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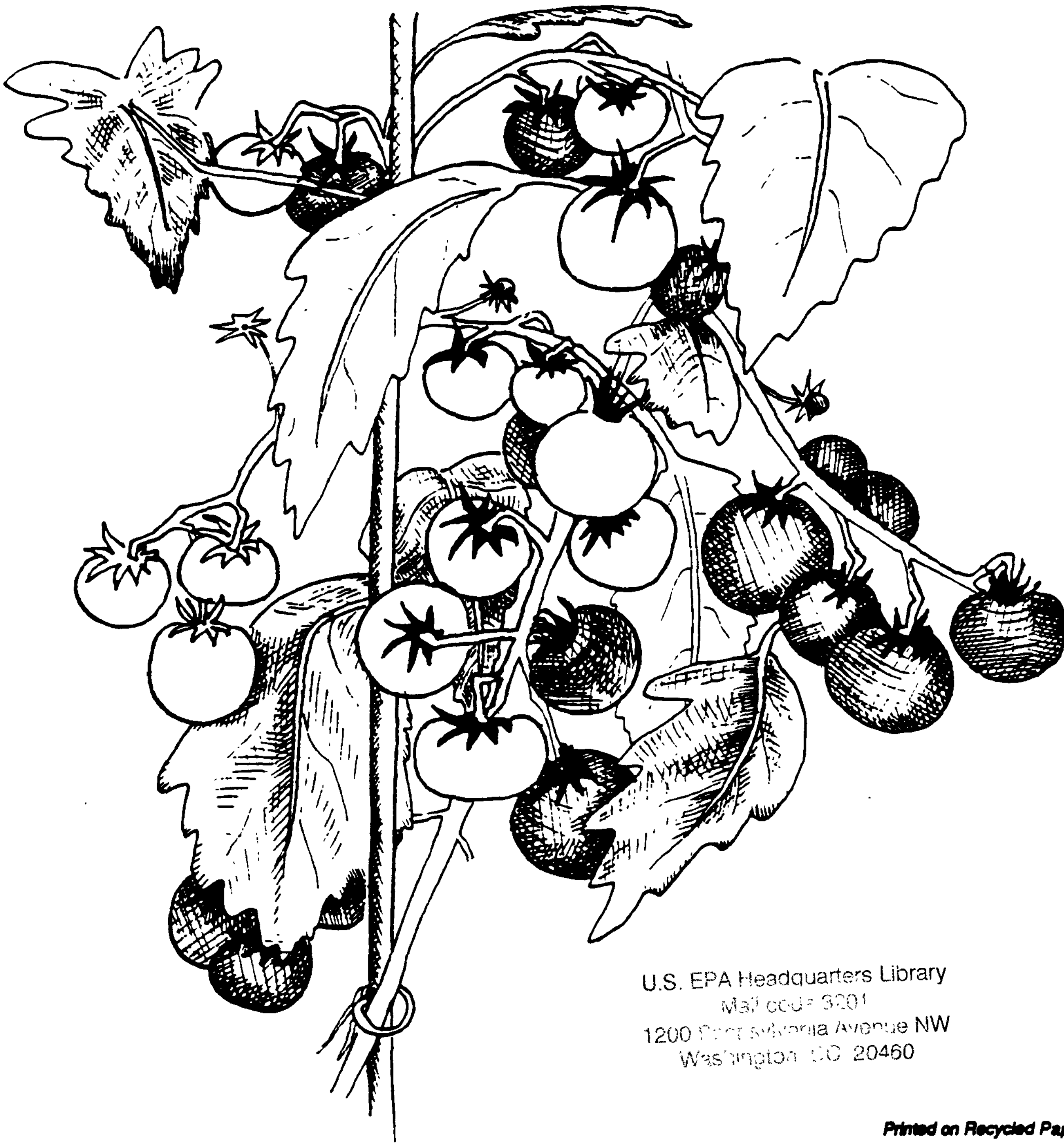
An Overview of Fruit and Vegetable Standards Relating to Cosmetic Appearance and Pesticide Use



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An Overview of Fruit and Vegetable Standards Relating to Cosmetic Appearance and Pesticide Use

prepared

by

Office of Policy, Planning, & Evaluation

United States Environmental Protection Agency

Acknowledgments

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Contents

Executive Summary

Industry, state governments, and the federal government establish standards that denote attributes of fruit and vegetable quality relating to the cosmetic appearance of fruit and vegetables; as stated in the 1990 Farm Bill, cosmetic appearance refers to external attributes that do not significantly affect yield, taste, or nutritional value. To the extent that adoption of more environmentally benign agricultural practices involving reduced rates of pesticide application may be hindered by existing standards, modification of these standards to allow an increased level of cosmetic damage, while still being acceptable to consumers, have the potential to allay concerns over the risks of pesticides.

The report describes the economic and regulatory incentives to use pesticides to enhance the cosmetic appearance of fruits and vegetables. It summarizes the findings of avialable literature on the subject. Results are presented of interviews with key individuals involved in the production of fruits and vegetables and in the implementation of federal programs concerning produce quality. Finally, it discusses where consumer education concerning trade-offs between pesticide use and cosmetic appearance could, through different buying patterns, change the way fruit and vegetables are produced. Further research is needed in all these areas to identify and quantify specific areas of improvement.

Chapter I: Economic Factors Affecting Grower Behavior

Market forces compel producers to minimize the risk of cosmetic damage (i.e. damage in terms of cosmetic appearance). Consumers' perception of fruit and vegetable quality is based, in part, on cosmetic quality (i.e. quality in terms of cosmetic appearance). In the retail fruit and vegetable markets, fruits and vegetables exhibiting the highest levels of cosmetic quality sell at premium prices. Retailers are interested in selling fruit and vegetables of high cosmetic quality since the products sell well at a relatively high margin of profit. In cases where fruits and vegetables destined for the fresh produce market exhibit lower levels of cosmetic quality, the selling price for growers can drop dramatically since most retailers only buy fruits and vegetables of the highest cosmetic quality. Producers aim to achieve standards set by buyers who demand high levels of cosmetic quality as well as the highest grade as set by industry, state, or federal government.

To maximize their own profit, producers attempt to grow, in a cost-effective manner, as many units as possible ensuring that a high percentage attains the highest grade and cosmetic quality; they minimize economic risk by growing over as long a season as possible. Techniques used to achieve these goals include the following: expanding the growing season, extending the shelf-life and/or shipping distance potential of produce, improving shipping qualities, improving produce appearance, reducing per unit costs of production, and protecting and enhancing yield. Innovations in these techniques that involve the use of chemical pesticides have reduced per unit costs, reduced transit losses, and yielded cosmetically appealing produce. On the other hand, pesticide use has led to considerable uncertainty regarding human health and environmental risks.

In recent years, producers have, to varying degrees, begun to adopt Integrated Pest Management (IPM), a system of agricultural practices which reduces reliance on chemical pesticides. Reduced pesticide use in turn leads to lower levels of pesticide residues in fruits and vegetables. Nevertheless, many growers have not adopted IPM, while those that have fully adopted IPM or organic methods confront difficulty in always meeting demanded levels of cosmetic quality.

Chapter II: Government Programs Affecting Produce Quality and Their Implications for Pesticide Use

Government interventions in the fruit and vegetable market are intended to protect the interests of growers, intermediaries and consumers. This chapter provides an overview of some of the major government programs affecting the fruit and vegetable supply.

USDA food grading standards are voluntary standards that enhance communication within the marketplace by providing a standard language of trade. Although the standards are voluntary, they are often made legally binding through marketing orders (MOs) or marketing agreements (for fruits and vegetables destined for import or export). Since grading standards do not provide intermediate handlers or consumers with information regarding potential pesticide residues, there is no standard language of trade between different levels of pesticide residues on conventionally grown fruits and vegetables.

Some states establish food grading standards in addition to, or in the absence of, USDA standards. In some states the cosmetic attributes included in the standards may be more stringent than those set by USDA.

The FDA sets Defect Action Levels (DALs) to protect consumers from producers selling adulterated food. Adulteration is generally defined as contamination by insect fragments, mold, excreta, or rodent hairs, even at microscopic levels. DALs can be legally binding and are generally based on unavoidable levels of adulteration. FDA acknowledges that unavoidable defects defined by DALs generally pose no hazard to human health. In the courts, avoidability is, for most DALs, determined by the lowest technologically feasible levels of adulteration. Given that conventional technology makes the prophylactic use (use in anticipation of pest infestation) of chemical pesticides, growers have an economic incentive to apply pesticides to insure they meet DALs. Further research is needed to determine how growers practicing IPM are hindered by DALs.

EPA registers pesticide products for use in the United States under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). A large number of pesticides currently registered are being reregistered under more stringent standards.

Marketing orders (MOs) are collective marketing agreements, which are legally binding on members of the industry. The goal of a MO is to control market quantity or quality (varying by commodity) to stabilize grower prices. Some MOs incorporate cosmetic attributes.

Chapter III: Market-based Factors Affecting Cosmetic Appearance

The bulk of fresh fruit and vegetables sold in supermarket chains are produced under long term contracts with growers in a few states. Because growers may not know where their produce is ultimately destined, all produce must meet high standards for transportability and storability. Hence, the relationship between cosmetic quality and quality necessary for storability and transportability becomes blurred.

Contractual agreements between buyers and sellers have the most direct influence on grower behavior in terms of pesticide use and cosmetic appearance. Generally, the greater the supply relative to demand, the more power the buyer has over the seller in setting price and quality requirements; in the U.S., supply is seldom scarce giving buyers the edge. Quality stipulations incorporated into contracts, serve as a way for buyers to obtain a consistent supply at a given price and quality by reducing or increasing quality standards to control supply.

As fruits and vegetables pass from the grower to intermediate handlers to the retailer and eventually to the consumer, quality suffers due to long shipping distances, handling, and time lag. To meet retail market quality standards, all intermediate handlers require a safety margin between the actual quality they buy and the promised quality of the product they deliver.

Buyers use contracts as a way to reduce economic risk where consumers reject produce because of the presence of insects or insect damage. Contracts specify levels of insects and damage thus influencing growing practices.

Research is needed to determine the extent to which financial lending practices or crop insurance inhibit the adoption of IPM techniques.

Chapter IV: Case Studies

Fresh Market Tomatoes

In the fresh tomato market, contractual obligations enforce standards of cosmetic quality that can drive pesticide use. are the overriding source of cosmetic quality standards. USDA grading standards are of secondary importance to these contractual obligations.

The U.S. No. 1 Grade for fresh market tomatoes allows for up to ten percent of a shipment to contain defects at the shipping point and fifteen percent to contain defects *en route* or at destination. Generally, packing houses aim for as low as five percent when making implicit or explicit contracts with growers.

To control defects, growers employ a number of techniques such as planting disease resistant, tough skinned tomato strains, and using pesticides to decrease cosmetic damage. In addition to other post-harvest innovations, the increased use of pesticides and fungicides have extended shipping distances and shelf-life.

In the fresh tomato market, tomatoes rejected in the primary retail market must be sold at great loss in secondary markets. The processing market requires a specially produced product, different from that produced for the retail market. As insurance against rejection in the primary market, growers face the incentive to adopt prophylactic strategies to control pests.

Processing Tomatoes

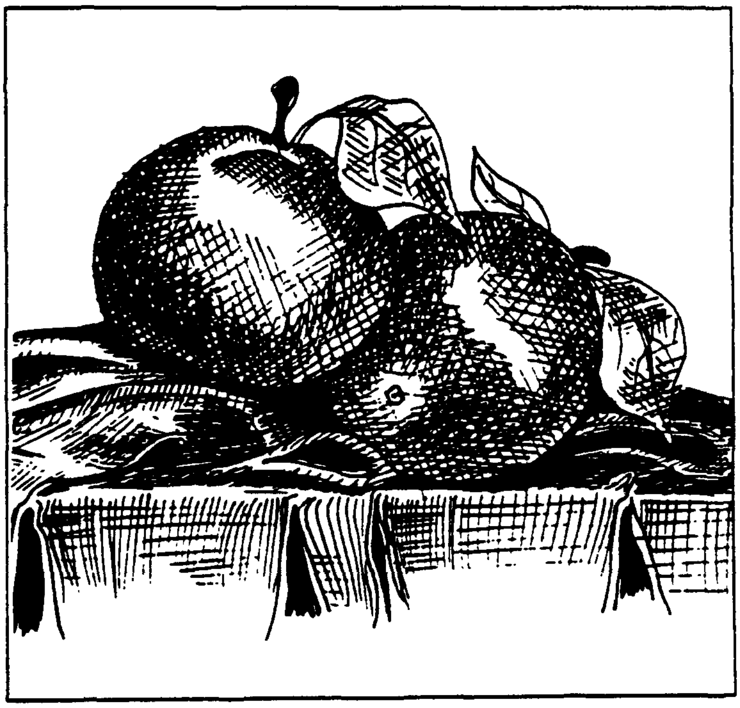
In the processing market, tomatoes with few exceptions, such as for canned whole tomatoes, are ground up, with the skins removed. Rarely do the fruits remain whole. Unlike the fresh market, certain cosmetic attributes do not affect the appearance of the final product. Nevertheless, there are still stringent cosmetic standards for processing tomatoes with industry standards dominating. The stringency of the standards, rather than improving quality can serve to reduce aggregate supply and provide a way for processors to reject shipments that exceed their desired production quantities. Similar to the fresh market, the cosmetic standards that growers must meet can require an array of chemically-intensive agricultural practices.

Apples

Similar to tomatoes, the operational standards for apples are set by the wholesale and retail market rather than the state or federal government. Unlike tomatoes, however growers producing for the fresh market have the option to sell to the processing market, though at lower profit than in the fresh market. In the red apple market, the marketplace is extremely strict with respect to color; retailers believe that consumer preferences lean toward big, bright apples. To maximize color and other cosmetic attributes, growers face incentives to apply pesticides prophylactically. Socioeconomic research shows consumers are willing to trade off only minor cosmetic damage for less pesticide use on apples.

Chapter V: Conclusions

Government standards establish the language of trade within the marketplace regarding quality. Industry standards, in most cases, contain higher quality levels than government standards and may be the driving force behind most pesticide use for cosmetic purposes. Standards on cosmetic attributes are sometimes used to restrict supply of fresh and processed fruits and vegetables. Though it is clear that some pesticides are used for the purpose of improving or assuring cosmetic appearance, how much is used is unclear. The dominance of fresh fruits and vegetables produced in a few states far from major population areas and hence the need for long distance transportation and storage blure the distinction between purely cosmetic attributes and quality requirements that assume transport and storage. However, to the extent to which local producers must meet national and regional standards, such standards are cosmetic and can affect pesticide use. Nevertheless, in many areas of the country, growers are currently producing high quality, cosmetically appealing produce with few or no pesticides. Much of this produce however, does not enter conventional distribution channels such as major national supermarket chains.



Introduction

Surveys suggest that consumers are concerned about the health effects from ingestion of pesticide residues in foods.[1] According to the 1990 Farm Bill, "cosmetic appearance" is

> the exterior appearance of an agricultural commodity, including changes to that appearance resulting from superficial damage or other alteration that do not significantly affect yield, taste, or nutritional value.[2]

There is evidence suggesting that some amount of pesticide use derives from farmers' attempts to protect or enhance the "cosmetic appearance" of their produce.[3] Though the exact relationship between pesticide use on fruits and vegetables and the occurrence of residues is unclear, reducing pesticide use (provided that by so doing, more toxic pesticides that are used at lower application rates are not substituted) is likely to lead to less pesticide residues in foods. It also lowers the likelihood of ecological damage associated with pesticide use.[4] An additional benefit would be the savings to producers from lowering their input costs. Thus, a win-win situation can be achieved for producers and consumers if producers can reduce their use of pesticides without adversely affecting the marketability of the produce as a consequence of impaired cosmetic appearance.

Industry, state governments, and the federal government establish standards that denote attributes of fruit and vegetable quality relating to the cosmetic appearance of fresh and processed fruits and vegetables, or to foreign matter in or on processed fruits and vegetables or fruits and vegetables destined for processing. The United States Department of Agriculture (USDA) sets voluntary standards for various attributes of fresh and processed fruits and vegetables, grains, meat, poultry, dairy products, cotton, and tobacco and assigns grades accordingly (see Appendix B).[5] Though voluntary, they serve the important role of vocabulary to the producer, wholesale and retail markets and thus facilitate trade by enhancing communication and minimizing confusion. Where USDA or state governments issue marketing orders (MOs) (legally binding rules for all producers in the production regions covered by the orders) for certain commodities which include minimum USDA or state grade requirements, the standards relating to cosmetic appearance incorporated in these grades become mandatory.[6] The Food and Drug Administration (FDA) sets compulsory standards for the maximum amounts of foreign materials, such as insect parts, that may be detected in or on certain items of produce and in processed fruit and vegetable products, as well as in grains and grain products and other miscellaneous foods.[7] The tolerances (ie: maximum levels) for pesticide residues in raw agricultural commodities are set by the Environmental Protection Agency (EPA) in its pesticide registration process.[8] To the extent that adoption of more environmentally benign agricultural practices involving reduced rates of pesticide application may be hindered by existing standards, their modification may allay consumer concerns with residues in foods. An added benefit is a reduction in the total chemical loading to the environment with concomitant gains in environmental quality.

