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Pesticide Use and Produce Quality

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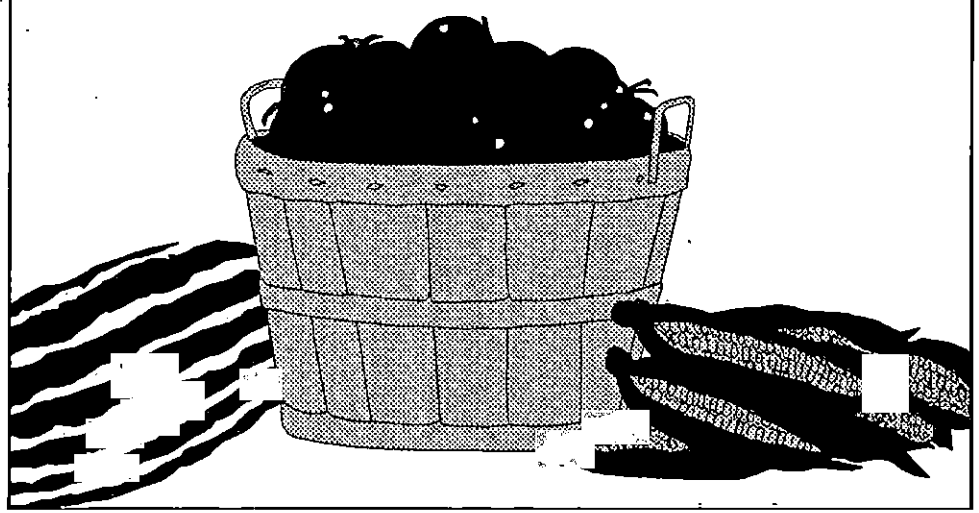

PESTICIDE USE AND CONSUMER DEMAND FOR PRODUCE QUALITY: A SURVEY OF EVIDENCE

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Health consciousness among U.S. consumers has increased over the past decade and has found expression in increased interest in diet (Cook). This dietary concern has brought the question of food quality to the forefront of public policy. Concern for quality has included both intrinsic quality of foods as well as the impacts of the production and marketing processes which may affect the quality of food that eventually reaches the consumer's table. Consumer surveys have provided evidence that consumers have high levels of concern about potential health risks of possible chemical residues on fresh produce (Zind, 1990; Ott and Maligaya; Food Marketing Institute; Sachs, et al.). This concern could result in two types of consumer behavior: 1) increased demand for chemical-pesticide-residue-free (CPRF), and/or organic produce or 2) decreased demand for fresh produce. Zind (1990) found evidence that aggregate demand for chemical-residue-free produce increased during the 1980s.

Consumer concern about pesticide residues presents a renewed challenge to economists to consider a series of questions that are associated with product quality. These have motivated economic analyses to predict changes in consumption induced by temporary or permanent changes in quality; to measure consumer valuations of levels and changes in product quality; and to identify market conditions that might rationalize public sector intervention. Within the context of produce, available studies have assessed the extent of consumer concern though few studies have tackled the quantification of "concern" in terms of economic value or of how that concern has been translated into changes in consumer consumption decisions.

Survey evidence has consistently found that consumers have both high and increasing levels of concern about health risks due to the possible presence of chemical residues on fresh produce. Past surveys have identified a shift by some consumers to CPRF produce; however, the nature and determinants of this demand are not well understood. Some survey evidence suggests the demand for alternative produce is driven by typical economic factors. Anxiety over product quality has often surged following news announcements of the discovery of residues or of new evidence establishing the health

risk of a particular residue. The "Alar scare" in March 1989, is a good example. News reports warned consumers about the potentially harmful effects of the chemical ripening agent Alar used in apple production. Following the announcement, demand for fresh apples plummeted and concern over the presence of residues on other produce increased. However, initial consumer response to such announcements has typically diminished rapidly over time. Available studies suggest that consumer response can be explained by economic determinants of consumer demand, despite the transitory reactions to news announcements.

