoppers in North Carolina food stores found shoppers did respond to information about the level of health risk associated with pesticide residues on produce. In addition, the information effect was a function of the amount of information shoppers had about produce prices (Eom). Information can have both supply-side and demand-side effects. On the demand-side, the effect of information on consumer demand is a function of: a) information search; b) knowledge; and c) quality of choice (Price, et al.). Finally, an application of conjoint analysis found that the order in which respondents viewed pictures of bibb lettuce with varying levels of price, packaging and pesticide-free labels influenced their response (Stevenson).

The author is unaware of studies investigating industry-wide effects of produce labels/brands. However, a model developed to evaluate quality reputation appears to be an appropriate vehicle for analyzing the impact of the reputation of produce labels/brands on firm and market performance (Shapiro).

### Welfare Gains

Though this is the most appropriate model for evaluating gains and losses by society, the lack of data renders the approach empirically inoperable. However, from a purely theoretical perspective, one study indicates that minimum quality standards, discernible to consumers upon inspection, cannot increase social welfare (Bockstael). Another puts forth the notion (counter-intuitive, perhaps) that producers could actually gain from pesticide restrictions if output product prices increase enough (Abler). Also, economy-wide effects concerning pesticide use are invariably based on information supplied by the scientific community and their track record appears to overestimate both the risks and benefits from pesticide use (Harper).

The preceding discussion on the dimensions of produce quality and pesticide use also needs to be couched within the existing produce marketing system. The section that follows will attempt to describe the produce marketing system and its ability to provide information about pesticide use and produce quality.

### The Produce Marketing System

First, it is imperative that industry representatives' and consumers' voices be heard in the debate of pesticide use and produce quality. All market participants can gain if the market truly reflects the needs of participants, but all participants can lose if discord and suspicion dominate the debate. Before proceeding, the market system needs to be identified. Table 1 is a simplistic depiction of the produce marketing industry.

An important issue to producers is the availability and cost of pesticides. Pesticide registration can cost as much as \$25 million (American Council for Science and Health, pp. 23-25). Another estimate is \$40 million to \$60 million (Council for Agricultural Sciences and Technology, pp. 8-9). More importantly, the Environmental Protection Agency (EPA) is reviewing a number of key pesticides for fruit and vegetable producers and a possible outcome is the removal of some pesticides from the market. A critical issue in the re-registration process is the EPA's policy of “acceptable risk”—one additional cancer per one million population. Also, the debate concerning the EPA's using “economic benefits to farmers” as part of its evaluation process has been heated and may change (League of Women Voters Educational Fund, pp. 6-9).

**Table 1. Produce Marketing System.**

<p><b><u>Producers</u></b></p> <ul style="list-style-type: none"> <li>▪ Industry organizations/associations</li> <li>▪ Market order commission representatives</li> <li>▪ Board members of cooperative</li> <li>▪ Private firms</li> </ul>	<p><b><u>Market Intermediaries</u></b></p> <ul style="list-style-type: none"> <li>▪ Brokers</li> <li>▪ Receivers</li> <li>▪ Wholesalers</li> <li>▪ Commission merchants</li> </ul>
<p><b><u>Retailers</u></b></p> <ul style="list-style-type: none"> <li>▪ Supermarkets</li> <li>▪ Independent grocery stores</li> <li>▪ Health food stores</li> <li>▪ Direct market sales</li> </ul>	<p><b><u>Consumers</u></b></p> <ul style="list-style-type: none"> <li>▪ Consumer organizations</li> <li>▪ Environmental groups</li> <li>▪ Food service establishments</li> <li>▪ individuals</li> </ul>

Another aspect of the debate is the relationship between commodity programs such as market orders or set-aside programs. Unfortunately, relatively little research has focused on the direct link between grade and size provisions of market orders and the use of pesticides to meet such provisions. However, there is some evidence that provisions of the Florida market order for tomato grades are not consistent with consumer preferences for quality (Sun and Conklin). An effort that looked specifically at the impact of changing U.S. grain sector policy found that pesticide use would decline after implementing various policies. Also, output product price would increase and input prices would decline (Helmert and Azzan).

A number of questions will remain unanswered if and when some pesticides are removed from the market. For example, will pesticide manufacturers stop production of certain pesticides? Is there any level of oncogenic risk from pesticides that is acceptable? Will consumers accept more blemishes on produce in order to have fewer pesticides applied (Gianessi and Greene)? Lastly, producer decisions on applying pesticides have incorporated considerations about the safety of farm workers and need to continue to do so (Schaub, p. 2).