Though not now considered in governments' conceptualization of quality, the possible presence of pesticide residues in foods are beginning to be considered by consumers as a determinant of quality, along with the more traditional attributes such as sweetness and maturity.[9] At the present time, information on the existence of pesticides in foods can be conveyed to assist consumers in their purchasing decisions only in states or communities where organic or "pesticide free" certification programs are in place.

This report provides an overview of what is known about the economic and regulatory incentives to use pesticides to enhance the cosmetic appearance of fruits and vegetables. In particular, it describes the institutional process and context in which quality standards for fruits and vegetables are set. In discussing how they are used in the market, this report assesses the potential for cosmetic criteria to lead to pesticide use. Areas are identified where intervention in the system could reduce the economic incentives to use chemical pesticides beyond what is necessary for nutritiousness and marketability. This report should be seen as complementary to further research on consumer attitudes towards pesticide use and cosmetic appearance of fruits and vegetables.[10]

Chapter I is a discussion of the economic motivations of farmers and growers. Chapter II outlines the major regulatory interventions governing fruit and vegetable quality. Chapter III depicts the relationship between major institutional factors and grower behavior as regards food quality, including stipulations written into farm loans and contractual agreements between buyers and sellers. To demonstrate the interplay between these several forces, Chapter IV presents case studies for apples and tomatoes grown for the fresh and processed market. Chapter V presents the major conclusions of this report. Appendix A contains procedures by which food grading standards, federal marketing orders, and defect action levels may be modified; Appendix B contains a recent listing of these standards.

Chapter I
Economic Factors Effecting Grower Behavior

Economic Motivations of Growers

In 1987, 3.5 million acres of vegetables and 4.6 million acres of orchards and vineyards were commercially harvested in the United States.[1] Out of a total of 282.2 million acres of harvested cropland across the country, fruits and vegetables accounted for only a small percentage of total land. But production on this land is generally intensive, especially in California and Florida where the longer growing season permits multiple harvests.[2] While a large percentage of total production occurs in these two states, significant areas of fruit or vegetable production can be found in many other states (for example, potatoes in Idaho and Maine, apples in Washington, Pennsylvania and the New England states, and grapes in New York).

It is commonplace to say that most farmers operate with a narrow profit margin. A farmer's fixed costs might include land rental or mortgage, equipment rental, construction loans, and property taxes. Operating costs encompass labor, seeds, agrichemical inputs such as fertilizers and pesticides, fuel, and equipment maintenance and repair costs. Labor costs to growers of fruits and vegetables are relatively high, since hand-picking is often required. Typically, fruits and vegetables require greater amounts of nutrient and are more susceptible to ruin from pest infestation than field crops (such as corn and soybeans), making their production more costly due to pesticide and fertilizer expenses. As high value crops, the economic value of an acre of fruits and vegetables far exceeds the value of an acre of cash grains. The loss of the production from a small number of acres through pest infestation can translate into significant revenue losses.

With high overhead, the grower strives to maximize yield in an economically efficient manner by selling as much as possible, at the highest selling price possible. Under the current market structure, enhanced cosmetic appearance can significantly increase the selling prices for growers, with chemical use minimizing the risk of cosmetic damage. The market forces which compel growers to meet high levels of cosmetic quality are discussed in depth throughout this report.

Consumer Preferences and Economic Motivations of Buyers

External characteristics perceived by the senses such as sight, touch, and smell are important in consumers' purchasing decisions, while internal characteristics perceived by taste (such as sweetness, juiciness, texture, and flavor) are important in determining acceptability and repurchase. Less-tangible characteristics such as nutritional value, health risk, and environmental risk also factor into consumer demand based on their perceived importance and the availability of information for decision making.[3] Cosmetic quality encompasses only a portion of the characteristics which form consumer perceptions of quality, but "because what constitutes fruit [and vegetable] quality is a subjective decision, produce purchased in the retail marketplace reflects the preferences of not only the consumer, but the grower, shipper, and distributor as well."[4] Hence, the consumers' perception of quality must be weighed against the sellers' profit motive, which may promote the sale of only what they perceive to be most profitable products.

According to many farmers and commodity groups, the American consumer is perceived to want produce that is highly aesthetically pleasing.[5] Food retailers evidently share this perception. Ray Harris, general manager of Harrison Farms, Aroostook County, Maine recently commented on the amount of potatoes wasted each year because restaurants and supermarkets refuse to buy misshapen potatoes. Chairman Tony Hall of the House Select Committee on Hunger indicated that 60 million tons of "so called imperfect food" is thrown away each year.[6]

This is not suggesting that consumers do not desire aesthetically pleasing fruits and vegetables. However, based on what is available to the consumer, "imperfect" is a relative term. For example, when the retail consumer in the produce section of the supermarket is deciding among fruits and vegetables that are generally uniform in size, shape, and color, a slightly smaller irregularly shaped and colored fruit or vegetable could be deemed undesirable, depending on the commodity.

In writing contracts with growers or shippers for supply of fresh produce, the profit-maximizing retail operator is interested in two things: salability and profit margin per unit. It is the multiplicative product of these which must be maximized, which is to say that a product which sells well, but only at a slim profit, or a product on which a high profit margin can be obtained but which sells in very limited quantities, are both inferior in profitability to a product which sells well at a relatively high margin of profit.

Produce exhibiting the highest levels of cosmetic quality typically sells for premium prices as it passes along the distribution chain since it is perceived that such produce will sell easily to the consumer at premium prices.[7] Even slight blemishes may render fruits and vegetables incapable of being sold to the fresh market -- in part because the blemish may render the items unsuitable for transport or storage, given the existing production and distribution system and the need to transport produce long distances.[8] Oversupply may create an incentive to sell only the most profitable commodities [For an illustration of how the distribution system has expanded the market, see Figure I-1]. Such commodities may find a market in processing, but for growers targeting the fresh market, this frequently means selling at lower levels of profit or even a loss.[9]

The message to the grower then is clear. Fruits and vegetables will sell more readily, and will obtain a higher price, if they are of better cosmetic quality. This is especially true of the fresh market, but applies as well to fruits and vegetables grown for processing.

Grower Objectives and the Use of Agricultural Chemicals

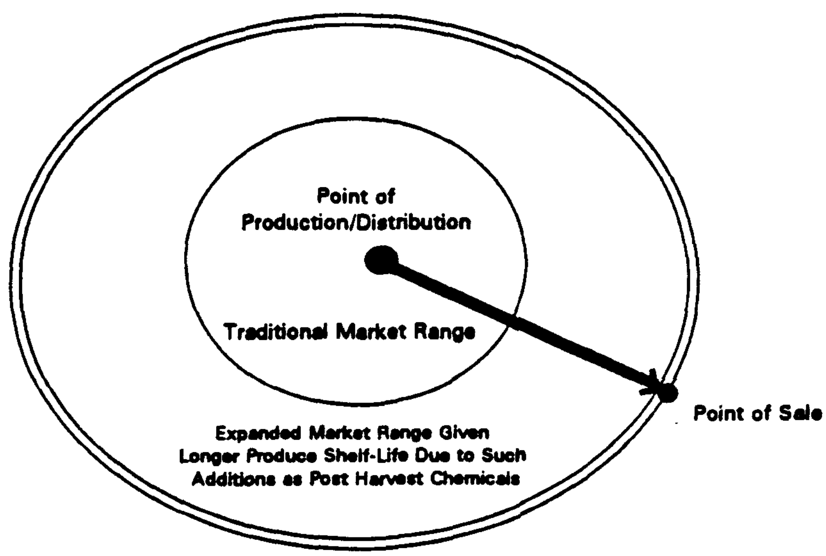
As the previous discussion suggests, the grower aims to achieve two primary objectives--one that is quality-related, the other quantity-related:

- In a cost-effective manner, sell as many units as possible, over as long a season as possible. By spreading out the growing season, a grower can minimize risks from loss due to weather and other factors, and can take advantage of periods of lower supply to receive premium prices.
- In a cost-effective manner, ensure that a high percentage of crop attains the highest grade and highest level of cosmetic appeal.[10]

Over the past several decades, a wide range of agronomical and technological innovations have emerged which facilitate, in one way or another, the attainment of these two primary objectives. The following are six examples of such innovations.

Figure I-1

Market Expansion Through Product Shelf-Life Extension



Various post-harvest innovations such as refrigeration, waxing, and post-harvest fungicide applications have allowed the traditional market range (in terms of both shipping distance and shelf-life) to expand dramatically.

1. Expanding the growing season.. This is accomplished using greenhouse starting, early and late growing varieties, growth regulators and artificial ripening (to ripen fruit, in color but not necessarily in sugar content, early and late in the natural growing season).

2. Extending the shelf-life and/or shipping distance potential of produce. This is achieved by the following: controlling pest incidence prior to harvest (insecticides, fungicides, herbicides); removing pests after harvest (post-harvest insecticide and fungicide application, or various mechanical means); applying sprout inhibitors to preserve items of produce longer into the off-season; refrigeration; controlled atmospheric storage; and, waxing. (See Figures I-1 and I-2)

3. Improving shipping qualities. Shipping costs and shipping losses have been reduced through the development of plant varieties (cultivars) which yield hardier, more uniformly-shaped (ie: `squarer' for packing purposes) fruits and vegetables, field cooling, and by picking and shipping fruits and vegetables while unripe and then artificially ripening them at the outlet market.

4. Improving produce appearance. This has been achieved through the development of plant varieties (cultivars) which yield more attractive and more durable fruits and vegetables, prophylactic chemical spraying to preclude potential minor pest damage, use of growth regulators to provide control over external attributes relative to the picking and distribution schedule (ie: simultaneous ripening of all fruit on a tree), artificial ripening, waxing, and use of fertilizers to enhance fruit size.[11]

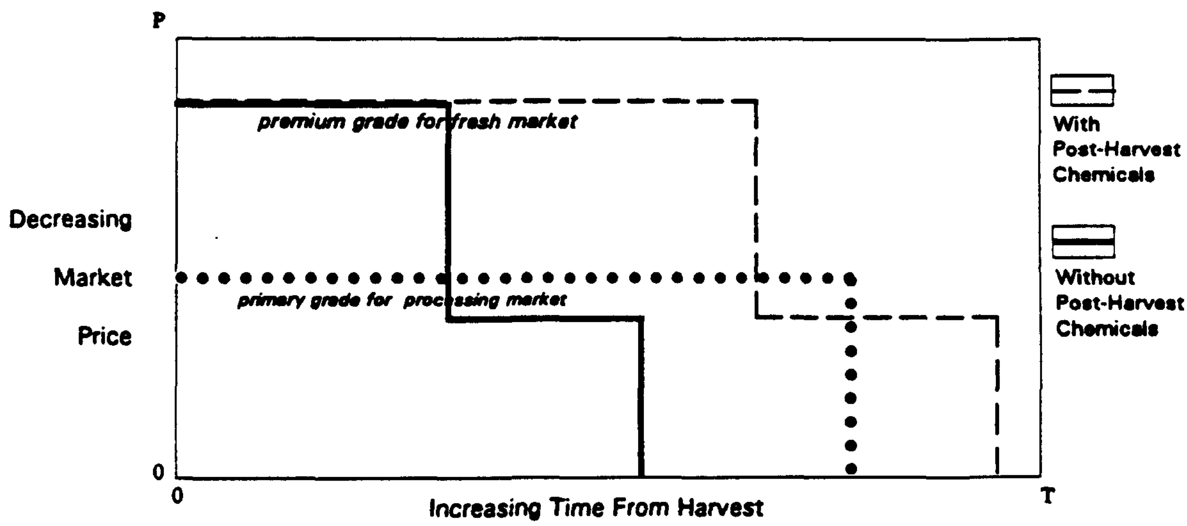
5. Reducing per unit costs of production. This usually means reducing labor inputs through the use of hardy plant varieties (cultivars), regularly-scheduled broad scale pesticide application, and mechanized picking and packaging.

6. Protecting and enhancing yield. Pesticides are designed to `protect yield' by ensuring the integrity of fruits and vegetables (to a degree based upon notions of what constitutes acceptable quality), and by minimizing competition from weeds. Enhancement of yield is generally accomplished by using high-yielding plant varieties (cultivars), and by irrigating and applying nutrient material--in the past several decades this has meant primarily quick-release (water soluble) inorganic fertilizers.

Such innovations have brought per unit production costs down, reduced transit losses, and yielded bountiful and beautiful produce. They have also, however, given rise to a system of food production for which there exists

Figure I-2

Theoretical Value of a Given Grade Over Time With and Without Post-Harvest Chemical Applications



Theoretically, as a given grade of a fruit or vegetable age, the market price eventually decreases. In the dashed line above, we illustrate how the use of post-harvest chemicals allows growers and distributors to effectively increase the economic value of their product. Also, the second pricing plateau with and without post-harvest chemicals illustrates sales of in-store 'seconds'.

considerable uncertainty regarding external costs (human health, ecosystems, and environmental resources). Though pesticide registration and cancellation, use restrictions, applicator certification and residue testing set certain bounds on pesticide use, the true magnitude of risks and actual damages cannot be stated with certainty, even under the most controlled scenarios.[12]

As a result of this uncertainty, the imparting of risk information to the consumer has not been systematized, and risk has only in exceptional cases entered into the consumption decision.[13] Some consumers buy organic or 'pesticide free' produce and pay a higher price to avoid the perceived pesticide risk. According to a study by James Hammitt prepared for the U.S. EPA, organic produce buyers as well as conventional produce buyers do not distinguish much among risk differences across different fruits and vegetables (which can vary widely) except in cases where the media has identified potential risks (as was the case with Alar for apples).[14] Without good information and labeling to make risk comparisons, concerned consumers are forced to use the choices available: organic certification programs, a handful of laboratory testing programs such as NutriClean, or non-certified labels and information given by some sellers.[15] According to many recent surveys, consumers are willing to make trade-offs between price and quality attributes such as environmental and health risk.[16] Like other products that are being marketed as healthy and environmentally friendly, different levels of health and environmental concern can further differentiate the quality of produce (in terms of environmental and health benefits).[17]

Efforts on the Part of Growers to Control Pesticide Costs

One professional estimate places returns to farmers for pesticide use between $3 and $5 for every $1 expended.[18] This suggests that pesticides are economically advantageous to growers, but it must be remembered that this return represents averted losses. Pesticides affect not only plant yield (production of fruit or vegetable biomass), but also protect economic yield (that is, harvest which is salable). Pesticide products represent significant expense to the farmer and it is in his or her economic interest to minimize pesticide use. Many farmers, in an effort to reduce pesticide costs, have recently begun to employ methods known collectively as Integrated Pest Management (IPM). While IPM systems are varied and encompass a wide range of biological and mechanical control strategies, many share the principle that in order to maximize economic return, some degree of pest damage is tolerable, and that pesticides should be employed only when a certain threshold of economic damage has been reached. Alternatively, IPM may mean that as a result of pest scouting, a small amount of pesticide is deemed necessary to eradicate pest eggs or larvae (hence potential economic damage) instead of the greater amount that would be required later if the eggs or larvae were to develop.[19] In either case, the objective of minimizing pesticide costs to the grower, while maintaining acceptable protection, governs use decisions (what exactly constitutes acceptable protection is a matter of degree, and reflects perceptions of what is marketable).