Few studies have considered the consumer's valuation of the absence of chemical residues in fresh food. Among those that have, fewer have presented a microeconomic motivation for the specification of estimated models. The objective of this paper is to review what microeconomics and empirical study have to say with respect to consumer demand response to produce quality. Pesticide residues will be used as a case for discussion. The paper will review available microeconomic theoretic results as well as results of empirical studies. The paper will identify what is currently known about the effects of pesticide use on consumer demand and will highlight issues that deserve attention. Conclusions will be drawn concerning what economics has to say about consumer demand for produce quality.

Three expressions of consumer concerns for produce quality are of particular interest: 1) the nature and extent of concerns; 2) the economic valuation of those concerns, e.g., extent of consumer expressed willingness-to-accept, or pay for, CPRF produce; and 3) the type and extent of changes in consumer behavior that have resulted from these concerns. Because these issues have been considered by past studies for fresh produce in general, no evidence exists for specific products. One exception is a recent study of consumer demand for fresh tomatoes (Weaver, et al.). In the spirit of a case study, results of this paper will be presented in summary.

What Can Be Learned from Economic Theory

Produce quality has been considered at a theoretical level, mainly within the context of food safety, where the focus has been on pesticide residues. Hammitt, and Swartz and Strand presented early considerations of the problem which focused on consumer willingness to pay (WTP) for changes in food safety. In general, the approach has been to model the consumer's household as involving both consumption and non-wage market production activities that convert market goods into characteristics over which preferences exist. Information is introduced into these models as a determinant of food quality or, more generally, of the UFBE. Risk has been introduced in instances in which information or exposure is stochastic or random (see, e.g., Foster and Just). In general, these models have considered only binary risk, that is, exposure either occurs or it

does not. No specifications allowing for accumulation of exposure necessary for effect to occur have been considered.

The conclusions of theoretical models focused on risk can be summarized as follows. First, a rationale for government regulatory intervention can only be based on imperfections in the competitiveness of markets. A clear government role is justifiable to assure provision of accurate and complete information concerning product characteristics. A second conclusion is that traditional demand models do not provide adequate bases for assessing the effects of changes in risk.

Published survey evidence suggests that consumers do not passively accept exogenous changes in exposure to food-borne risk. Instead, consumers have been found to be willing to pay for perceived net personal health benefits of consuming CPRF produce. However, they also have numerous means of averting exposure entirely or altering the personal effects of an exogenous exposure to a change in produce quality. Weaver (1992) presents a microeconomic approach to measuring WTP and its determinants that responds to these observations. A household choice model is presented which simultaneously considers: 1) the cost of illness, 2) the disutility of illness, and 3) expenditures and effort directed at averting or defending exposure or effect of the perceived pesticide residual. Given that purchase of CPRF produce is an action of aversion, the consideration of averting behavior must be an essential part of any explanation of WTP. Further characteristics of consumer behavioral response and actions of aversion to perceived chemical-pesticide residues would include product switching and the presence of corner solutions for some types of produce. In such cases, perceived exposures to chemical pesticide residues would be endogenous.

The use of household models for consideration of WTP has a long history (Dickie and Gerking). The model presented by Weaver (1992) has origins in both the health and pollution literatures (e.g., Harrington and Portney; Courant and Porter; and Harford). The model incorporates three features of the choice problem faced by the consumer: 1) exposure to an exogenously originating externality (or UFBE); 2) opportunity for defensive action to mitigate the impacts of the exposure, e.g., washing, peeling, etc.; and 3) opportunity for avoidance of exposure through substitution of other products. While uncertainty is not explicitly considered, the model is congruent with risk neutrality. The models illustrate the effect of availability of CPRF produce and conceptualize the consumer as a hedonist facing choices among consumption flows, defensive actions, and labor allocation. Consumption flows are interpreted as arising from both commodity and service consumption activities whereas the correspondence between flows from commodity or services are not restricted to one-to-one. One such flow is illness. Weaver (1992) specifies all illnesses to be perfect substitutes and allows for an impact on

choices by introducing time spent ill into a household time constraint. Illness is assumed to be manageable, to a degree, through labor allocation affecting leisure time and through defensive action. Illness is also affected by exogenous health debilitating exposures. Exposures are assumed independent of defensive actions.