Market intermediaries and retailers probably derive the greatest benefits from the current information transmitted through USDA produce grade standards. Conversely, one could argue that these two entities stand to lose the most if the grade standards are changed. Market intermediaries and retail produce buyers play a very important role in determining the type of produce attributes demanded in the market. Even though most would argue that the consumer ultimately decides what produce attributes the market will supply, other decisions by market intermediaries and retailers can play an equally large or larger role. For example, a wholesaler's decision to buy full or mixed loads from a distant supplier may likely be

a function of transportation costs; the relative perishability and compatibility of the items in the mixed load; the prior or future "deals" cut between the wholesaler and supplier; whether the supplier is willing to provide volume discounts; the shelf life left in the produce items when the wholesaler receives them; and other factors not entirely related to consumer preferences. The retail produce buyer generally operates in a climate requiring particular levels of sales and profits over a specified time period. Again, the produce buyer's decision to carry items and/or allocate more or less shelf space incorporates factors such as: what the competition is doing; what items are or will be on ad; whether a produce item is short or long a particular week; prior or future "deals" cut with produce suppliers; how to display a particular produce item—i.e., end-of-aisle; or promotions sponsored by commodity organizations. In fact, organic produce suppliers argue that retail produce buyers have curtailed the expansion of the market by their merchandising and space allocation decisions concerning the display of organic produce.

Conversely, retailers who initially were advertising pesticide-residue-free produce no longer do so because of potential liabilities from "truth-in-advertising" statutes. Also, retailers state that organic produce costs more than what their average shoppers are willing to pay and, therefore, it is not a profitable item for retailers to carry. Since large supermarket retailers now bypass market intermediaries and buy directly from produce shippers, the role of market intermediaries is more important in the small retail market channel. The small retailer market channel generally has higher prices for all items because volumes are smaller and overhead is higher. Therefore, carrying relatively higher-priced produce—organics—is more difficult. The notion that organic produce is more expensive is not universally true, however.

There is no doubt that the current debate about produce quality and pesticide use is a result of efforts by environmental groups and consumer organizations. Their position at the table discussing pesticide-use policy has, up to now, been vacant, but there will be no such vacancy in the future. A relatively silent entity has been the food service industry, but the potential for this industry to play a significant role in the debate between produce quality and pesticide use is large. A vehicle for change is the food service industry's practice of contracting with suppliers. In addition, the fact that food service firms generally represent large-volume purchases adds clout to their ability to influence market outcomes. For example, a food service operator can require (some do already) from their suppliers that produce meet a particular level of pesticide use in the production and distribution of the produce. Because the relative cost of produce for a food service establishment is low, the firm can afford to pay a higher price for produce meeting pesticide-use (non-use) requirements. From the supplier's perspective, entering a contract minimizes market risk and therefore he/she is more amenable to meeting

varying criteria for his/her produce. Demographic variables also contribute to the food service industry's ability to wield more market power in the future. More individuals are eating from menus prepared for larger and expanding populations—nursing homes, prisons, consolidated school and municipal districts, increased cafeterias at work sites and/or offices, etc.—and, therefore, the directors of food service at these institutions represent a larger and expanding market.

Finally, the trend in the consumption of produce continues to be upward and the primary reason for increased consumption is health/nutrition (*The Packer*, p. 16). The advent of the *5-a-Day Program* will contribute to the trend and will most likely accelerate it. The U.S. population currently is eating 3.4 servings per day of fruits and vegetables. Therefore, meeting the 5-serving goal represents a 32 percent increase (Subar, et al., p. 2).

### Summation

Private sector institutions will play a diminished role in the debate concerning produce quality and pesticide use. Indeed, the Clinton administration has just announced a policy to reduce the amount of pesticides used in the production of food (Burros, p. 1). This is not to say that the private sector will play an insignificant role, but rather that the industry's share of the policy-setting "pie" will be smaller. However, the total market for produce has increased and probably will continue to do so, therefore, the relative health of the industry is not in jeopardy. What is in jeopardy is the industry's ability to be the primary (sole) user and, therefore, the primary entity that will continue to define USDA produce grade standards. Along with the loss of being the "primary user" of USDA grade standards will be the loss of the responsibility of being the sole payee for the USDA grade standards system. Consumers and other market participants will most likely have to bear some of the costs of changing USDA produce grade standards.