IPM may result in lower environmental and human health risks than conventional practices by reducing the amount and/or frequency of chemical spraying. On the whole, the emphasis that IPM places on the minimization of chemical costs to the grower offers significant potential for pollution prevention and hence environmental benefits.[20]

Many farmers, however, do not adopt IPM techniques, even where they are available. They may use pesticides 'prophylactically,' that is, they apply pesticides preventively, without prior observation of pests or pest larvae in the field. Some of these farmers are resistant to change, others may wish to adopt IPM but have reservations about whether it will work for a particular pest, whether they will be able to sell their produce, or whether it adequately compensates for the additional knowledge and management required. Still others have adopted IPM but feel constrained in their use of such strategies because of the need to *insure* that their products meet certain standards of quality. Organic growers too, who operate according to the principle that no synthetic chemical product is to be used on plants and thereby can generally receive premium prices for their produce, may be constrained in marketing by standards of quality that they cannot meet, or can meet, but only at greater costs of production.[21]

Chapter II
Government Programs Affecting Produce Quality and Their Implications for Pesticide Use

Efficient operation of the fruit and vegetable market demands adequate protection of the interests of growers, intermediaries and consumers alike. Government interventions into the fruit and vegetable supply (summarized in Table II-1 on the following page) are intended to ensure such protection. The following statements briefly describe the roles envisioned for some of these:

- *Voluntary food grading standards (federal or state)* convey important information to producers and middlemen about the nature of a product to be bought, thereby facilitating marketing transactions.
- *Compulsory federal Defect Action Levels (DALs)* screen out fresh (in the case of strawberries) and processed foods containing excessive amounts of contaminants, including filth of all types.
- *Compulsory federal and state pesticide registration requirements* effectively prohibit the use of chemicals that pose unacceptable risks to farm workers, the environment, and consumer health. At the same time, the economic value of a pesticide product is recognized and a well considered risk-benefit test supplies the basis for regulatory decision-making. Chemicals that demand special care are subject to restricted use provisions.
- *State monitoring of compliance with pesticide use guidelines* coupled with *federal and state monitoring and enforcement of maximum permissible residue levels in foods* ensure that consumers do not ingest levels of pesticides that could result in adverse health effects and that the environment is not adversely affected.
- *Federal and state marketing orders (MOs)* provide for the orderly marketing of agricultural products in order to protect the farm sector against debilitating fluctuations in supply and prices. Created voluntarily by industry, marketing orders become mandatory for all growers within the marketing region represented.

Considerable uncertainty exists about how well pesticide risks are controlled under this system of government interventions. In the four to five decades during which the regulatory program has evolved, pesticides have been registered under differing regimens for data quality. Under the Federal Insecticide, Fungicide, Rodenticide Act (FIFRA) of 1988, there are tight statutory deadlines for re-registration of more than 600 pesticide chemicals by 1997, but re-registration under strict and uniform standards is a time consuming and expensive process (for industry and government alike).

The effectiveness of compliance and monitoring efforts is difficult to gauge. States and local authorities generally do not have adequate resources to fully determine compliance with pesticide laws. Food and Drug Administration residue testing, for its part, seeks to spot shipments contaminated by any one of hundreds of active ingredients in billions of pounds of produce. Meanwhile, so called "inert" ingredients, many of which are not biologically inert, have not been adequately tested for their risks to health or the environment, or have been shown at some level to be hazardous to health and the environment, are generally not monitored at all.[1]

While regulation provides a crucial measure of control over gross negligence and misuse, the great demands it imposes on institutional resources and the constraints imposed by the unavailability of data suggest that identification of opportunities for voluntary risk reduction can significantly enhance the effectiveness of the total program. Such an opportunity may exist where pesticide use is influenced by cosmetic quality goals. The remainder of this chapter provides a more detailed look at some of the major government programs affecting the fruit and vegetable supply.

USDA Food Grading Standards

As of September 30, 1989, there were 157 U.S. grade standards covering 85 fresh fruits, vegetables and related commodities and 157 U.S. grade standards covering 74 processed fruits, vegetables, and related commodities.[2] The standards enable the marketplace to function smoothly by providing a standard language of trade. As with any product, the wary wholesale buyer wants to know what he or she is buying and the producer needs to know what minimum specifications a buyer seeks. United States Department of Agriculture (USDA) grading standards establish such specifications for a variety of food items, including fresh and processed fruits and vegetables, grains, meat, poultry, dairy products, cotton and tobacco. Hence, an East Coast apple broker buying apples from a Washington grower, for instance, can be assured of a given standard of quality (however defined). Established to aid transactions between buyers and sellers, the grading standards are *voluntary*. As long as produce is not represented as meeting a given USDA standard when it does not, it may be sold on the open market. Unlike the Food and Drug Administration's Defect Action Levels (discussed later in this chapter), USDA's grading standards cannot be invoked to ban produce from interstate commerce (unless a MO is in place). With the exception of the Federal Grain Inspection Service which administers grain standards, the administering agency within USDA for both

Table II-1
Summary of Regulatory Factors Affecting Grower Behavior

Program	Purpose	Effectiveness
Grading Standards [Federal/USDA] Voluntary	To provide a standardized trading language for fruits, vegetables, and nuts, relating to attributes such as size, shape, color, maturity, defects, shipping and edible qualities.	Ensure that buyer and seller are discussing the same quality attributes. A major tool in the marketplace.
State Grading Standards [State/State agricultural entities and produce marketing boards]	More stringent than federal standards in order to enable a state or region build name recognition for quality and improve market share.	Effectiveness varies from state to state.
Defect Action Levels [Federal/FDA] Mandatory	To prevent rotted or filthy (insect parts, rodent haris, excreta, and mold) food from contaminating the U.S. food supply.	Reflect technologically feasible removal rates. Effective in keeping filthy processed foods from market.
Federal Marketing Orders [Federal/USDA] Mandatory for growers within production region voting to enact an MO	To improve supply and price stability by controlling the supply and/or quality of a commodity reaching domestic markets; to develop new markets for commodities.	Relatively successful at expanding uses for commodities through quality control, research and promotion on production, distribution, consumption and volume control. Producer-run. See discussion for relation to pesticide use.
State Marketing Orders [State or regional/State agricultural entities] Mandatory for industries electing to be subject to them	To focus on building a brand name and market share, and expanding the demand for a commodity.	Effectiveness varies from state to state.
Pesticide Registration [Federal/EPA] Mandatory	To prevent the use of pesticides which pose unacceptable risks – human health or otherwise – such as through the ingestion of pesticide residues on food, under generally accepted agricultural practices.	Over 600 pesticides must be reregistered against current risk standards. The process has been legislated under the FIFRA of 1988 to be completed by 1997.
Pesticide Residue Testing [Federal/FDA] Mandatory	To prevent domestic or imported fruits and vegetables which contain pesticide residue levels above EPA tolerances from reaching consumers.	Reliability of tests has been questioned; see discussion.

grading standards and federal marketing orders is the Agricultural Marketing Service (AMS).

Attributes covered by the grading standards for fruits and vegetables (depending on the commodity) include: size, shape, color, uniformity of color, taste, sugar content, firmness, tenderness, smoothness, dryness (for tree nuts), maturity, freedom from decay, freedom from surface blemishes and various types of injury, and freedom from other defects considered to indicate unwholesomeness, likelihood of spoilage in the course of shipping, or relative unsaleability.[3] For some crops, USDA also sets tolerances for variations in size or other attributes among a given load.

Grade standards for fruits and vegetables facilitate transactions in the wholesale market but they generally do not enter directly into the purchasing decisions of consumers. The primary exception to this rule for fruits and vegetables is pre-packaged produce, (often the case with potatoes, for example) whose packaging may bear indication of the product's grade. The grading standards were not originally intended to provide information to the consumer. A mechanism does exist, though, by which the grading standards can be changed in order to respond to consumer preferences, as manifested primarily by purchasing behavior (For an outline of how a grading standard may be changed refer to Appendix A).

It is open to question how well and how readily the grading standards respond to consumer preferences and whether they more clearly reflect an accommodation of dominant production technologies, which are perceived or purported to provide what the consumer wants. In the case of attributes which are of concern to the consumer but which cannot be assessed by the senses--visual, tactile or olfactory--such as the occurrence of pesticide residues, or the nutritional value of a fresh food item, consumer preferences are not easily communicated to the food industry through purchasing behavior. As stated in Chapter I (see page I-4), consumer preferences regarding such attributes could benefit both consumers and producers through a demand for new products. Where willingness-to-pay studies have been conducted, consumer behavior has been demonstrated to change with additional exogenously supplied information (such as decreased pesticide use).[4] Evident consumer concern about pesticide residues in food and environmental risks from pesticides has led to the demand for organic produce and for a program to certify its production without the use of synthetic pesticides.[5]

The grading standards do not provide intermediate handlers or consumers with information regarding potential pesticide residues. All food actually reaching the market is assumed safe because of the existence of the various regulatory interventions: EPA pesticide registrations (e.g., use requirements contained on pesticide labels and pesticide residue tolerance levels), state enforcement of pesticide laws, and FDA spot checks to determine pesticide residues in produce. However, considerable uncertainties remain regarding human health risks.

Several other points concerning grading standards and their potential to affect pesticide use are outlined below:

- *Although the standards are voluntary, there may not be alternative markets for raw produce that does not make the highest grades.* Growers have little choice on whether to meet the "voluntary" standards. In order to sell their produce at a reasonable price, they virtually *must* meet them, or else sell in secondary markets such as road side stands, farmers' markets, or processing markets (if such alternatives are available) where prices are generally much lower.
- *Grading standards are often made legally binding*[6] *through marketing orders or marketing agreements and for produce destined for import or export.* In such cases, the grower does not have the option to sell produce of a greater degree of imperfection (that which obtains a lower grade), even where markets exist for such grades. While MO's usually establish "exempt outlets," to which produce failing to meet MO requirements can be shipped, prices commanded at outlet markets are likely to be significantly lower than primary markets.
- *Grading Standards may constrain the use of IPM techniques.* Conversations with IPM consultants suggest that more growers would adopt IPM techniques were it not for cosmetic criteria contained in the grading standards.[7]

State Grading Standards

Some states also establish food grading standards, in addition to, or in the absence of, USDA standards. For processing fruits and vegetables, states generally use USDA standards unless no USDA standard exists for a given product (which is the case with certain specialty fruits or vegetables grown in small quantities). For fresh produce, both USDA and state grading standards may exist.

State standards usually establish minimum maturity, as well as other criteria, some of which pertain to cosmetic attributes of the product.[8] Some states establish more stringent standards than those established by USDA--this may help a state to build a reputation and/or brand name based on higher than average quality. In such cases, quality is usually viewed primarily in terms of cosmetic appearance.

FDA Defect Action Levels

The Food, Drug, and Cosmetic Act prohibits the introduction, delivery, sale, or receipt in interstate commerce of any "adulterated" food. The Act defines as "adulterated" any food consisting "in whole or in part of any filthy, putrid, or decomposed substance, or if it is otherwise unfit for food."[9] The Food and Drug Administration (FDA) of the U.S. Department of Health and Human Services is responsible for upholding these provisions. The primary means by which the agency does so is through the setting and enforcement of Defect Action Levels (DALs).

The DALs provide a regulatory mechanism whose objective is to keep adulterated foods, both fresh and processed, from reaching the consumer.[10] DALs are maximum permitted levels of adulteration--exceedance of these levels can result in confiscation and destruction of the load in question. FDA may also initiate detentions, prosecutions, injunctions, and recalls. Food deemed adulterated has generally been contaminated by insect fragments, excreta, rodent hairs or mold. FDA's interpretation of "adulteration" extends, in some cases, to tiny amounts of insect fragments or rodent filth that are detectable only by using a microscope.

Regardless of the growing and processing methods used, food will virtually always contain *some* insect fragments and mold; hence, virtually all food is to some degree adulterated.[11] Therefore, FDA sets the DALs to permit small levels of adulteration in raw produce and processed food that are deemed "unavoidable" based on predominant agricultural practices (including the use of pesticides) and processing technologies (including various means of removal in cleaning processes). The DALs are based on estimates of "attainable" levels found by conducting a nationwide "market basket" survey of the product to be regulated. For new DALs, a sampling size of 1500 is generally used; for updating old samples, 500 are used.[12] While the samples do ensure adequate geographical representation, and may be taken in a number of years to obtain an average level of insect infestation, they *do not* differentiate between different growing methods (chemical-intensive, IPM, organic). Since organic and IPM growers who fully adopt IPM precepts comprise a small part of the market supply, DALs generally reflect levels that are attainable under more chemically-intensive systems.

Because DALs were not developed in consideration of possible pesticide use, they, at least in some cases, presuppose a use of pesticides that runs contrary to the practices and objectives of IPM growers -- applying pesticides only after a threshold of economic damage has been met. Less pesticide use is likely to allow greater amounts of minute insect parts to occur on raw produce, which will likely mean more insect parts pass through processing into the final product. Also, the use of beneficial insects to reduce the population of destructive insects, can result in higher levels of insect fragments on the harvested commodity. Hence, under certain circumstances, DALs pose an obstacle to the adoption of IPM techniques, though this is a supposition that needs to be researched. Significantly, many DALs have been made more stringent over time, paralleling technological advancements that have allowed industry to prevent or remove more and more adulterating materials, whether harmful or innocuous.[13]

FDA acknowledges (and the preface to the DALs states) that unavoidable defects that are the subject of the DALs pose *no hazard to human health*.[14] Research in this area corroborates FDA's position--ingestion of minute or relatively small amounts of insect debris has been found to pose no discernible health concerns.[15]

The basing of the DALs on predominant agricultural and manufacturing methods that provide greater protection from adulteration than what is necessary to protect human health establishes the DALs as technology standards. The level at which a given DAL has been set, in certain cases, provides a measure of "cosmetic" protection well beyond what many would consider excessive adulteration. The amount of insect parts which constitutes "adulteration" is a matter of degree, but should be investigated with a view to its implications for pesticide use. It might be noted that systemic pesticides cannot be washed off of a fruit or vegetable, while tiny insect parts, rodent hairs, and excreta can.

Unlike USDA grading standards, FDA's DALs can be legally binding. While technically the standards are "guidelines" and do not carry the force of law,[16] they are generally upheld in the courts. DALs have not been established for all processed foods. However, even for products without established DALs, growers and processors are still bound to produce unadulterated products according to the definition of "adulterated" set out by FDA (that is, adulteration which is avoidable using standard agricultural or processing technologies). This *de facto* standard has developed because, in the event of a lawsuit over contamination, the courts have usually taken the same approach as FDA, basing their decision on whether the contamination at issue, given the current state of technology, was "usual" or "unavoidable." Thus, a court may rule that a product is contaminated simply because it contains some level of avoidable defects, regardless of whether it poses health risks or is detectable without a microscope.[17]

A grower is generally unable to assess what level of insect infestation will be acceptable under the DALs. Because DALs are measured at the marketplace rather than in the field (providing further opportunity for pest infestation during storage and transport), and because commodities for which *no* DALs have been developed are still subject to similar standards enforced through court proceedings, the grower must seek simply to minimize all insect contamination.[18] Thus, there is an incentive for farmers to apply pesticides prophylactically, even if they do not believe it is necessary to control a pest population from causing significant yield loss; if the commodity does not meet the DALs, "economic yield" is zero.

More study, given regional differences in pest pressure, would be necessary to determine whether a grower could reasonably expect to satisfy the majority of the DALs despite reductions in the use of pesticides and changing growing practices.

EPA Pesticide Registration and Special Review

Pesticide products must be registered with the U.S. Environmental Protection Agency before they are permitted to be used in the United States. EPA registers pesticides under authority of the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). In the early 1970s, more stringent registration standards were developed. Pesticides which had been registered before 1972, however, were permitted to remain in use under the provisions of their earlier registrations, pending review under the more stringent standards. The majority of pesticides in use today fall into this category. When a pesticide registered under the former standards meets certain toxicological and environmental triggers, it goes into a process called Special Review. A part of this special review process considers the economic value of the pesticide in question (ie: its indispensability or substitutability).

The case of Alar suggests how 'indispensability' might be overestimated because farmers feel bound to achieve certain cosmetic criteria. Alar is a growth regulator (regulating fruit set, size, coloring, and ripening) used predominantly on apples. Alar was manufactured by Uniroyal until June of 1989 when the company decided to halt sales due to a heightened level of public concern over human health risks. Although EPA's Scientific Advisory Panel (SAP) recommended banning Alar in 1985, Alar was not banned, in part, because of its perceived economic 'indispensability'.[19] The 1989 apple harvest, the first without Alar, produced a near record crop and the 1990 harvest was predicted in November 1990 to be about average. Meanwhile, on an industry-wide basis, prices remain strong, despite the fact that some varieties are not as red as they were in the past and may not make the Extra Fancy grade. The president of a major trade group conceded that "the loss of Alar is not a major catastrophe for growers."[20] This is not to deny there were economic benefits of Alar (which varied depending on variety and location), but it does suggest the need to look carefully at chemicals that growers perceive to be indispensable to their long-term economic viability.

Federal and State Marketing Orders

Marketing orders (MOs) are industry self-regulation programs that grew out of adverse market structure conditions in the agricultural sector during the Depression. At that time, growers received low returns on their production because of the market power of a small number of packing houses and large processing operations able to dictate selling prices for many small farmers in various regions of the country.[21] To gain market power and boost growers' incomes, these small farmers banded together into a type of growers' union. Although growers are producers of a good, they were exempted from anti-trust law under the Capper-Volstead Act of 1922, and allowed to form marketing cooperatives.