From the general model presented by Weaver, a series of conclusions can be drawn about the demand for food products that may contain UFBEs. First, a safe conclusion is that very few qualitative predictions are available from this type of microeconomic theory. Secondly, the paper clarifies that where exposure can be averted, willingness to pay for a change in exposure will be decomposable into terms measuring the pecuniary, direct utility, and indirect utility costs of illness, as well as the marginal cost of aversion or mitigation of an exposure. This result clarifies that contingent valuation studies may be misleading if they fail to evaluate mitigation or aversion. Similarly, cost-of-illness estimates would fail to provide sufficient information for estimation of willingness to pay.

An Overview of Empirical Evidence

Past survey results contribute a consistent set of evidence with respect to: 1) the level of consumer concern about chemical pesticide residues, and 2) changes in consumer behavior resulting from those concerns as well as from news announcements of possible significant risks (e.g., the Alar scare). This literature also provides some evidence concerning consumer WTP for CPFR produce. In addition, these studies identify important demographic characteristics of consumers and elaborate their impact on attitudes and behavior.

Level of Concern

The Packer magazine provides a series of results that indicate a stable and significant level of consumer concern. Typically, more than 75 percent of respondents indicate high levels of concern about the possible presence of harmful chemical residues in fresh produce. This level of concern is corroborated by the work of Ott and Maligaya; Ott; the Food Marketing Institute; Zellner and Degner (1989); Sachs, et al.; and Weaver, et al. Each of these studies found more than half of their sample reporting high levels of concern. In these results, evidence of concern can be interpreted as indicating a combination of belief that exposure to residuals occurred from consumption and that such exposure is somehow harmful.

Changes in Behavior

The Packer survey results indicate a substantial portion (roughly 1 in 5) of concerned consumers have changed consumption decisions with respect to fresh produce. Evidence from *The Packer* 1990 sur-

vey registered substantial increases in concern and action in response to it following the Alar and Chilean grape announcements. *The Packer* 1989 survey indicated that about a quarter of the concerned respondents had altered their purchasing behavior. About half of the respondents changed behavior by buying CPFR produce, while 16 percent bought more canned and frozen produce and 13 percent reduced fresh produce purchases.

Evidence of Willingness to Pay to Avert Exposure

Less evidence concerning willingness to pay (WTP) for CPRF produce is available from past studies. Ott found that about two-thirds of his respondents stated an increase in WTP of more than 5 percent for CPRF produce while one-third were unwilling to pay that much. A 1989 Gallup Poll found that about half the respondents were willing to pay more for CPRF produce. More than 40 percent indicated a WTP more than 10 percent additional, while 16 percent indicated a WTP up to 20 percent more for CPRF produce. Ott and Maligaya found that WTP declined rapidly when cosmetic defects and insect damage associated with CPRF produce were considered. These results suggest that consumers are WTP for CPRF produce and that this WTP is sensitive to product characteristics.

In *The Packer* 1989 and 1990 surveys, respondents were specifically asked whether they sought and/or purchased organic or chemical-free produce, and how much they were willing to pay for this alternative produce. In order to assess willingness to pay, the 1990 Packer survey asked respondents whether cost was a factor in their decision to buy organic produce. More than half (57 percent) either strongly agreed, agreed, or somewhat agreed, while 34 percent disagreed, and 9 percent were unsure.

Ott and Maligaya; and Ott report results from a survey of more than 300 supermarket shoppers as they entered supermarkets in four suburban Atlanta locations. Each respondent was given a two-page questionnaire to complete. Results indicated a high level of concern (50.5 percent of respondents said they were very concerned or concerned, however, 52 percent indicated no change in shopping behavior). Regarding willingness to pay, about two thirds (65.5 percent) said they would be willing to pay over 5 percent more for pesticide-free produce, while about one-third (34.4 percent) said they would be unwilling to pay over 5 percent more.

Gallup Poll results from a survey completed in the summer of 1989 indicated that 50 percent of respondents would be willing to pay more for organic produce than for conventional produce. However, only 41 percent of respondents said they would be willing to pay up to 10 percent more for organic, 16 percent said they would be willing to pay up to 20 percent more. Less than 10 percent said they would be willing to pay more than 20 percent additional for organics.

The Role of Consumer Demographics

Both *The Packer* surveys and Ott have considered the relationships among consumer characteristics and attitudes. Ott extended his consideration to include the effects on WTP in an effort to identify the market for CPRF produce. *The Packer* studies found age, income status and sex of the respondent correlated with both the extent of concern and change in purchasing behavior. In addition, Ott and Maligaya also found educational attainment to be an important determinant of consumer WTP for CPRF produce.