It is not a foregone conclusion that USDA grade standards need changing, but what is clear is that some system needs to be implemented that transmits pesticide use and produce quality information through the marketing channel(s). Since current grade standards serve the function of transmitting produce quality information along the marketing channel, then many market participants, particularly consumers, feel it is also the appropriate vehicle for transmitting information on pesticide use. However, before embarking on such a course, research needs to be conducted on what is meant by "cosmetic standards" and the appropriateness of the current grade system to inform all market participants of such standards. More specifically, future research on the relationship between pesticide use and cosmetic standards needs to ask the following:

1. To what extent do cosmetic standards lead to greater/lesser food contamination?
2. How, if at all, do cosmetic standards increase human poisoning?
3. To what extent do cosmetic standards contribute to environmental pollution?
4. To what extent do cosmetic standards increase energy use in produce production?
5. To what extent do cosmetic standards increase/decrease produce costs to consumers (Pimentel, et al.)?

Two final points warrant identification for further research. The first is the relationship between the *5-a-Day Program* and the ability of low-income consumers to purchase 5 servings a day. Will the *5-a-Day Program* increase demand to the point at which produce prices increase significantly? This is a particularly relevant question if the EPA's re-registration process removes a number of pesticides from the market and results in decreased supply. The second point is related to the first. What level of future U.S. produce consumption will be produced outside the United States? The issue has particular relevance to pesticide use and produce quality because of the pesticides available to foreign producers that may not be available to domestic producers. For example, if a particularly effective pesticide which breaks down quickly after use and is not found on the actual produce at the time it is imported is available only to foreign producers, can domestic producers claim a competitive disadvantage? Or will the imported produce help keep prices low and available to low-income consumers?

This paper began with a quote and it concludes with another that identifies a potential vehicle for addressing the issue of produce quality and pesticide use. In fact, it reflects on changes that are already taking place in the marketplace:

*Brand labeling of fresh produce . . . may provide the necessary vehicle for changing consumer orientation from an emphasis on appearance to less pesticide use, particularly if the label can serve as a guarantor of consistently high consumption quality* (Shewfelt, p. 105).

### REFERENCES

- Abler, D.C. "Issues in Pesticide Policy: Discussion." *Northeastern J. Agr. Res. Econ.*, Oct. 1992, pp. 93-95.
- American Council on Science and Health. *Pesticides: Helpful or Harmful?* New York, NY, Sept. 1988.
- Armbruster, W. "Fresh Produce Quality, Food Safety and Environmental Concerns." *J. Food Dist. Res.*, Feb. 1990, pp. 75-78.
- Bockstael, N. "The Welfare Implications of Minimum Quality Standards." *Am. J. Agr. Econ.* 66(1984):466-471.
- Burros, M. "U.S. Is Taking Aim at Farm Chemicals in the Food Supply." *The New York Times*, June 27, 1993.
- Carter, H.O., and C.F. Nuckton. *Chemicals in the Human Food Chain: Sources, Options and Public Policy*. California Agricultural Issues Center, University of California, Davis, June 23, 1988.
- Council for Agricultural Science and Technology. *Pesticides and Safety of Fruits and Vegetables*. Comments from CAST, No. 1800-1, Washington, DC, Dec. 1990.