These cooperatives often failed for lack of discipline. Some growers chose not to participate reducing the cooperatives' ability to bargain, while cooperative members often cheated when faced with unsold goods by selling on the open market.

In response to the difficulties growers were facing, the federal government legislatively authorized collective marketing arrangements, which, once approved by an industry (usually growers of a given fruit or vegetable), were legally binding on all members of the industry. MOs are the contracts which specify the legally binding conditions of association for each participating industry. The goal of a MO is to control market quantity or quality (it varies by commodity), with the ultimate goal of stabilizing or boosting grower prices. To some degree, MOs may also improve long-term demand for a commodity, which may also stabilize or boost commodity prices. Once a MO is accepted by an industry and by the Secretary of Agriculture, all industry handlers, whether they favored the order or not, are bound to abide by it.

MOs theoretically may increase incentives to use pesticides. By limiting supply to the primary markets through grade requirements, in certain cases, marketing orders increase competition among growers (especially in regard to factors incorporated into MOs for the premium market). With quality attributes related to cosmetic appearance, to a large extent, determining access to the premium and primary markets, there is greater incentive to use pesticides as insurance against damage that can down-grade fruits and vegetables. The methods by which MOs may affect supply or quality are described below. (For a listing of federal MOs and when they were established, see Appendix B)

Components of Marketing Orders

Federal MOs differ in their components and goals. For example, regional or state-specific MOs do not generally attempt to control supply. Instead, they aim to increase demand by ensuring consistent quality within a geographic area and to develop a brand name. Unless a region produces a large majority of the national supply, attempts to control supply through a regional MO would likely be defeated by producers outside the region. Rather than the desired increase in product price, the participants in the MO would simply see a loss of market share.

Marketing order components fall into several categories: supply management, quality controls, and demand management. These three categories are described below.[22]

Supply Management

In theory, supply management is supposed to increase returns to growers and reduce price volatility of the products. Actual effects on prices in practice are not entirely clear and depend on (1) whether the marketing order is national or regional, and (2) the role of imports

Ways Supply Can Be Managed Through Marketing Orders

1. *Producer allotments* fix the quantities that handlers for specific growers may sell in a specific market. The allotments agreed upon are generally based on historical sales and may or may not allow market entry for new producers.

2. *Market allocation* fixes the maximum quantity that handlers may ship to different markets. By restricting supply to high-return markets and diverting the remainder to less profitable ones (ie: domestic fresh vs. export or processed), overall returns are increased. This may actually hurt producers who grow primarily for the secondary market or who are unable to gain a foothold in the restricted market.

3. *Reserve pools* are crop set-asides for future changes in markets. They stabilize the quantity supplied to markets over time by reducing supply during peak shipments and increasing supply during low periods. Reserve pools are very similar to market allocations, except that the "excess" product is not immediately diverted to other uses (such as the processing market). The pool may be used in the primary market at a later date, diverted to secondary markets, or utilized for non-food uses (e.g.: feed, ethanol).

4. *Market Flow Regulations* are a subset of supply controls and aim to restrict supply over time, rather than by markets. In theory, all production is sold (though in practice not all produce may be marketable in the next time period, due to rot, etc.), but returns are increased by regulating the rate at which it is sold. Two approaches are used to regulate market flow:

- *Prorates* specify the maximum amount a handler may ship to a primary market in a specific period of time (week or month).
- *Shipping holidays* are periods during which all commercial shipping is prohibited. Shipping holidays are used primarily to avoid a build-up of supplies in terminal markets during periods of restricted trade activity.

and other substitutes for the product (e.g., processed fruit products, such as orange juice, substituting for fresh orange consumption). Where successful, supply management can increase prices received for produce by reducing the quantity supplied for marketing. The four ways in which supply can be managed are listed in the box on page II-6.

Quality Control

Quality controls establish minimum grade, size, and maturity requirements for a product. They are enforced through federal, state, or other designated inspection services and often consist simply of making USDA food grading standards for a particular commodity mandatory. While quality controls may sometimes protect the consumer from immature and poor quality fruits and vegetables, they may also provide another form of supply control. For example, MO provisions for kiwifruit prevent oval kiwis from being marketed, even though they are identical (other than in shape) to kiwis that do reach market.[23]

Two researchers found that in most cases the specified requirements remain unchanged from one marketing year to another. Such behavior suggests that the industry means to impose and maintain a minimum level of product quality over time. In some cases, the requirements are frequently changed, both within a shipping season and from one season to another possibly due to fluctuates in the level of quality due to weather, unusual pest infestations or other extenuating circumstances. This suggests quality standards are used as a form of quantity control to manipulate the amount sold.[24] In practice, quality control provisions may be set in such a way as to circumvent the need to change them, in view of the legal morass that may be encountered:

> Federal and state statutes often require drawn out legislative or administrative procedures to modify or amend. . . Therefore, marketers are better off maintaining somewhat low quality standards that are general enough to allow interpretation or other methods (such as speeding up any manual inspection processes) to provide the flexibility to maintain even supply in both times of surplus and times of shortage.[25]

Factors other than strict statutory language play an important role in grower decisions; for instance, Jesse and Johnson acknowledge that "the vigor with which quality regulations are enforced varies considerably among orders."[26]

Thus, while explicit quality controls (in the form of MOs) may not restrict supply, market interpretations of the orders, especially during periods of excess supply relative to demand, may implicitly lead to a very different result. These interpretations, which are flexible due to supply and quality levels within the market, become the marketplace-enforced messages that growers must listen to in order to remain in business.

Demand Management

Marketing orders are also used to facilitate joint research and advertising and promotional activities to enhance consumer demand. For example, the costs for industry promotion of California pears, plums, and fresh peaches are paid by fees assessed at the handler level.[27]

Effects of Marketing Orders

In January 1992 there were 44 MOs covering 32 crops in 32 states[28] designed to help the small farmer ("price-taker") get a fair price from monopsonist buyers ("price-setter"). Whether they have successfully done this is unclear. One USDA study found that "price comparisons for fruits and vegetables covered by federal marketing orders with similar or identical commodities not under orders suggest that the orders have not yielded higher or more stable farm prices." The authors of this report did not find any study to indicate the contrary.[29]

Some growers are large enough to bargain successfully with the large produce buyers. These growers exert market power over smaller growers and may create barriers to entry to prevent new competition.[30] The buyer still controls the purchase conditions because marketing order-based standards are often flexible enough, in regard to certain quality levels, to give the packing houses latitude over what they may or may not legally accept, depending on growing and market conditions. This flexibility, especially in the face of perpetual oversupply of many products, makes bargaining more difficult for the seller.

Although MOs do exempt certain outlets, on an industry-wide basis, they effectively act as barriers for the marketing of less aesthetically perfect produce. Today, secondary grades of fresh produce seldom appear in supermarkets.

On the basis of the case studies researched in this report, it appears that MO quality requirements are generally less stringent than the market-based cosmetic standards that growers must ultimately meet. It is unclear which changes to MOs to reflect less stringent cosmetic standards lead to changes in grower behavior and pesticide use patterns without concomitant changes in consumer behavior. The latter may require consumer education.[31]

As to changes in the process of establishing marketing orders, Feenstra asserts that the members of the marketing order administrative committee, the organization responsible for carrying out the marketing order statutes, represent only the interests of the major forces in the industry.[32] Although MOs are designed to help small farmers, who make up a large share of the producers employing low-input agricultural practices, they may be very poorly represented.

Chapter III
Market-based Factors Affecting Cosmetic Appearance

A number of market-based factors may promote pesticide use and pose barriers to the adoption of less chemically-intensive systems. These practices include contractual purchase agreements between the grower and the processor, wholesaler or retailer, and stipulations over growing practices on the part of lending institutions or crop insurers (see Table III-1 below).

Contractual Agreements Between Buyers and Sellers

Contractual agreements between buyers and sellers have the most direct influence on grower behavior regarding pesticide use and cosmetic criteria. Government standards enforce the minimum quality standards allowable in the marketplace, but the actual standards required by buyers may be set at will. Generally, the greater the supply of produce relative to demand, the more power the buyer has over the seller in setting price and quality requirements; in the United States, supply is seldom scarce giving buyers the edge. Thus, while formal standards exist for fruits and vegetables for both the fresh and processing markets,

for many crops the operationally effective standards are those that are required by contractual agreement between producers and buyers, or by the joint agreement of producers through marketing cooperatives and marketing orders. In most cases this latter type of quality standard is much more stringent than the statutory standard.[1]

Table III-1
Summary of Market-based Factors Affecting Grower Behavior

Program	Purpose	Effectiveness
Written or *de facto* contractual agreements		
LEVEL: Local contracts, which in the aggregate, affect national markets INSTITUTIONS: packing houses, brokers, large retail chains, and processors Voluntary, but certain terms have become mandatory	To ensure the buyer gets exactly the type of product desired. May contain stricter guidelines thany any government standards. Can be sued to control volume. Explicit contractual requirements may, over time, become market-enforced, *de facto* industry standards.	As the market standard for 'quality', represents the most direct impact on grower behavior. The relative market power of buyer or handler compared to grower affects the nature of the agreement in terms of quality characteristics and growing practices.
Conditions for crop loans or crop insurance		
LEVEL: Local contracts, federal insurance INSTITUTIONS: banks, crop insurers Voluntary, but terms of agreements become legally binding	To provide grower with financial resources and income security. Minimize risk to the lender by maximizing short-term grower return through perscribed growing practices.	Can curtail grower flexibility in accepting some pest related crop losses, and to try new management techniques, which are not generally approved by lenders and insurers.

The importance of written or *de facto* contractual agreements is apparent in the case studies of apples and tomatoes presented in Chapter IV.

Contractual agreements accomplish a number of important things. They allow growers to plan crop plantings with some degree of knowledge about future sales and future revenues. They provide processors and retail chains a similar ability to plan production strategies, as well as an assurance that existing capacity will be filled. They also ensure that some minimal level of quality will be provided to the buyer. Contracts cannot control acts of nature that alter the quality of delivered produce nationally or regionally. Nor will contracts *necessarily* protect a buyer from over-commitments to buy produce of a particular quality in bumper years. However, in order to protect the buyer from both the problems of oversupply and undersupply, contracts are often made flexible by leaving room for somewhat subjective quality assessments by the buyer. Product attributes not differentiable in the marketplace (e.g.: the presence of different levels of residual pesticides below EPA tolerances) are unlikely to be included in such agreements, and will therefore be left out of production decisions. To the extent that contracts are used to *reduce or eliminate* pesticide usage, they may have a dramatic effect on grower practices as well.[2]

The nature of purchase contracts varies according to the relative powers of buyer and seller. A small tomato grower contracting with a large processor may have few or no alternative markets for his tomatoes, while the large company has multiple sources for obtaining tomatoes (i.e., the buyer acts as a monopsonist). In such a case, the contractual agreement reached is likely to favor the large firm because of the grower's limited bargaining power.

Industry Concentration and Market Power

The fruit and vegetable industry has seen a shake-out of many wholesalers and intermediate distributors.[3] While wholesalers and distributors still exist, by vertically integrating their own distribution, retail chains now serve a majority of the distribution channels. As a result, the buyers of produce are now concentrated in fewer and fewer retail chains, which are now the largest purchasers from packing houses. It is these large retail supermarket chains, therefore, that set most of the operational decisions on fruit and vegetable aesthetics. If their contractual standards are not met, the retail buyers do not have to pay full price at the packing houses. Rather than risk monetary losses, the packing houses take steps to ensure that the growers meet these standards.[4]

Downgrading Quality Standards Along the Produce-Handling Chain

Standards enforced by the retail chains, the last stopping point before produce is sold, has led to another problem. Because fresh fruits and vegetables are harvested, packed, and often shipped long distances before they reach the retail chains for sale (where produce quality is checked), there is a risk that the produce may be damaged or aged during handling and shipping. Thus, while the produce may have been initially up to the contracted standards, it may no longer satisfy the agreed upon quality standards when it reaches the point of sale. If this occurs, it could cost the growers and handlers both money and future contracts.

To protect themselves against the possibility of not meeting the standards established by the large retail chains, all intermediate handlers require a safety margin between the actual quality of the produce they buy and the promised quality of the produce they deliver. For example, one apple grower described how his apples were advertised by a broker as "better than Extra Fancy" (the highest USDA apple grade), since they did exceed US Extra Fancy standards. However, by the time they reached the stores, they would go out on the shelves as US #1, the third highest grade. Downgrading quality along the chain protects the intermediate handler from complaints from the seller and protects the seller from complaints from consumers.[5]

Qualitative Measures to Protect the Produce Buyer

There are assertions that standards have been kept purposefully vague to allow produce buyers or processors to buy a volume that equals their needs (1) by excluding produce that technically meets quality standards during times of oversupply, or (2) by buying "below" grade produce in lean production years. According to one study, middlemen such as packers, shippers, and marketing cooperatives act independently by using "quality standards *not* so much as ensure a safe and nutritious produce for the consumer, but to control *which* and *how much* produce gains access to the market."[6]

Supply control is established at the packing houses by increasing quality standard decisions, thereby reducing the volume of fruit "making grade." Because the grower has no objective way to determine ahead of time what level of quality will be acceptable at the packing house, as many defects as possible are eliminated to ensure the load will be saleable. Eliminating most defects on many fruits and vegetables requires extremely careful harvesting and handling, and, under most circumstances, the use of pesticides -- unless there is an alternative distribution channel for the grower, such as the organic market, which pays a premium for lower (or no) pesticide usage, the grower cannot recoup the greater cost of production.

Pest control exhibits diminishing returns per unit of pesticide applied as the allowable defects approach zero. Allowing higher damages with less chemical controls may both reduce pesticide use and increase returns. For example, Dr. Ted Wilson, a researcher at UC Davis, estimates that pesticide use on processing tomatoes may, under some circumstances, be reduced 40-60%, with a concomitant reduction in cosmetic quality.[8]

Use of Quality Standards To Control Supply in the Citrus Market

Qualitative judgments regarding fruit quality play a role in supply control in the citrus industry in the West. The enforcing agent in the orange market is not a retail chain, but rather the growers' cooperative, Sunkist Growers, Inc.

Sunkist sets standards based on attributes such as flavor, form, color, texture, condition, freedom from decay, and freedom from defects.[9] The interpretation of these standards fluctuate depending on growing season and time of season. While less variation is tolerated on the Sunkist brand name, fairly wide variation exists for other grades - especially when supply is low (i.e., more cosmetic damage is allowed).[10]

Oranges trademarked Sunkist are excluded if they are more than slightly scarred, puffed, sunburned, rough, soft overmature, or damaged by frost or aging. Sunkist claims inspectors are adequately trained to consistently judge these criteria[11]; however, van den Bosch suggests

> it is difficult to know exactly what "more than slightly scarred" means. Additionally, the cause of many of the defects is not specified...The wide range of exterior defects specified in the quality standards are not detected by any quantitative technique. Rather, the oranges are screened visually by packing-house workers as they are carried down a conveyor belt.[12]

Contractual Agreements to Reduce Risk to the Buyer

Because, in many cases, there is no viable fresh market for "secondary" quality fresh fruits and vegetables, producing such produce exposes more than just the farmer to unacceptable financial risk. Buyers fear that presenting fresh produce with an occasional insect will prevent produce sales and convey a message that the rest of the produce is impure. They

> maintain that the presence of one insect often indicates that more may be present in the shipment. It makes no difference whether the insect is one which attacks the commodity. Evidence of insect damage is treated almost as seriously as the presence of insects. Buyers said that produce must be practically free of insect damage to be saleable.[13]

This appears no less true today then it was in 1978, judging by the effort that the growers with whom we spoke put towards prevention of insect damage to their produce. To reduce their risk (whether perceived or real) of a reaction from consumers, buyers insist on an absence of any insects on their fruits and vegetables.