A variety of demographic characteristics associated with consumer concerns were identified in past surveys. *The Packer* 1990 study suggested that demographic characteristics influenced the responses given to various questions concerning residues on fresh produce. The study found that, over the previous year, a smaller percentage of older respondents indicated increased concern about chemical residues on produce. Forty-four percent of those 60 and older said they were more concerned than a year ago, as did 46 percent of those 50 to 59 years old. In the 18-to-49 age range, 50 percent said they were more concerned than a year ago.

The Packer study also found that low-income consumers were more likely in 1990 to alter their purchasing habits as a result of concern over chemical residues. More than one-third (35 percent) of households earning $10,000 or less reported they had altered their buying habits over the past year as a result of increased concern over residues. Less than a quarter (23 percent) of the households earning more than $30,000 reported similar action. Consistent with the above finding, more low-income groups said they would buy organic produce regardless of cost. Thirty-two percent of the households earning less than $10,000 said they would buy organic regardless of cost, while only 21 percent of those over $30,000 said they would do the same.

The appearance of a "certified-safe-by-residue-testing" tag on produce was ranked as being more important by women and low-income groups than by men and high-income groups. Fifty-five percent of female respondents said "certified safe" was extremely or very important, while only 39 percent of male respondents said it was important. Also, 63 percent of low-income respondents said it was extremely or very important, while only 48 percent of $30,000-plus households said it was important.

Ott and Maligaya identified several significant demographic factors that appear to affect consumer attitudes and behavior. Females were found to be more concerned about pesticide residues than were males. On the other hand, males were more likely to believe pesticides could be used safely and did not pose any danger to consumers. Also, college graduates were more concerned than non-college graduates about pesticide use in produce. In addition, shoppers

who did not report their income were more concerned than low-income shoppers, while those shoppers aged 50 and older were more concerned about pesticide use in produce than were their younger counterparts. Ott and Maligaya found no significant relationship between race and shoppers' concern about pesticide use. Ott used this variation in consumer attitudes and behavior to develop a profile of demographic characteristics of consumers that would constitute a target market for CPRF produce. Results suggest white, middle-class consumers older than 30 would be a target market for high-quality CPRF produce.

When Ott and Maligaya turned to an examination of buying habits as a result of this concern, however, they found that whites were more likely than non-whites to pay higher prices for pesticide-free produce. Females, non-college graduates and low-income households were found to be less willing to accept cosmetic defects in pesticide-free produce than were males, college graduates, and high-income shoppers respectively. Shoppers aged 18 to 29 were found to be more willing to accept insect damage on pesticide-free produce than those aged 50 and older.

Consistency of Past Evidence

The above studies indicate there has been increasing concern over the use of pesticides and chemical residues on produce and an increasing desire on the part of consumers to buy chemical-free and/or organic alternatives. Nonetheless, several inconsistencies in consumer responses can be found when respondents were questioned on the specifics of buying organics. In *The Packer* study, 57 percent said they would buy organic regardless of the cost. However, when these respondents were later asked to rank the importance of sixteen characteristics they might consider when buying fresh produce, "organically grown" was listed as one of the least important, along with origin labeling, brand name and prepackaging. In addition, the increased availability of organic produce in supermarkets does not seem to be a major factor in increasing the consumption of fresh produce. Only 10 percent of the respondents included "increased organic purchases" as a reason for increased produce consumption, which was last on a list of twelve possible reasons for increased consumption.

Ott and Maligaya also found that despite a high concern about chemical residues and a seemingly high willingness to purchase alternative fresh produce, this willingness declined rapidly when willingness to accept cosmetic defects and insect damage associated with residue-free produce was considered. Thirty-eight percent of the respondents said they would be willing to accept cosmetic defects, compared with 62 percent who said they would be unwilling to accept those defects. When insect damage was considered, the number willing to accept dropped even further. Twelve percent said

they would be willing to accept insect damage in order to have pesticide-free produce, while 88 percent said they would be unwilling to accept that. Considering the often lower cosmetic quality and higher insect damage of alternative produce, the above findings are important and warrant further study to determine willingness to pay for such produce.