- Eom, Y.S. "Consumers Respond to Information About Pesticide Residues." *Food Review*, Oct.-Dec. 1992, pp. 6-11.
- Gianessi, L.P., and C. Greene. *The Use of Pesticides in the Production of Vegetables: Benefits, Risks, Alternatives and Regulatory Policies*. Washington, DC: Resources for the Future, 1989.
- Green, C., and G. Zepp. "Changing Pesticide Regulations: A Promise for Safer Produce." *Nat'l. Food Rev.*, July-Sept. 1989, pp. 12-16.
- Harper, C.R. "Issues in Pesticide Policy: Discussion." *Northeastern J. Agr. Res. Econ.*, Oct. 1992, pp. 96-97.
- Helmers, G.A., and A. Azzam. "The Effect of Commodity Programs on Fertilizer and Pesticide Use in Agriculture." Paper presented at AAEE-WAEA meetings, Vancouver, BC, Aug. 1990.
- Jordan, J.L., R.L. Shewfelt, S.E. Prussia, and W.C. Hurst. "Estimating Implicit Marginal Prices of Quality Characteristics of Tomatoes." *S. J. Agr. Econ.*, Dec. 1985, pp. 39-146.
- Jordan, J.L., and A.H. Elnagheeb. "Public Perceptions of Food Safety." *J. Food Dist. Res.*, Sept. 1991, pp. 13-22.
- Kramer, C.S., and K.P. Penner. "Food Safety: Consumers Report Their Concerns." *Nat'l. Food Rev.*, Spring, 1986, pp. 21-24.
- League of Women Voters Education Fund. *America's Growing Dilemma: Pesticides in Food and Water*. Washington, DC: Mar. 1990.
- Lynch, L. "Consumers Choose Lower Pesticide Use Over Picture-Perfect Produce." *Food Rev.*, Jan.-Mar. 1992, pp. 9-11.
- Misra, S.K., C.L. Huang, and S. Ott. "Consumer Willingness to Pay for Pesticide-Free Fresh Produce." *West. J. Agr. Econ.*, Dec. 1991, pp. 218-227.
- Morse, S.C., and D.B. Eastwood. *A Theoretical and Empirical Investigation of the Hedonic Price Equation for Foods*. University of Tennessee Ag. Exp. Sta. Bull. 666, Knoxville, Feb. 1989.
- Ott, S.L. "Supermarket Shoppers' Pesticide Concerns and Willingness to Purchase Certified Pesticide Residue-Free Fresh Produce." *Agribus*. 6(1990):593-602.
- Packer, The. "Fresh Trends: A Profile of Fresh Produce Consumers." Overland Park, KS, 1993.
- Pimentel, D., E. Terhune, and W. Dritschillo, et al. "Pesticides, Insects in Foods, and Cosmetic Standards." *BioScience*, Mar. 1977, pp. 178-185.
- Price, L.L., L. Feick, and R.A. Higie. "Information Sensitive Consumers and Market Information." *J. Cons. Aff.*, Winter, 1987, pp. 328-341.
- Sachs, C., D. Blair, and C. Richter. "Consumer Pesticide Concerns: A 1965 and 1984 Comparison." *J. Cons. Aff.*, Summer, 1987, pp. 97-106.
- Schaub, J.R. "Pesticides: How Safe and How Much?" *Nat'l. Food Rev.*, Apr.-June, 1991, pp. 2-5.
- Shapiro, C. "Premiums for High Quality Products as Returns to Reputations." *Quart. J. Econ.*, Nov. 1983, pp. 659-679.
- "Shewfelt, R.L. Quality of Fruits and Vegetables." *Food Tech.* 44(1989):99-106.
- Stevenson, C.L. "Consumer Preferences for Greenhouse Grown Bibb Lettuce: An Application of Conjoint Analysis." Paper presented to the Faculty of the Graduate School of Cornell University in Partial Fulfillment of the Requirements for the Degree of Masters of Science, Aug. 1993.
- Subar, A.S., J. Heimendinger, S.M. Krebs-Smith, B.H. Patterson, R. Kessler, and E. Pivonka. *A Day for Better Health: A Baseline Study of Americans' Fruit and Vegetable Consumption*. Rockville, MD: National Cancer Institute, July, 1992.
- Sun, T., and N.C. Conklin. "Consumer's View of Tomato Quality." *Nat'l. Food Rev.* 35(1988):27-29.
- Underhill, S.E., and E.E. Figueroa. "Consumer Preferences for Non-Conventionally Grown Produce." Paper presented at the Valuing Food Safety and Nutrition Workshop, Alexandria, Virginia, June 2-4, 1993. Forthcoming in proceedings.
- United States Environmental Protection Agency. "Pesticides and the Consumer." *EPA J.* (A-107). Washington, DC: Office of Public Affairs, May, 1987.
- United States Government Accounting Office. Report to Congressional Requesters. "Food Safety and Quality: What Does What in the Federal Government." GAO/RCED91-19B. Washington, DC: Resources, Community and Economic Development Division, Dec. 1990.
- vanRavenswaay, E.O., and J.P. Hoehn. "The Impact of Health Risk on Food Demand: A Case Study of Alar and Apples." Paper presented at the Economics of Food Safety Workshop, Alexandria, Virginia, June 4-6, 1990.
- Weaver, R.D., D.J. Evans, and A.E. Luloff. "Pesticide Use in Tomato Production: Consumer Concerns and Willingness-to-Pay." University Park, PA: Dept. of Agr. Econ. and Rural Soc., Pennsylvania State University, June, 1991.