Some buyers or processors attempt to control the quality of their contracted produce by explicitly requiring particular growing practices in the contract. Thus, contracts may force the grower to

> spray fields a stipulated number of times each season regardless of insect infestation to "assure" a bug-free crop. A grower's failure to follow the treatment schedule is sufficient basis for contract cancellation.[14]

Implicit control of growing practices, through buying decisions, also seems to affect grower pesticide use. For example, processors can and do raise the threat of "load dumping" at the processing plant in the event that the grower has not followed the prescribed pesticide control practices. This threat is taken quite seriously since "it is quite easy to find insects or 'insect' damage in any load of produce if one really tries."[15]

The greater the degree to which the buyer can stipulate growing practices, the more accurately he or she can predict expected crop losses. With more certainty on the amount of damaged produce to expect, the buyer may determine the supply needed for production or sale with a lower margin of error. A lower margin of error improves buyer profitability. While expected losses from organic or IPM techniques could potentially be predicted with equal accuracy, doing so is more difficult and requires an understanding of many more production factors.[16]

Retail Chain Produce Contracting and Pesticide Use

In an effort to ensure that their supermarkets have fresh produce year-round, produce buyers have placed a premium on the surety of supply. Thus, a supplier that promises a constant supply of tomatoes year round may win the entire contract for tomatoes in that chain,[17] although the chain may sell artificially ripened, out of state or foreign, tomatoes even during the local tomato season.[18] Such contracts make it very difficult forsmaller, local suppliers to feed the local retail outlets, even when their crop is *in season*.[19]

To supply fresh produce year round, the large growers and supply houses need to rely on several post-harvest technologies. To give produce a longer shelf-life, there has been a large increase in post-harvest chemical applications, wax applications, and controlled atmospheric storage.[20] Waxes reduce crop moisture loss 30-40% preventing the shriveling of the produce and the onset of decay. Half a dozen different waxes are currently FDA-approved.[21] Many of the wax applications also contain fungicides to further reduce losses from rot. Many of the fungicides used are suspected carcinogens, though the levels present on foods are likely to pose a relatively low risk.[22] When combined with the waxes, the fungicides can be washed off only by using detergent and water.

Suppliers have also had to develop growing regions in the South to supply northern markets during winter months. Unfortunately, some of the major growingareas for this purpose, such as Florida, are quite humid and have severe problems with mold and fungus. Southern growers must use far more fungicides on their crops than growers in other regions of the country.[23] Thus, through contracts to supply the northern consumer with fresh produce year-round, pesticide use has been affected by (1) application of post-harvest chemicals to ensure transportability and storability and (2) shifting of production to areas of the country (or different countries) where greater pesticide usage is necessary.

Bank and Crop Insurance Restrictions on Grower Practices

Farming is a cash flow industry. Investments in land are enormous, as are expenditures on farm equipment to work the land. Seed, fertilizer, and pesticides are all substantial costs. An agricultural financing system has evolved whereby the grower will often borrow against future crops in order to pay for the needed inputs to those crops. Growers also purchase insurance against crop failure to reduce risk from year to year. As a result, if a grower loses a crop to pest infestations, the grower's bank and insurer also lose. As was demonstrated in other contractual agreements, parties subject to high risk intervene with grower choices in an effort to reduce that risk. The federal government and the institutional lenders also intervene to minimize their respective risks. Further research is needed to determine the full extent to which these restrictions may affect grower practices.[24]

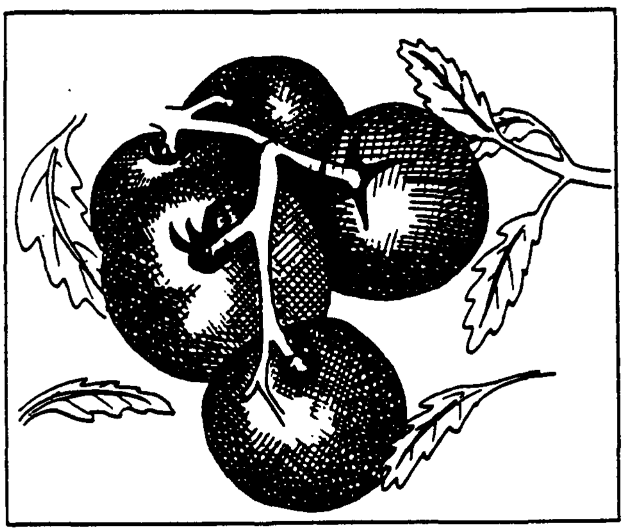
Chapter IV
Case Studies[1]

Fresh Market Tomatoes

In the fresh tomato market, contractual obligations are generally more highly associated with pesticide use for cosmetic purposes than MOs or food grading standards.

In the fresh market, USDA Standards for Grades of Fresh Tomatoes include the following quality attributes: color, size, maturity, firmness, shape, smoothness, freedom from defects (including insect injury, puffiness, catfaces, scars, growth cracks, and hail), and freedom from decay, freezing injury, and sunscald.[2] The USDA Standards for Grades of Fresh Tomatoes were made mandatory in all Federal MOs affecting fresh market tomatoes.[3]

While Federal standards allow 15 percent of the tomatoes, *en route* or at destination, to be lower than U.S. #1 Grade[4], the packing houses must sort the bad tomatoes out by hand. Generally, packinghouses aim for as low as a 5 percent incidence of tomatoes below U.S. #1 Grade. Packing houses' explicit (contractual) or *de facto* (based on past actions) standards, rather than MOs or food grading standards, appear to be the quality standards of greatest import to the grower in pesticide use decisions. However, most of the key elements of packinghouse standards are drawn from the quality criteria incorporated in federal standards and hence their importance should not be overlooked.



To control the number of rejects, a number of strategies are employed. Growers choose to plant tomato strains that are disease resistant, and have tough skins and a slightly square shape for better packing. Pesticides are used, generally on a basis of cosmetic damage threshold rather than an economic damage threshold. With a cosmetic damage threshold to ensure that the final product meets the standards at packing houses,

> growers must use more pesticides than they might otherwise. Some growers, in fact, may spray up to 40 times a season in some fresh market tomato districts...[5]

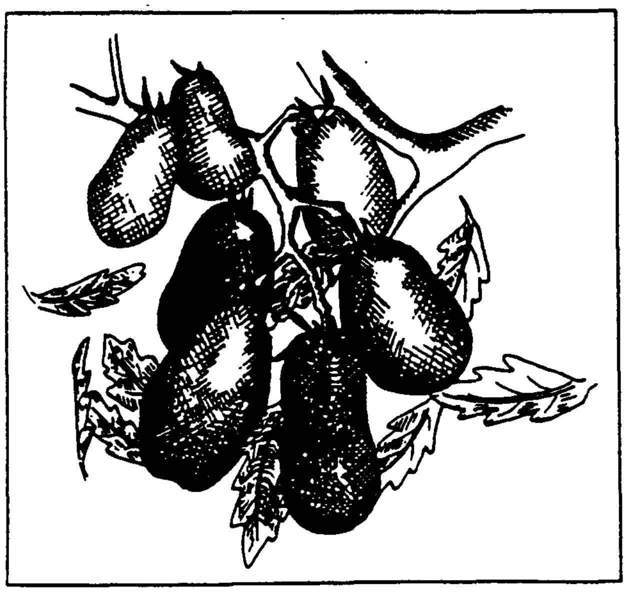
However, this pesticide use can be significantly reduced. Preliminary results of a 1986 study of 40 IPM fresh market tomato growers in Florida found that available IPM methods reduced insecticide inputs by about 21 percent and yielded an average increase in net returns of $121/acre for the 62 percent of the growers reporting increased returns.[6] What the exact relationship is between IPM methods and cosmetic damage thresholds is unclear and needs to be researched.

The trend towards year-round marketing of fresh tomatoes in supermarkets throughout the United States has led to an expansion of tomato production areas throughout the southern U.S. and Mexico and has been accompanied by the development of longer-term contracts between supermarkets and these producers. Mexico supplies a high percentage of tomatoes in late Winter, where they are washed in a chlorine bath and then ripened with ethylene gas.[7] Some of the pesticides frequently applied to tomatoes (dimethoate for thrips, methamidophos for stink bugs) are systemic, that is, they are absorbed into fruit or vegetable tissue, and cannot be washed off.[8] Fungicides are added to tomatoes for long-term storage and long-distance shipping. There are claims that the use of fungicides would, to a great extent, be unnecessary if the tomatoes were properly cooled, packed, and sent to local market for consumption within

1-2 weeks, instead of the 3-4 weeks' time it takes to send them through more complicated distribution channels to more distant markets.[9] The 1-2 week period is generally not enough time for the tomatoes to develop mold. Fungicides are also heavily used to treat end-of-season (post-Oct. 15th) tomatoes. Hence, like many other fruits and vegetables, there are trade-offs between year-round availability and pesticide use for fresh tomatoes.

To improve shipping qualities, tomatoes frequently are picked "mature green"[10] and gassed at shipping point or destination with ethylene. Ethylene gas alters the color, but does not yield the same tissue changes that lead to ripe tomato flavor. So long as the skin is not cracked and the tomato has a good pale red color, the grower and broker will have fulfilled their contractual agreements. Despite the availability of in-season tomatoes locally grown and naturally vine ripened tomatoes. The existence of long-term contracts with brokers and growers in California and Florida often prevents local growers from selling to local markets in-season.[11]

The costs to a grower of having his or her tomatoes rejected is very high. Because the production of fresh and processing tomatoes are each very specialized activities, they are essentially different crops.[12] Thus, a grower for the fresh market has very few alternatives for crops not making grade: he or she may not be able to sell to processors, regardless of the price, and long-term contracting by the retail outlets greatly reduces any options for direct marketing of either a primary- or a secondary-quality product. Faced with almost no options, and with a great deal of time, money, and capital tied into tomato production, prophylactic pesticide application can almost become a necessity.



Processing Tomatoes

Tomatoes grown for processing are used in products such as ketchup, tomato sauces, juices, soups, pastes and whole canned tomatoes. In most of the products, the tomatoes are ground up, often the skins are removed, and rarely (canned whole tomatoes are an exception) do the fruits remain whole. Strict restrictions on certain cosmetic attributes rarely affect the appearance of the final product. While processed tomatoes which are heavily infested with insects may be undesirable, the presence of '2x' instead of 'x' microscopic insect fragments in spaghetti sauce is unlikely to cause any additional health risk.[13] Yet, whether the lowering of the cosmetic standards results in a significant reduction in the level of pesticide residues in the foods needs to be investigated.

Processing tomatoes are one of the few processing commodities that has a State of California quality standard. The state has standards for worm damage; in recent years, an estimated two-thirds of the pesticides used in the production of processing tomatoes has been for tomato fruit worm control. According to van den Bosch, a large portion of this pesticide use is historically for cosmetic purposes.[14] Until 1968, the standard allowed up to 10 percent worm damage. In 1968, this standard was reduced to 2 percent. In the late 1970s,

> processor contracts generally [didn't] allow more than 1 percent worm damage, and in fact many contracts allow the buyer to reject shipments which contain in excess of 1/2 percent worm damage, and in some cases, the buyer may require zero worm damage.[15]

In 1987, a state processing tomato MO was formed. The quality standards set out by the order duplicate those previously included in the California Food and Agriculture Code. Factors monitored include color, worm damage, dirt, mold, green, material other than tomatoes, and various tomato diseases. The California marketing order level for worm damage is still 2 percent, while many processors still require less than 0.5 percent worm damage, despite that processed tomatoes are usually pulverized and the damage would never be visible. Regardless of the rationale behind the processor's damage standards,

> losses are high for growers whose loads exceed the 0.5 percent worm damage threshold. Not only are their loads rejected, but they stand to lose future contracts with the processor if they consistently exceed the standard.[16]

With a contracted damage level of 0.5 percent, the grower aims for zero damage in order to have some degree of safety. Although there are growers profitably using integrated pest management (IPM) or organic methods to produce processed tomatoes, they are unlikely to produce zero loss. Even doing so with frequent sprayings of chemicals is likely to be extremely difficult.[17]

As with fresh market tomatoes, grower behavior is driven by industry standards which incorporate, and make more stringent, the quality criteria of government standards. Critics argue that these industry standards, rather than improving the quality of the final product, serve instead to reduce aggregate supply and provide a way for the processors to reject shipments that exceed their desired production quantities.

To meet the zero damage target, growers face economic pressure to plant extra acreage and use pesticides more aggressively. Insecticides and fungicides are used, often prophylactically--that is, in anticipation of a pest problem but without good information on the existence or extent of the problem--to ensure that the crop will not be rejected outright by the processor for failure to meet the contractual standards.

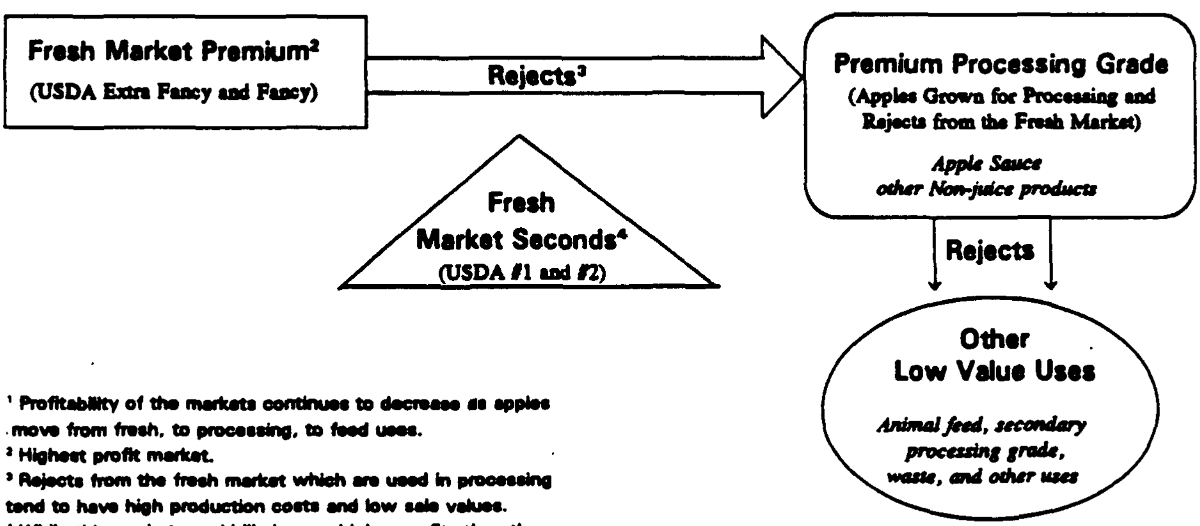
Processors may also intervene directly in growing processes to ensure a uniform product that meets their specifications. For example,

> not only do canneries want red tomatoes, but they want them to arrive in an even flow throughout the season. To obtain red tomatoes regularly, particularly early and late in the season, canneries can contract with growers to use a chemical growth regulator called ethephon (Ethrel). Ethephon triggers the release of ethylene in processing tomatoes, which turns them red. It is used on approximately 30 percent of the total processing tomato acreage.[18]

Even though definitions regarding what pests are a purely cosmetic nuisance (versus pests that are destructive to productive capacity as well) vary greatly, there is some evidence that a substantial amount of pesticides used on processing tomatoes are used to meet cosmetic quality standards.[19] With slightly higher crop loss rates, pesticide use may be reduced, as suggested by

> research done from 1980-84 by Craig Weakley, a Sutter county [California] farm advisor, shows that insecticide use could be reduced by 40% by growers using an IPM

Figure IV-1
Produce Marketing Options in the Apple Market[1]



[1] Profitability of the markets continues to decrease as apples move from fresh, to processing, to feed uses.
[2] Highest profit market.
[3] Rejects from the fresh market which are used in processing tend to have high production costs and low sale values.
[4] While this market would likely earn higher profits than the processing markets, no secondary fresh market currently exists, and USDA #1 and #2 grades are used in processing.

sampling technique and economic versus cosmetic thresholds for worms.[20]

Nevertheless, growers will not change their processes so long as doing so would leave them with a nonmarketable commodity. Research is necessary to investigate public willingness to accept greater insect damage or contamination in exchange for lower pesticide use.

Apples

Apples are not subject to any federal MOs, although Washington apples are subject to the Washington State MO. Quality and levels are specified officially only through USDA's "United States Standards for Grades of Apples."[21] These grades are voluntary; however, they serve, in effect, as the minimum quality levels fresh apples. The operational standards, which drive the grower's behavior, are set by the market through brokers, packinghouses, and retail chains. Unlike the fresh tomato market, where growers unable to sell in the primary market do not have the opportunity to sell in the processing tomato market, apple growers can use the processing market to sell off their lower quality fruit. There are, however, some growers who do produce directly for the processing market.