Finally, the findings of the Gallup Poll of 1989 suggest that people desire residue-free produce if the price is right. Half of the respondents indicated that they would be willing to pay more for organic produce; however, when constrained by an increase in cost (20 percent more than conventional produce), less than 10 percent were still "willing."

Results from a Product Specific Study

Studies reviewed in the previous section had a general focus on fresh produce. In contrast, a recent study by Weaver, et al., provides evidence concerning product specific demand effects of produce quality characteristics. Within the realm of fresh produce, one of the most widely-consumed products is fresh tomatoes. Because of their high per capita consumption, tomatoes join oranges as a major contributor of vitamin A and C to the U.S. diet. However, high consumption rates as well as intensity of pesticide use on tomatoes led the National Research Council to identify tomatoes as the food crop that contributes the greatest to oncogenic risk from pesticide residues. More than 90 percent of this risk was found to originate from fungicides used in tomato production. Three aspects of consumer attitudes and concerns were of particular interest in the Weaver, et al., study: 1) the nature and extent of concerns, 2) extent to which these concerns have resulted in changes in consumer behavior, and 3) the extent of consumer willingness to accept or pay for CPRF produce and tomatoes. While some of these issues have been considered by past studies for fresh produce in general, no evidence has been presented for specific products such as tomatoes.

The Weaver, et al., study used personal interviews of shoppers in the produce section in each of three retail grocery locations in State College, Pennsylvania, during November, 1990. In total, 560 interviews were completed, distributed equally across locations. Shopper participation was solicited for a five- to ten-minute interview. Interviewers followed a fixed questionnaire. The sample did not represent a national random sample; however, demographics of the sample respondents present the basis for generalization to other similar populations. The sample was characterized by a high educational level (24 percent some college, 35 percent finished college, 28 percent some graduate education), a relatively low employment rate for the main wage earner (only 70 percent fully employed, 13 percent part-time, and 16 percent unemployed), a nearly flat income distribution (equal percentages across income classes), predominance

of whites (96 percent white), predominance of females (64 percent), and the following age distribution: 36 percent younger than 30 years of age; 48 percent 30 to 55; and 16 percent over 55.

Several characteristics of fresh tomato and produce consumption were established by the survey. First, fresh tomatoes ranked second to lettuce in frequency of purchase throughout the year. Twenty-four percent of the respondents purchased lettuce most frequently, thirteen percent indicated tomatoes as the most frequently purchased type of produce. Purchases of fresh tomatoes are seasonal, nearly half (49 percent) of the respondents purchased fresh tomatoes at least once per week in the summer/fall season, while just under a third (32 percent) purchased them at least once per week in the winter/spring season. Frequency of purchase was found to be higher in the summer/fall season presumably because of the accessibility of vine-ripened tomatoes.

Specific factors influencing consumer purchases of fresh tomatoes were identified to determine the relative importance of specific product and economic characteristics that would be expected to vary between CPRF tomatoes and those produced using standard commercial methods. Price ranked third in importance, being cited by more than 60 percent of respondents. Of equal interest to development of both production and marketing strategies are results that indicated the unequivocal relative unimportance of shape, size and use of cellophane packaging. These results, in combination with the cited importance of flavor and appearance, suggest that appearance characteristics of interest to the consumers in this sample do not include shape or size.

The finding of a high level of importance for flavor, accompanied with a low level of importance of brand, raises an important issue for further research. If flavor is important, do current marketing practices provide an adequate and efficient means for consumers to identify tomatoes with preferred flavor? Results of the survey may reflect that branding under current use identifies characteristics such as shape and size that are unimportant to consumers.

Concern about pesticide residues on fresh produce was found to be quite high with 71 percent of the respondents concerned, though this frequency of concern was lower than that found in previous studies. The Weaver, et al., study pursued identification of two bases of concerns on several levels not considered by past studies: 1) personal health risk of consumption, and 2) implications of the pesticide use that go beyond those that may personally affect the consumer. More than 80 percent of respondents agreed or strongly agreed that chemical residues on produce are personally harmful to the consumer. Similarly, respondents agreed or strongly agreed that use of pesticides harms farm workers (80 percent), wildlife (88 percent), groundwater (91 percent) and the environment (85 percent), as shown. These results suggest that concern goes beyond personal

consumption impacts and includes what might be thought of as *altruistic concern* for the external effects of pesticide use. Existence of this type of concern is important to distinguish from concerns with respect to personal effects. Altruistic concerns are ones for which consumers have no marketplace where the concern can be directly expressed through changes in consumption behavior.