A major selling factor in the red apple market is perceived to be color, and the marketplace is extremely strict with respect to this parameter. The marketplace standards do not need to be set contractually, although they sometimes are. In many cases, however, buyers base their decisions on what they think consumers want. They learn by experience. Hence, if a packer ships a load that is rejected by the market, he changes his packing standards so that his apples will not be rejected again. This process of upholding apple "quality" occurs regardless of the way the apples get into the retail channel (e.g. through a broker, a shipper, a packer, or direct marketing).[22]

Color is important to growers because it sells apples. Consumer preferences are believed to be dominated by a desire for big, bright red apples. While this preference would appear to be valid in the case where all else is equal, consumer awareness of differentials in pesticide residues may significantly redefine the preference. One study demonstrated that consumers are willing to trade off 11.9% damage (measured as percentage of the surface area of an apple)[23] for no pesticide residues in the apple.[24]

In the current marketplace, however, color earns profits. Good color, with no disease or insect damage, is the aim of the fresh market grower. Especially good color on some apples in a batch may compensate for other defects. Thus, slightly higher bruising rates and some below-color fruits in a crate may be allowed so long as there are some deep red, shiny apples. To maximize the number of apples with good color, growers may pick more than once in a season (allowing maximum tree ripening time), although multiple harvests add to production costs.[25]

The quality standards currently enforced by the marketplace substantially exceed those set by USDA. Fresh apples meeting grade U.S. #1, the third highest grade, and which show mild scars from healed insect stings, can no longer be marketed in the fresh market. US Fancy, the second highest grade, is marketable, but not profitable (unless there is a shortage). Most of the fresh market is served by apples meeting and/or exceeding the requirements of US Extra Fancy. Thus, most growers aim for this grade. If the highest grades are not achieved, a grower's crop is destined for the processing apple market (see Figure IV-1). The sale of apples to the processing market by growers who have used growing and handling practices with the intent to sell to the higher profit fresh market, is usually a last resort to reduce losses, as the costs of production are generally higher than the prices paid by apple processors.[26]

One grower estimates pesticide usage for apples to be 50-60% of what it once was.[27] Possible causes of this reduction are a desire to reduce chemical control costs, or pressure to reduce chemical usage from environmental regulations. Pesticide use for some apple pests remains high, however, and use rates vary substantially with location. For example, control of apple scab in California, due to its dry climate, can generally be accomplished with 2-5 chemical applications per season. The same control in New York state, which has more summer rain, can take 15-20 applications.[28]

Frequent sprayings of pesticide are used to attain a high proportion of the total crop in the Extra Fancy grade, significant quantities of pesticides are often used. One farmer who describes himself as a "serious" IPM grower, produces 90-95 percent of his crop in the Extra Fancy grade.[29] A high proportion of his spraying is to get from his crop the extra 5-6 percent Extra Fancy at the packinghouse. IPM in recent studies[30] has the potential to reduce pesticide use between 25 and 30 percent in some areas.[31] Yet, because there are usually no profitable markets for secondary quality fresh apples, and because spraying is generally relatively cheap compared to the economic impact of fruit losses,[32] there may be no economic incentive to reduce spraying and accept a lower percentage of Extra Fancy.

Chapter V
Conclusions

Government standards establish the language of the marketplace regarding quality and cosmetic appearance. Industry standards, after incorporating the language of government standards, are more stringent than government standards and may be the driving force behind most pesticide use for cosmetic purposes. Competition in the marketplace revolves around meeting and exceeding these standards. Cosmetic quality standards may be used to restrict supply of raw fruits and vegetables to both the fresh and processing markets. Though it is clear that some pesticides are used for the purpose of improving or assuring cosmetic quality, how much is used for that purpose is unclear. Nevertheless, a significant number of growers in selected areas of the country are currently producing high quality, cosmetically appealing produce with few or no pesticides. That federal and industry standards can inhibit the adoption of alternative agricultural practices that rely less on chemical pesticides is clear. However, the consumer willingness to accept trade-offs in price and cosmetic quality in exchange for reduced pesticide use needs to be further investigated.

Next Steps

- Work with USDA and FDA
  1) to identify research on the impact of the cosmetic criteria of quality standards on pesticide use, compared to pesticide use to prevent loss;
  2) to review the extent to which cosmetic criteria impede the adoption of alternative agricultural production techniques that are more protective of the environment;
- Evaluate the reduction in health risks associated with reducing the stringency of cosmetic standards for certain crops to allow greater use of alternative or low input agricultural practices.

Areas of Future Research

- Examine the problems associated with grower certification, and the enforcement of production-based standards.
- Examine in more detail the problems associated with defining "organic" and "IPM" practices, and implementing programs using such grades.
- Examine post-harvest chemical usage in general, and the cost trade-offs (in dollars and the number of days of extended shelf life) between post-harvest refrigeration, controlled atmosphere storage and post-harvest chemical treatments, in particular. By determining how strong the incentive is to use post-harvest chemicals, it may be possible to reduce the use of such chemicals. Post-harvest use of chemicals affects whether a product can be marketed as "organic" and the ability to predict risks from pesticide residues in foods.
- Initiate feasibility studies (or a tracking system for currently-existing studies) on the ability to produce certain commodities with fewer, or no, pesticide applications.
- Explore IPM techniques with regard to reductions in pesticide usage and changes in effective yields.

Appendix A

Creating or Modifying USDA Grading Standards for Fresh Produce

There are nine general steps in the creation and modification of USDA grading standards. This regulatory process, which can take from 1 to 4 1/2 years from start to finish, is described below.[1]

Step 1: Initiation of New or Revised Standards

Creation of new standards or revisions of old standards can be initiated by interested parties through correspondence with the Chief of the Fresh Products Branch, Fruit and Vegetable Division of the Agricultural Marketing Service, USDA. Historically, the requests are initiated by industry groups. The industry may form a national standards committee to represent as much of the industry as possible, although there is no statutory percentage of the industry that must be represented. USDA makes a qualitative judgment as to whether enough of the industry is represented so that going on with the process makes sense. A majority of the committee must vote in favor of the new standards in order for the process to begin.

Because USDA views the grading standards simply as a standardized wholesaler trading language, created for and used by the producers, the ability for consumers to alter this process is not known.[2]

Time frame: Initiation occurs any time a change is desired.

Step 2: Industry Meeting

Upon receiving a request from industry, a USDA standardization specialist may attend industry meetings to explain the process for standards change and answer any questions from industry.

Time frame: There could be one week to 2 years between initial interest and USDA meeting with industry.

Step 3: Initiation of a Formal Request for Change

Procedures to revise a standard begin when industry formally requests a change. If the request is considered "reasonable and beneficial" to industry by USDA, the USDA standardization specialist would get approval from the Chief of the Fresh Products Division to file a work plan. A work plan must be filed with the Office of the Assistant Secretary for Marketing and Inspection Services to obtain authorization to proceed with industry's request.

The judgment of "reasonable and beneficial" is a qualitative assessment made by USDA. This determination is made by USDA officials considering both consumer interests and industry preferences. Requests based on short-term phenomena (such as severe frosts), or which are likely to benefit only a small number of growers are rejected by USDA.

Time frame: May require up to six weeks for final approval of work plan.

Step 4: The Market Survey

Once a work plan has been approved, if there are significant changes requested by the proposal, the USDA standardization specialist may develop a "market survey" to get ideas and comments from those who may be affected by the proposal before an official proposal is developed and published in the Federal Register. (Where only minor changes to the standard are requested, steps 4-6 are by-passed.) The specialist contacts inspection personnel, state and local government officials, members of the research community, growers, packers, receivers, and anyone helpful in providing useful information about the product and necessary changes in the product standard.[3]

According to USDA officials, consumer or environmental interests are unlikely to be solicited directly for input since USDA does not maintain a standard roster of names for each mailing, on the premise that each commodity has a very different constituency.

Time frame: 1 month to 1 year (for seasonal products) after request for standard change is approved.

Industry may also organize a committee to develop its own survey to develop the information necessary for a revision in the standards rather than rely on a USDA market survey. In such a case, an industry survey would be done instead of a USDA survey. Survey or polling requirements are not procedurally set. Industry is responsible for forming a representative industry group. Survey results may be used to request specific changes in the standards on behalf of that industry. The industry group may either give their recommendations directly to USDA for further action, or first present their findings to the entire industry (e.g., at an industry annual meeting) for approval.

Time frame: Approximately 2 months.

Step 5: Mailing the Market Survey

If the market survey is undertaken by USDA (rather than by an industry group), the survey is mailed out to all relevant parties, including those in the industry and "anyone that might have an interest in submitting comments" (generally state inspectors, state agricultural associations, and industry trade associations). Environmental and consumer interests are not regularly solicited.

Time frame: At least 90 days for responses.

Step 6: Review Survey Comments

Survey comments are reviewed by USDA for completeness and degree of controversy over the changes. A high degree of controversy may lead to a second survey.

Time frame: Evaluation of comments usually takes about 4 weeks.

Step 7: Proposed Rule Developed

The USDA standardization specialist uses all of the information generated thus far to prepare a proposed rule for publication in the Federal Register. The specialist also is responsible for ensuring that the proposed rule is in the public interest.

Time frame: 2 weeks to prepare a proposed rule; 3-12 additional weeks for USDA clearances and publication in the Federal Register.

Once published in the Federal Register, the proposed rule is subject to a comment period. Small changes to existing standards may have only a 30 day comment period. Other rules may have a comment period as long as one year.

Time frame: 1 to 12 months.

Step 8: Comments of Proposed Rule Reviewed

Comments on the proposed rule-making are then evaluated by the specialist. If the comments show a wide range of disagreement between portions of the industry or if USDA believes that it is not in the public interest, the proposed rule change may be withdrawn. The industry would be notified about the problem, and may be brought together for another industry meeting, or a new market survey would be issued. If industry generally agrees with the proposal, a final rule would be developed.

Time frame: Evaluation of comments usually takes 6 weeks.

Step 9: Issuance of Final Rule

The final step of this process is the issuance of the Final Rule, which is a rewrite of the proposed rule, including any relevant comments. Final rules must be authorized through the same process as the proposed rule. Rules generally become effective 30 days after publication in the Federal Register.

Time frame: 5 to 14 weeks.

Creating or Modifying Defect Action Levels[4]

Creating or modifying a defect action level involves a number of steps, presented below.

Step 1: Initiation of New or Revised Standards

Initiatives for new or modified DAL's generally originate in one of the FDA district offices, or through an industry request. FDA tries to target commodities that have a long history of "filth" contamination. Industry may request new or revised defect action levels for a couple of possible reasons. They may wish to protect their product's image by eliminating avoidable defects from the marketplace which could cause consumer aversion to their commodity. Alternatively, industry may wish to have a government body determine that a particular defect is, indeed, ***unavoidable***, thereby eliminating a basis for rejection of their goods.[5] The unbiased appearance of government standards seems to be an issue in requesting FDA DAL's, since many industry groups already have their own quality assurance standards which measure the same or similar criteria, and which are often more stringent than FDA standards.[6]

Step 2: Industry Survey

Following a request for a revised defect action level, FDA undertakes an industry survey to assess, given current technology, unavoidable defects. The survey is national and involves 1500 samples for new DAL's and 500 samples for revisions. Samples are analyzed by FDA district laboratories. A new defect action level is set at the 95th percentile of purity (i.e., 5% of the current market will fail).[7] The survey may take one year, or may be conducted over a series of years to compensate for annual variations in adulteration levels.

Step 3: Publication in the Federal Register

Once FDA has developed modified Defect Action Levels, they will publish the new standard in the Federal Register. There is then a 60 day comment period for all interested individuals or industries. This comment period may be extended to one year for seasonal commodities to facilitate data collection.

Step 4: Final Decision by FDA

At the end of the comments period, FDA will announce its final decision regarding the propriety of the new or revised DAL's. Sixty days after the publication of the final decision in the *Federal Register*, the new DAL will become effective.

Creating or Modifying Marketing Orders

As was the case with USDA grading standards and FDA defect action levels, creating or modifying marketing orders can be a complex and drawn out process. The necessary steps are presented below.[8]

1) Orders are initiated *by growers*, either directly or through their cooperative organizations. Industry representatives submit a proposal to the Secretary of Agriculture for an order.
2) The Secretary of Agriculture (or the appointed USDA representative) makes a preliminary investigation to determine the feasibility and necessity of a marketing order.
3) If this investigation determines an order is needed, a notice of public hearing is issued.
4) At the public hearing, any interested party may present information or opinions related to the proposed order.
5) After assessing available information from the meeting, the Secretary of Agriculture determines whether a proposed order is appropriate, and whether to continue the process of order formation or modification.
6) This is followed by a comment period on the proposal. Any interested person may file exceptions or recommendations. Following the comment period, and analysis and integration of comments, USDA issues a final decision and order.
7) The final order is then presented to industry for a vote. Approval of a new order, or modifications to an old order, requires two-thirds of the producers voting (three-fourths for California citrus fruit), or by 50 percent of the producers representing two-thirds of the volume sold by voting farmers.
8) Once approved, orders are managed by committees of growers, or growers and handlers, and are binding on all handlers in the areas designated.
9) An order can be ended if at least half of the producers (or producers representing at least half of the production) vote to end it. Growers may periodically vote to continue their orders.[9]

Marketing orders can be amended by following the same general procedure used to initiate new orders. Roles for the non-industry interests are somewhat limited, and include:

- Submitting requests to the Secretary of Agriculture to amend Marketing Order
- Providing evidence during the hearing or comment period
- Providing evidence to USDA that the order is operating against the public interest, in the hopes that the Secretary of Agriculture may rescind it
- Obtaining an appointment on an administrative committee as a non-industry member (this is difficult to do because not all committees have non-industry members).[10]

Appendix B

Table B - 1.0
Quality Factors for Fresh Fruits in the U.S. Grades (US) and the California Food and Agricultural Code (CA)

Fruit	Standard (date*)	Quality Factors
Apple	US (1976)	Maturity, color (color charts) related to grade, firmness, shape and size, and freedom from decay, internal browning, internal breakdown, scald, scab, bitter pit, Jonathan spot, freezing injury, water core, bruises, russeting, scars, insect damage, and other defects.
	CA (1983)	Maturity (as determined by soluble solids content (SSC) and firmness tests) *Cultivar* — *SSC (%)* — *Firmness (lb)* Red Delicious — 11.0 — 18 Golden Delicious — 12.0 — 18 Jonathan — 12.0 — 19 Rome — 12.5 — 21 Newtown Pippin — 11.0 — 23 McIntosh — 11.5 — 19 Gravenstein — 10.5 — --
Apricot	US (1928) CA (1983)	Maturity, size, shape, and freedom from defect and decay.
Avocado	US(1957)	*For Florida avocados:* Maturity, shape, texture, skin and flesh color, and freedom from decay, anthracnose, freezing injury, bruises, russeting, scars, sunburn, mechanical damage, and other defects.
	CA (1983)	Maturity (17% to 20.5% dry weight of the flesh depending on cultivar), size, and freedom from defect, insect damage, freezing injury, rancidity, and decay.
Blueberry	US (1966)	Maturity, color, size, and freedom from defect and decay.
Cherry, sweet	US (1971)	Maturity, color, size, shape, and freedom from cracks, hail damage, russeting, scars, insect damage, and decay.
	CA (1983)	Maturity (entire surface with at least a solid light red color and/or 14% to 16% soluble solids depending on the cultivar), and freedom from bird pecks, insect injury, shriveling, growth cracks, other defects, and decay.

Sources For Tables 1.0 - 1.3: Adel A. Kader, "Standardization and Inspection of Fresh Vegetables," in University of California Cooperative Extension Service Postharvest Technology of Horticultural Crops, 1985, pp. 124-130. U.S. Standards have been updated as of October 1991 using USDA/AMS grades (see references for full citations); California standards were not updated.
**Date when standard was issued or revised.*

Fruit	Standard (date*)	Quality Factors
Citrus, Grapefruit	US (1950)	*California and Arizona:* Maturity, color, firmness, size, shape, skin thickness, smoothness, and freedom from defect and decay.
	US (1980)	*Florida:* Maturity, color (color charts), firmness, size, smoothness, shape, and freedom from discoloration, defect, and decay.
	US (1969)	*Texas and other states:* Maturity, color, firmness, size, shape, smoothness and freedom from discoloration, defect and decay.
	CA (1983)	Maturity (minimum soluble solids/acid ratio of 5.5 or 6 [desert areas] and >2/3 of fruit surface showing yellow color - 0.9 GY 6.40/5.7 Munsell color) and freedom from decay, freezing damage, scars, pitting, rind staining, and insect damage.
Citrus, Lemon	US (1964)	Maturity (28% or 30% min. juice content by volume depending on grade), firmness, shape, color, size, smoothness, and freedom from discoloration, defect, and decay.
	CA (1983)	Maturity (30% or more juice by volume), size uniformity, and freedom from decay, freezing damage, drying, mechanical damage, rind stains, red blotch, shriveling, and other defects.
Citrus, Lime	US (1958)	Color, shape, firmness, smoothness, and freedom from stylar end breakdown, bruises, dryness, other defects, and decay.
	CA (1983)	Maturity, and freedom from defect (freezing injury, drying, mechanical damage) and decay.
Citrus, Orange	US (1957)	*California and Arizona:* Maturity, color, firmness, smoothness, size, and freedom from defect and decay.
	US (1980)	*Florida:* Maturity, color (color charts), firmness, size, shape, and freedom from discoloration, defect and decay (used also for tangelos).
	US (1969)	*Texas and other states:* Maturity, color, firmness, shape, size and freedom from discoloration, defect and decay.
	CA (1983)	Maturity (soluble solids/acid ration of 8 or higher and orange color on 25% of the fruit - 7.5 Y 6/6 Munsell color - or soluble solids/acid ratio of 10 or higher and orange color on 25% of fruit - 2.5 GY 5/6 Munsell color), size uniformity, and freedom from defect and decay.
Citrus, Tangerine and Mandarine	US (1948)	*States other than Florida:* Matunty, firmness, color, size, and freedom from defect and decay.
	US (1980)	*Florida:* Maturity, color (color charts), firmness, size, shape, and freedom from defect and decay.
	CA (1983)	Maturity (yellow, orange, or red color on 75% of fruit surface and soluble solid/acid ratio of 6.5 or higher), size uniformity, and freedom from defect and decay.
Cranberry	US (1971)	Maturity, firmness, color, and freedom from bruises, freezing injury, scars, sunscald, insect damage, and decay.
Date	CA (1983)	Freedom from insect damage, decay, black scald, fermentation, and other defects.

Fruit	Standard (date*)	Quality Factors	
Dewberry, blackberry	US (1928)	Maturity, color, and freedom from calyxes, decay, shriveling, mechanical damage, insect damage, and other defects	
	CA (1983)	Maturity and freedom from decay and damage due to frost, bruising, insects, or other causes.	
Grape, table European Vinifera type	US (1991)	Maturity (as determined by percent soluble solids as set forth by the producing states), color, uniformity, firmness, berry size, and freedom from shriveling, shattering, sunburn, waterberry, shot berries, dired berries, other defects, and decay. Bunches: fairly well-filled but not execessively tight. Stems: not dry and brittle, and at least yellowish green in color. For states other than California and Arizonia, and countries exporting to U.S.:	
		Cultivar	*Minimum SSC (%)*
		Muscat	17.5
		Cardinal, Emperor, Perlette, Ribier, Olivette Blanche, Rish Baba, Red Malaga, and similar varities	15.5
		All other cultivars	16.5
American bunch type	US (1983)	Maturity, (juiciness, ease of separation of type skin from pulp), color, firmness, compactness, and freedom from defect and decay.	
Kiwifruit	US (1986)	Maturity (more than 6.5% soluble solids), firmness, cleanness, uniformity, and freedom from worm holes, growth cracks, insect injury, broken skin not healed, bruises, sunscald, freezing injury, internal breakdown, and decay. Free from injury by bruises, leaf or limbrubs, discoloration, hail, growth cracks, scab, scars, heat, sprayburn, or sunburn, scale, insects, other diseases, and mechanical or other means.	
Nectarine	US (1966)	Maturity, color depending on variety, shape, and size, and freedom from growth cracks, insect damage, scars, bruises, russeting, split pits, other defects, and decay.	
	CA (1983)	Maturity (surface ground color, fruit shape), and freedom from insect injury, split pits, mechnical damage, and decay.	
Olive	CA (1983)	Freedom from insect injury, especially scale.	
Peach	US (1952)	Maturity (shape, size ground color), and freedom from decay and defect (split pit, hail injury, insect damage, growth cracks).	
	CA (1983)	Maturity (skin and flesh color, and fullness of shoulders and suture), and freedom from defect and decay.	
Pear Winter	US (1955)	Maturity (color, firmness), size, and freedom from internal breakdown, black end, russeting, other defects, and decay.	
Summer and Fall	US (1955)	Maturity (color, firmness), shape, size, and freedom from defect and decay.	
	CA (1983)	Maturity (Barlett: Average firmness test of <25lb. and/or soluble solids content 13%, and/or yellowish green color - CDFA color chart), and freedom from insect damage, mechanical damage, decay and other defects.	

Fruit	Standard (date*)	Quality Factors
Persimmon	CA (1983)	Maturity as indicated by surface color. *Hachiva:* Blossom end's color is organge or reddish color equal to or darker than Munsell color 6.7 YR 5.93/12.7 on at least 1/3 of the fruit's length with the remaining 2/3 a green color equal to or lighter than Munsell color 2.5 GY 5/6. *Other cultivars*: A yellowish green color equal to or lighter than Munsell color 10 Y 6/6. Freedom from growth cracks, mechanical damage, decay, and other defects.
Pineapple	US (1990)	Fruit: maturity, firmness, stem removal, uniformity of size and shape, freedom from fresh cracks, rodent feeding, freezing injury or frozen, decay, and freedom from injury by discoloration, insects, and tolerances. Tops: single stem, color, length, straightness, and freedom from injury by crown slips, bruising, sunburn, gummosis, internal breakdown, insects, healed cracks, mechanical or other means.
Plum and fresh prune	US (1969)	Maturity, color, shape, size, and greedom from decay, sunscald, split pits, hail damage, mechanical damage, scars, russeting, and other defects.
	CA (1983)	Maturity as indicated by surface color (minium color requirements are described for 56 cultivars), and freedom from decay, insect damage, bruises, sunburn, hail damage, gum spot, growth cracks, and other defects.
Pomagranate	CA (1983)	Maturity (<1.85% acid content in juice and red uice color equal to or darker than Munsell color 5 R 5/12), freedom from sunburn, growth cracks, cuts or bruises, and decay.
Quince	CA (1983)	Maturity, and freedom from insect damage, mechanical damage, and decay.
Raspberry	US (1931)	Maturity, color, shape, and freedom from defect and decay.
	CA (1983)	Maturity, and freedom from decay and damage due to insects, sun frost, bruising, or other causes.
Strawberry	US (1965)	Maturity (>1/2 or >3/4 of surface showing red or pink color, depending on grade), firmness, attached calyx, size, and freedom from defect and decay.

Table B - 1.1
Quality Factors for Fresh Vegetables in the U.S. Grades (US) and the California Food and Agricultural code (CA)

Vegetable	Standard (date*)	Quality Factors
Anise, sweet	US (1973)	Firmness, tenderness, trimming, blanching, and freedom from decay and damage caused by growth cracks, pithy branches, wilting, freezing, seedstems, insects, and mechanical means.
Artichoke	US (1969)	Stem length, shape, overmaturity, uniformity of size, compactness, and freedom from defect and decay.
	CA (1983)	Freedom from decay, insect damage, and freezing injury.
Asparagus	US (1966)	Freshness (turgidity), trimming, straightness
	CA (1983)	Turgidity, straightness, percent showing white color, stalk diameter, and freedom from decay, mechanical damage, and insect injury.
Bean, lima	US (1938)	Uniformity, maturity, freshness, shape, and freedom from damage (defect) and decay.
Bean, snap	US (1990)	Uniformity, cleanness, size, maturity, freshness (firmness), and freedom from defect and decay.
Beet, bunched or topped	US (1955)	Root shape, trimming of rootlets, firmness (turgidity), smoothness, cleanness, minimum size (diameter), and freedom from defect.
Beet greens	US (1959)	Freshness, cleanness, tenderness, and freedom from decay, other kinds of leaves, discoloration, insects, mechanical injury, and freezing injury.
Broccoli	US (1943)	Color, maturity, stalk diameter and length, compactness, base cut, and freedom from defects and decay.
	CA (1983)	Freedom from decay and damage due to overmaturity, insects, or other causes.
Brussel sprouts	US (1954)	Color, maturity (firmness), no seed stems, size (diameter and length), and freedom defect and decay.
	CA (1983)	Freedom from decay and damage due to overmaturity, insects, or other causes.
Cabbage	US (1945)	Uniformity, solidity (maturity or firmness) no seed stems, trimming, color, and freedom from defect and decay.
	CA (1983)	*Conform to U.S. commercial grade or better.*
Cantaloupe	US (1968)	Soluble solids (>9%), uniformity of size, shape, ground color and netting; maturity and turgidity; and freedom from "wet slip", sunscald, and other defects.
	CA (1983)	Maturity (soluble solids >8%), and freedom from insect injury, bruises, sunburn, growth cracks, and decay.
Carrot, bunched	US (1954)	Shape, color, cleanness, smoothness, freedom from defect, freshness, length of tops, and root diameter.
	CA (1983)	Number, size, and weight per bunch, freshness, and freedom from defect and decay (tops).

Vegetable	Standard (date*)	Quality Factors
Carrot, topped	US (1965)	Uniformity, turgidity, color, shape, size, cleanness, smoothness, and freedom from defect (growth cracks, pithiness, woodiness, internal discoloration).
	CA (1983)	Freedom from defect (growth cracks, doubles, mechanical injury, green discoloration, objectionable flavor or odor) and decay.
Carrots, with short trimmed tops	US (1954)	Roots: Firmness, color, smoothness, and freedom from defect (sunburn, pithiness, woodiness, internal discoloration, and insect and mechanical injuries) and decay. Leaves: (Cut to <4 inches). Freedom from yellowing or other discoloration, disease, insects, and seed stems.
Cauliflower	US (1968)	Curd cleanness, compactness, white color, size (diameter), freshness and trimming of jacket leaves, and freedom from defect and decay.
	CA (1983)	Freedom from insect injury, decay, freezing injury, and sunburn.
Celery	US (1959)	Stalk form, compactness, color, trimming, length of stalk and midribs, width and thickness of midribs, no seed stems, and freedom from defect and decay.
	CA (1983)	Freedom from pink rot and other decay, blackheart, seed stems, pithy condition, and insect damage.
Collard greens and broccoli greens	US (1953)	Freshness, tenderness, cleanness, and freedom from seed stems, discoloration, freezing injury, insects, and diseases.
Corn, green	US (1954)	Uniformity of color and size, freshness, milky kernels, cob length, freedom from defect, coverage with fresh husks.
	CA (1983)	Milky, plump, well-developed kernels, and freedom from insect injury, mechanical damage, and decay.
Cucumber	US (1958)	Color, shape, turgidity, maturity, size (diameter and length), and freedom from defect and decay.
Cucumber, greenhouse	US (1934)	Freshness, shape, firmness, color, size (>5.5 inches), and freedom from decay, cuts, scars, and other defects.
Dandelion greens	US (1955)	Freshness, cleanness, tenderness, and freedom from damage caused by seed stems, discoloration, freezing, diseases, insects, and mechanical injury.
Eggplant	US (1953)	Color, turgidity, shape, size, and freedom from defect and decay.
Endive, escarole, or chicory	US (1964)	Freshness, trimming, color (blanching), no seed stems, and freedom from defect and decay.
Garlic	US (1944)	Maturity, curing, compactness, well-filled cloves, bulb size, and freedom from defect.
	CA (1983)	Size (bulb diameter).
Honeydew and honeyball melons	US (1967)	Maturity, firmness, shape, and freedom from decay and defect (sunburn, bruising, hail spots, and mechanical injuries).

Vegetable	Standard (date*)	Quality Factors
	CA (1983)	Maturity, soluble solids (>10%), and freedom from decay, sunscald, bruises, and growth cracks. Honey ball melons should be netted and should have pink flesh.
Horseradish roots	US (1936)	Uniformity of shape and size, firmness, smoothness, and freedom from hollow heart, other defects, and decay.
Kale	US (1934)	Uniformity of growth and color, trimming, freshness, and freedom from defect and decay.
Lettuce, crisp-head	US (1975)	Turgidity, color, maturity (firmness), timming (number of wrapper leaves), and freedom from upburn, other physiological disorders, mechanical dmage, seed stems, other defects, and decay.
	CA (1983)	Freedom from insect damage, decay, seed stems, upburn, freezing injury, broken midribs, and bursting. For sectioned, chopped, or shredded letuce: Same as inteact heads plus freedom from discoloration and excessive moisture.
Lettuce, greenhouse leaf	US (1964)	Well-developed, well-trimmed, and freedom from coarse stems, bleached or discolored leaves, wilting,freezing, insects, and decay.
Lettuce, romaine	US (1960)	Freshness, trimming, and freedom from decay and dmage caused by seed stems, broken, bruised, or discolored leaves, tipburn, and wilting.
Melon casaba and Persian	CA (1983)	Maturity, and freedom from growth cracks, decay, mechanical injury, and sunburn.
Mushroom	US (1966)	Maturity, shape, trimming, size, and freedom from open veils, disease, spots, insect injury, and decay.
Mustard greens and turnip greens	US (1953)	Freshness, tenderness, cleaness, and freedom from dage caused by seed stems, discoloration, freezing disease, insects, or mechanical means. Roots (if attached): firmness and freedom from damage.
Okra	US (1928)	Freshness, uniformity of shape and color, and freedom from defect and decay.
Onion, dry		Maturity, firmness, shape, size (diameter), and freedom from decay, wet sunscald, doubles, bottlenecks, sprouting, and other defects.
Creole	US (1943)	
Bermuda-Granex-Grano	US (1985)	
Other cultivars	US (1971)	
Onion, green	US (1947)	Turgidity, color, form, cleaness, bulb trimming, no seed stems, and freedom from defect and decay.
Onion sets	US (1940)	Maturity, firmness, size, and freedom from decay and damage caused by tops, sprouting, freezing, mold, moisture, dirt, disease, insects, or mechanical means.
Parsley	US (1945)	Freshness, green color, and freedom from defects, seed stems, and decay.
Parsnip	US (1945)	Turgidity, trimming, cleanness, smoothness, shape, freedom from defect and decay, and size (diameter).

Vegetable	Standard (date*)	Quality Factors
Pea, fresh	US (1942)	Maturity, size shape, freshness, and freedom from defect and decay.
Pea, Southern (cowpea)	US (1956)	Maturity, pod shape, and freedom from discoloration and other defects.
Pepper, sweet	US (1989)	Maturity, firmness, color, shape, size, and freedom from damage and injury (sunburn, bacterial spot, freezing injury, hail, scars, sunscald).
	CA (1983)	Freedom from insect damage and decay.
Potato	US (1972)	Uniformity, maturity, firmness, cleanness, shape, size, and freedom from sprouts, blackheart, greening, and other defects.
	CA (1983)	A minimum equivalent of U.S. No. 2 grade. Maturity is described in terms of extent of skin missing or feathered.
Radish (topped)	US (1968)	Tenderness, cleanness, smoothness, shape, size, and freedom from pithiness and other defects.
Rhubarb	US (1966)	Color, freshness, straightness, trimming, cleanness, stalk diameter and length, and freedom from defect.
Shallot, bunched	US (1946)	Firmness, form, tenderness, trimming, cleanness, and freedom from decay and damage caused by seed stems, disease, insects, mechanical and other means. Tops: freshness, green color, and no mechanical damage.
Spinach leaves	US (1946)	Color, turgidity, cleanness, trimming, and freedom from defect.
Spinach plants	US (1956)	Freshness, cleanness, trimming, and freedom from decay and dmage caused by coarse stalks or seed stems, discoloration, insects, and mechanical means.
Spinach, bunched	US (1987)	Cleanness, freshness, trimmness, degree to which well grown, freedom from decay, freedom from damage (coarse stalks, seedstems, flower buds, discoloration, wilting, foreign material, insects, freezing, mechanical and other).
Squash, summer	US (1984)	Immaturity, tenderness, shape, firmness, and freedom from decay, cuts, bruises, scars, and other defects.
Squash, winter and pumpkin	US (1983)	Maturity, firmness, freedom from discoloration, cracking, dry rot, insect damge, and other defects; uniformity of size.
Sweet potato	US (1963)	Firmness, smoothness, cleanness, shape, size, and freedom from mechanical damage, growth cracks, internal breakdown, insect damage, other defects, and decay.
	CA (1983)	Freedom from decay, mechanical damage, insect injury, growth cracks, and freezing injury.
Tomato	US (1991)	Maturity and ripeness (color chart), firmness, cleanness, uniformity, shape, smoothness, size, and freedom from defect (puffiness, hail, sunscald, freezing injury, scars, catfaces, growth cracks, insect injury, and other defects) and decay.
	CA (1983)	Freedom from insect and freezing damage, sunburn, mechanical damage, blossom-end rot, catfaces, growth cracks, and other defects.

Vegetable	Standard (date*)	Quality Factors
Tomato, greenhouse	US (1966)	Maturity, firmness, shape, size, and freedom from decay, sunscald, freezing injury, bruises, cuets, shriveling, puffiness, catfaces, growth cracks, scars, disease, and insects.
Turnip and rutabaga	US (1955)	Uniformity of root color, size, and shape, trimming, freshness, and freedom from defects (cuts, growth cracks, pithiness, woodiness, water core, dry rot).
Watermelon	US (1978)	Maturity and ripeness (optional internal quality criteria: soluble solids content = >10% very good, >8% good), shape, uniformity of size (weight),and freedom from anthracnose, decay, sunscald, and whiteheart.
	CA (1983)	Maturity (arils around the seeds have been absorbed and flesh color is >75% red), and freedom from decay, sunburn, flesh discoloration, and mechanical damage.