Sachs, et al., also presented results indicating altruistic concern for the use of chemical pesticides on consumers, farm workers and wildlife. Their results were based on a telephone survey and indicated 79 percent of respondents were concerned about the danger pesticides posed to farm workers, 81 percent were concerned about the effects on wildlife, while 71 percent were concerned about danger posed to consumers of pesticide-treated produce. In comparison, the Weaver, et al., results indicate higher frequencies of concern for each of these categories as well as what must be viewed as an extreme frequency of concern for harmful effects of pesticides on groundwater (91 percent).

Perceptions of the benefits of pesticide use on fresh produce were also assessed by Weaver, et al. Results indicated that respondents generally believed pesticide use generated benefits through expansion of supply and increased storage life (77 percent and 55 percent, respectively, answered, yes). However, respondents did not believe, in general, that pesticide use reduced risk to consumers of fresh produce originating from natural toxins or poisons. Respondents were split on whether pesticide use reduced prices (50 percent yes, 37 percent no) or increased quality (47 percent yes, 44 percent no). These results suggest that consumer concerns for both harms and benefits must be assessed if behavior is to be accurately predicted. This study shows that strong concerns for harm are balanced to some degree with perceptions of the benefits of pesticide use on fresh produce.

With respect to changes in market behavior, the Weaver, et al., study found that the majority of respondents did not change their buying habits due to their concern for pesticide use in fresh produce production. For those who did change their behavior, three strategies dominated: 1) 41 percent bought more organic/CPRF; 2) 22 percent reduced purchases of fresh produce; and 3) 28 percent stopped purchase of produce highlighted by the media as dangerous due to the presence of residues. The Weaver, et al., study found a much greater frequency of change of behavior than found in *The Packer* surveys or the Ott and Maligaya survey. These latter studies found that only about 25 percent and less than 10 percent of their respective samples changed behavior.

With respect to willingness to purchase and pay for CPRF tomatoes, respondents to the Weaver, et al., survey indicated respondents believed CPRF tomatoes would have more cosmetic defects (57 percent said yes) and would be of equal size. A weak

consensus existed among respondents that CPRF tomatoes would not be different in shape uniformity. Consistent with respondent concern for appearance as a determinant of purchase decision, responses indicated a slight consensus (52 percent) that respondents would not purchase CPRF tomatoes that had cosmetic defects. Ott and Maligaya found a higher percentage (62 percent) of respondents would not accept cosmetic defects in fresh produce. Going further with respect to appearance, a strong willingness to purchase was found for CPRF tomatoes despite being smaller in size (87 percent yes) or non-uniform in shape (88 percent yes). These results suggest consumers may exclude size and uniformity of shape from the set of cosmetic appearance characteristics relevant to willingness to purchase, a result also found for fresh produce in general.

Willingness to pay for CPRF tomatoes represents a statistic that summarizes extent of willingness to purchase, level or extent of concern and the extent of willingness to take action through avoidance and changing purchase behavior. The Weaver, et al., survey found that responses concerning WTP were nearly evenly distributed with roughly a quarter of respondents indicating willingness to pay in each of four categories—no more, up to 5 percent more, up to 10 percent more, more than 15 percent more. Their results indicate that only 19 percent of the respondents were not willing-to-pay more while 25 percent were willing-to-pay up to 5 percent more, 30 percent were willing-to-pay up to 10 percent more, and almost 26 percent were willing-to-pay more than 15 percent more for chemical pesticide-free tomatoes.

Conclusions

Available evidence supports the conclusion that consumers are concerned about the presence of chemical residues on fresh produce and the implied health risks. The Weaver, et al., results also indicate that a large proportion of respondents perceive pesticide use on fresh produce has beneficial effects. Further, their results indicate concerns go beyond personal effects and extend to external effects of chemical pesticide use on fresh produce. Their findings suggest that not only are consumers of conventional fresh produce concerned about their own personal health, but that a substantial number hold altruistic concerns about the effects of pesticide use on farm workers, groundwater, wildlife and the environment. The implication is that consumer response may go beyond merely eliminating residues from produce purchased.

Interpreted as a measure of the existence of market-based incentives for new product innovation, substantial consumer willingness to pay for chemical-pesticide-residue-free tomatoes has been found. In the Weaver, et al., study, more than three out four respondents were willing-to-pay more and almost 26 percent were willing-to-pay more than 15 percent more for such tomatoes. Their results also suggest that: 1) appearance may be the most important factor influencing fresh produce purchase decisions, and 2) a majority of respondents perceived chemical-pesticide-residue-free tomatoes as being characterized by more cosmetic defects than typical commercial tomatoes. This suggests that willingness to pay for chemical-pesticide-residue-free tomatoes with acceptable appearance and freedom from cosmetic defects is greater than or equal to willingness to pay indicated by respondents.

Joint consideration of the Weaver, et al., results that size and shape of tomatoes are relatively unimportant while taste is rated as important among characteristics affecting purchase decisions, suggests several policy implications. First, based on the results of their survey, R&D focused on reduction of cosmetic defects of chemical-pesticide-residue-free tomatoes would be expected to yield higher value pay-offs than R&D focused on size and shape of the fruit. Secondly, taste was a clearly identified characteristic important to purchase decisions. An important research issue raised by this finding is whether current marketing practices provide an operational means for the consumer to identify tomatoes most likely to satisfy their taste preferences. Clearly, labeling and promotion of taste may hold greater promise as a means of increasing market value of tomatoes than might be suggested by the current survey's finding that label is unimportant to consumer purchase decisions.

The Weaver, et al., results provide evidence from several perspectives concerning the demand for chemical-pesticide-residue-free tomatoes. First, their results indicate cosmetic appearance and price can be expected to be critical factors determining the level of demand. Results for indicated willingness to pay suggest that a price premium for such tomatoes may exist, (more than 25 percent of the respondents indicated a willingness to pay more than 15 percent more for such tomatoes than the price of typical commercial tomatoes). The result is subject to the caveat that intended or indicated levels of willingness to pay were measured, not actual willingness to pay. Based on past research of the predictive accuracy of consumer purchase intentions, greater confidence could be placed in results based on a study of actual willingness to pay.

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THE ROLE OF USDA GRADE STANDARDS IN QUALITY DETERMINATION

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As concern over health risks of pesticide residues and environmental damage from pesticide use increases, consumers and various advocacy groups are attempting to draw a link between the appearance of fresh fruits and vegetables and use of pesticides. Concern over this relationship is nearly two decades old and has been the focus of intense debate in the past three years. The target of the debate is U.S. Department of Agriculture (USDA) grade standards which, some allege, cause "excessive" pesticide use, that is, pesticide use beyond that which is socially desirable.

Specifically, the grade standards under fire have been deemed "cosmetic standards," meaning they are solely appearance standards and not indicators of taste or nutrition. However, the term "cosmetic" is not used in USDA grade standards and some confusion exists over exactly which standards are the "cosmetic" ones. Even when certain standards are singled out and pronounced "cosmetic," defenders of these standards attempt to show that they are proxies for taste or other "non-cosmetic" attributes or that produce grown through good management practices to control quantity will automatically meet the quality standards set.

In actuality, survey results indicate that many consumers do prefer appearance quality to reduced pesticide use (van Ravenswaay and Hoehn 1991a, b; Weaver, et al., 1991). If this is true, and assuming that pesticide-use regulations are set properly and adhered to by growers, pesticides are not "overused." Many studies have been conducted to show that USDA grade standards do increase pesticide use (see Conklin and Mischen 1993 for a complete review of these studies). These studies have focused on individual crops and consumers' attitudes regarding pesticide use. While consumers are concerned about the health and environmental risks of pesticide use, and some consumers will indeed pay to have produce grown without pesticides, the studies on "cosmetic" standards are less convincing. These studies focus on specific produce items and tend to use biased questions such as, "How important are 'cosmetic' standards in producing your crop?" (Rosenfeld 1991; Sorensen 1991). They have