Table B - 1.2
Quality Factors for Processing Fruits in the U.S. Standards for Grades (US) and the California Food and Agricultural Code (CA)

Fruit	Standard (date*)	Quality Factors
Apple	US (1961)	Ripeness (not overripe, mealy or soft), and freedom from decay, worm holes, freezing injury, internal breakdown, and other defects that would cause a loss of >5% (U.S. No. 2) by weight.
Berries	US (1947)	Color, and freedom from caps (calyxes), decay, and defect (dried, undeveloped and immature berries, crushing, shriveling, sunscald, insect damage, and mechanical injury).
Blueberry	US (1950)	Freedom from other kinds of berries, clusters, large stems, leaves and other foreign material, and freedom from damage caused by decay, shriveling, dirt, overmaturity, or other means.
Cherry, red sour	US (1941)	Color uniformity, and freedom from decay, pulled pits, attached stems, hail marks, windwhips, scars, sunscald, shriveling, disease, and insect damage.
Cherry, sweet for canning or freezing	US (1946)	Maturity, shape, freedom from decay, worms, pulled pits, doubles, insect and bird damage, and mechanical injury, and freedom from damage caused by freezing, softness, shriveling, cracks and skin breaks, scars and sunscald. Tolerance is 7% (U.S. No. 1) or 12% (U.S. No. 2) by count.
Cherry, sweet for sulfur brining	US (1940)	Maturity (ease of pit separation), firmness, shape, and freedom from decay and defect (bruises, bird and insect damage, skin breaks, russeting, shriveling, scars, sunscald, and limbrubs).
Cranberry, red sour	US (1957)	Maturity, color, firmness, size, and freedom from defect (insect damage, bruises, scars, sunscald, freezing injury, and mechanical injury) and decay.
Currant	US (1952)	Color, stem attached, and freedom from decay and damage caused by crushing, drying, shriveling, insects and mechanical means.
Grape, America type for processing and freezing	US (1975)	Maturity (>15.5% soluble solids), color, freedom from shattered, split, crushed, or wet berries, and freedom from decay and from damage caused by freezing, heat, sunburn, disease, insects, or other means.
Grape, juice (European or vinifera type)	US (1939)	Maturity (>16% to 18% soluble solids depending on cultivar), freedom from crushed, split, wet, waterberry and redberry, and freedom from defect (insect, disease, mechanical injury, sunburn, and freezing damage).
Grape for processing and freezing	US (1977)	Maturity (>15.5% soluble solids content), and freedom from decay and defect (dried berries, discoloration, sunburn, insect damage, and immature berries).
Peach, freestone for canning, freezing, or pulping	US (1966)	Maturity, color (not greener than yellowish green), shape, firmness, and freedom from decay, worms and worm holes, spilt pits, scab, bacterial spot, insects, and bruises. Grade is based on the severity of defects with 10% tolerance.
Pear for processing	US (1970)	Maturity, color (less than yellowish green), shape, firmness, and freedom from scald, hard end, black end, internal breakdown, decay, worms and worm holes, scars, sunburn, bruises, and other defects. Grade is based on the severity of defect with 10% tolerance.

Fruit	Standard (date*)	Quality Factors
Raspberry	US (1952)	Color, and freedom from decay and defect (dried berries, crushing, shriveling, sunscald, scars, bird and insect damage, discoloration, or mechanical injury).
Strawberry, growers stock for manufacture	US (1935)	Color, freedom from decay and defect (crushed, spit, dried or undeveloped berries, sunscald, and bird or insect damage), size, and cap removal.
Strawberry, washed and sorted for freezing	US (1935)	Color, cleanness, size, cap removal, and freedom from decay and defect (crushed, split, dried or undeveloped berries, bird and insect damage, mechanical injury).

Table B - 1.3
Quality Factors for Tree Nuts in the U.S. Standards for Grades (US) and the California Food and Agricultural Code (CA)

Fruit	Standard (date*)	Quality Factors
Almond, shelled	US (1960)	Similar varietal characteristics (shape, appearance) size (count per ounce), degree of dryness, cleanness (freedom from dust, particles, and foreign materials), and freedom form decay and defect (rancidity, insect injury, doubles, split or broken kernels, shriveling, brown spot, or gumminess).
Almond, in-shell	US (1964)	Shell: similar varietal characteristics (shape, hardness), cleanness (freedom from loose extraneous and foreign materials), size (thickness), brightness and uniformity of color, and freedom from discoloration, insect infestation, adhering hulls, and broken shells. Kernal: Degree of dryness, and freedom from decay and defect (rancidity, insect damage, shriveling, brown spot, gumminess, and skin discoloration).
Brazil nut, in-shell	US (1966)	Shell: Degree of dryness, cleanness (freedom from dirt, extraneous, and adhering foreign materials), size (diameter), and freedom from damage caused by splits, breaks, punctures, oil stains, and mold. Kernel: Degree of development (must fill more than 50% of the shell capacity), freedom from decay and defect (rancidity, insect damage, and discoloration).
Filbert, in-shell	US (1970)	Shell: Shape, size (diameter), cleanness, brightness, and freedom from defect (blanks, broken or split shells, stains, and adhering husk). Kernel: Degree of dryness (less than 10% moisture content), development (must fill more than 50% of the shell capacity), shape and freedom from decay and defect (insect injury, shriveling, rancidity, and discoloration).
Mixed nuts, in-shell	US (1970)	Each species of nut must conform to a minimum size and grade (same quality criteria used for that species). Grade of the mix is also determined by percent allowable for each component (almonds, brazils, filberts, pecans, walnuts).

Fruit	Standard (date*)	Quality Factors
Pecan, shelled	US (1969)	Degree of dryness, degree of development (amount of meat in proportion to width and length), color (plastic models for color standards are available), color uniformity, size (number of halves per pound or diameter of pieces), freedom from decay and defect (shriveling, insect damage, internal discoloration, dark spots, skin discoloration, and rancidity), and cleanness (freedom from dust, dirt and adhering material).
Pecan, in-shelled	US (1976)	Shell: Color uniformity, size (number of nuts per pound), cleanness, and freedom from decay and defect (insect damage, dark stains, spilt or cracked shells, and broken shells). Kernel: Same as for shelled pecans (above).
Pistachio Nuts, in-shell	US (1986)	Size, freedom from foreign material, loose kernels, shell pieces, particles and dust, and blanks, free from damage by adhering hull material, light stained, dark stained, and other external (shell) defects. Shells: free from non-split shells and shells not split on suture. Kernels: dryness, and freedom from damage by minor mold, immature kernels, kernal spots, and other internal (kernal) defects. Free from serious damage (insect injury, insect damage, mold, rancidity, mold, and decay).
Walnut, shelled	US (1976)	Shell: Dryness, cleanness, brightness, freedom from decay and defect (splits, discoloration, broken shells, perforated shells, and adhering hulls), and size (diameter). Kernel: Same as for shelled walnuts (above).
	CA (1983)	Shell: Dryness, size, and freedom from blanks, decay, and defect (insect damage, adhering hulls, and perforations affecting more than 1/8 of the surface). Kernel: Size, and freedom from decay and defect (insect damage, shriveling, and rancidity).

Table B-2.0
Fruit, Vegetable, and Specialty Crop Federal Marketing Agreements and Orders
(Current as of January 1992)

M.O. No.	Area and Commodity	* Grade	* Size	Pack & Container	Flow to Market	Market Allocation	Reserve Pool	Producer Allotments	R & D	Adver-tising	Committee Headquarters
	Fruits										
905	FL Citrus Fruit	x	x	3	4						Lakeland, FL
906	TX Oranges & Grapefruit	x	x	x					x	x	McAllen, TX
907	CA-AZ Navel Oranges[1]		x		x				x		Newhall, CA
908	CA-AZ Valencia Oranges[1]		x		x				x		Newhall, CA
910	CA-AZ Lemons[1]		x		x				x		Newhall, CA
911	FL Limes	x	x	x	x	x			x	x	Homestead, FL
915	FL Avocados	x	x	x	4				x	x	Homestead, Fl
916	CA Nectarines	x	x	x					x	x	Sacramento, CA
917	CA Pears & Peaches	x	x	x					x	x	Sacramento, CA
918	GA Peaches	x	x								Macon, GA
919	CO Peaches	x	x						x		Palisade, CO
920	CA Kiwifruit	x	x	x					x		Sacramento, CA
921	WA Peaches	x	x	x					x		Yakima, WA
922	WA Apricots	x	x	x					x		Yakima, WA
923	WA Cherries	x	x	x					x		Yakima, WA
924	WA-OR Fresh Prunes	x	x	x					x		Yakima, WA
925	CA Desert Grapes	x	x	x	4				x		Indio, CA
926	CA Tokay Grapes	x	x	x	x				x	x	Lodi, CA

*Source: USDA/AMS, 1992. *Restrictions on imports as well as domestic commodity for tomatoes, black olives, prunes, avocados, limes, grapefruit, irish potatoes, oranges, onions, walnuts, dates, filberts, table grapes, kiwifruit and raisins.*
[1]Order only [2]Agreement only [3]Export only [4]Shipping holiday [5]Reserve only [6]Applies to only withheld cranberries
[7]Contains authority for a voluntary producer diversion program [8]Contains indemnity provisions for aflatoxin damaged peanuts

M.O. No.	Area and Commodity	* Grade	* Size	Pack & Container	Flow to Market	Market Allocation	Reserve Pool	Producer Allotments	R & D	Adver-tising	Committee Headquarters
927	OR-WA-CA Winter Pears	x	x						x	x	Portland, OR
928	Hawaii Papayas	x	x	x					x	x	Honolulu, HI
929	10 States-Cranberries	6	6					x	x		Wareham, MA
931	WA-OR Bartlett Pears	x	x	x					x		Portland, OR
932	CA Olives	x	x						x	x	Fresno, CA
	Vegetables										
945	ID- E. OR Potatoes	x	x	x							Idaho Falls, ID
946	WA Potatoes	x	x	Pack							Moses Lake, WA
947	OR-CA Potatoes	x	x	Pack					x		Salem, OR
948	CO Potatoes	x	x	x					x		Monte Vista, CO
950	ME Potatoes	x	x	x							Inactive
953	VA-NC Potatoes	x	x								Eastville, VA
955	Vidalia (GA) Onions								x	x	Vidalia, GA
958	ID-OR Onions	x	x	x	4				x	x	Parma, ID
959	S. TX Onions	x	x	x	4				x		Mercedes, TX
965	TX Valley Tomatoes[1]	x	x	x					x	x	McAllen, TX
966	FL Tomatoes	x	x	x					x	x	Orlando, Fl
967	FL Celery	x	x	x	x			x	x	x	Orlando, Fl
971	S. TX Lettuce	x	x	x	x	x			x		Mercedes, TX
979	S. TX Melons	x	x	x				x			Mercedes, TX
	Specialty Crops										
981	CA Almonds	x	5			x			x	x	Sacramento, CA

Source: USDA/AMS, 1992. *Restrictions on imports as well as domestic commodity for tomatoes, black olives, prunes, avocados, limes, grapefruit, irish potatoes, oranges, onions, walnuts, dates, filberts, table grapes, kiwifruit and raisins.*
[1]Order only [2]Agreement only [3]Export only [4]Shipping holiday [5]Reserve only [6]Applies to only withheld cranberries
[7]Contains authority for a voluntary producer diversion program [8]Contains indemnity provisions for aflatoxin damaged peanuts

M.O. No.	Area and Commodity	* Grade	* Size	Pack & Container	Flow to Market	Market Allocation	Reserve Pool	Producer Allotments	R & D	Advertising	Committee Headquarters
982	OR-WA Filberts	x	x	Pack		x			x	x	Tigard, OR
984	CA-OR-WA Walnuts	x	x	Pack		x	x		x		Sacramento, CA
985	Far West Spearmint Oil						x	x	x		Pasco, WA
987	CA Dates	x	x	Cont.		x			x	x	Indio, CA
989	CA Raisins[7]	x	x			x	x		x	x	Fresno, CA
993	CA Prunes[7]	x	x	Pack		x	x		x		San Fran, CA
	M.A.										
146	Peanuts (16 states)[2,8]	x	x								Atlanta, GA

*Source: USDA/AMS, 1992. *Restrictions on imports as well as domestic commodity for tomatoes, black olives, prunes, avocados, limes, grapefruit, irish potatoes, oranges, onions, walnuts, dates, filberts, table grapes, kiwifruit and raisins.*
[1]Order only [2]Agreement only [3]Export only [4]Shipping holiday [5]Reserve only [6]Applies to only withheld cranberries
[7]Contains authority for a voluntary producer diversion program [8]Contains indemnity provisions for aflatoxin damaged peanuts

Table B - 3.0
Defect Action Levels (as of January 1989)

Product	Defect (Method)	Action Level
Allspice	Mold (MPM-V32)	Average of 5% or more berries by weight are moldy
Apple Butter	Mold (AOAC 44.197)	Average of mold count is 12% or more
	Rodent Filth (AOAC 44.086)	Average of 4 or more rodent hairs per 100 grams of apple butter
	Insects (AOAC 44.086)	Average of 5 or more whole or equivalent insects (not counting mites, aphids, thrips, or scale insects) per 100 grams of apple butter
Apricot, Peach, and Pear Nectars and Purees	Mold (AOAC 44.202)	Average mold count is 12% or more
Apricots, canned	Insect Filth (MPM-V51)	Average of 2% or more by count insect-infested or insect-damaged in a minimum of 10 subsamples
Asparagus, canned or frozen	Insect Filth (MPM-V93)	10% by count of spears or pieces are infested with 6 or more attached asparagus beetle eggs and/or sacs
	Insects (MPM-V93)	Asparagus contains an average of 40 or more thrips per 100 grams OR
		Insects (whole or equivalent) of any size average 5 or more per 100 grams OR
		Insects (whole or equivalent) of 3mm or longer have an average aggregate length of 7mm or longer per 100 grams of asparagus
Bay (Laurel) Leaves	Mold (MPM-V32)	Average of 5% or more of pieces by weight are moldy
	Insect Filth (MPM-V32)	Average of 5% or more pieces by weight are insect-infested
	Mammalian excreta (MPM-V32)	Average of 1 mg or more mammalian excreta per pound after processing
Beets, canned	Rot	Average of 5% or more pieces by weight with dry rot
Berries: Drupiet, canned and frozen (blackberries, raspberries, etc.)	Mold (AOAC 44.205)	Average mold count is 60% or more
	Insects and larvae (AOAC 44.069)	Average of 4 or more larvae per 500 grams OR
		Average of 10 or more whole insects or equivalent per 500 grams (excluding thrips, aphids and mites)
Ligon, canned	Insect larvae (MPM-V64)	Average of 3 or more larvae per pound in a minimum of 12 subsamples
Multer, canned	Insects (MPM-V64)	Average of 40 or more thrips per No. 2 can in all subsamples and 20% of subsamples are materially infested
Broccoli, frozen	Insects and mites (AOAC 44.106)	Average of 60 or more aphids, thrips and/or mites per 100 grams

SOURCE: Center for Food Safety and Applied Nutrition, Food and Drug Administration. *The Food Defect Action Levels*, current through January 1989.

Product	Defect (Method)	Action Level
Brussels Sprouts, frozen	Insects (MPM-V95)	Average of 30 or more aphids and/or thrips per 100 grams
Capsicum: Pods	Insect filth and/or mold (MPM-V32)	Average of more than 3% of pods by weight are insect-infested and/or moldy
Ground Capsicum (excluding paprika)	Mold (AOAC 44.213)	Average mold count is more than 20%
	Insect filth (AOAC 44.131)	Average of more than 50 insect fragments per 25 grams
	Rodent filth (AOAC 44.131)	Average of more than 6 rodent hairs per 25 grams
Ground Paprika	Mold (AOAC 44.213)	Average mold count is more than 20%
	Insect filth (AOAC 44.146)	Average of more than 75 insect fragments per 25 grams
	Rodent filth (AOAC 44.146)	Average of more than 11 rodent hairs per 25 grams
Cassia or Cinnamon Bark (whole)	Mold (MPM-V32)	Average of 5% or more pieces by weight are moldy
	Insect Filth (MPM-V32)	Average of 5% or more pieces by weight are insect-infested
	Mammalian excreta (MPM-V32)	Average of more than 1 mg or more mammalian excreta per pound
Cherries, brined and maraschino	Insect Filth (MPM-V48)	Average of 5% or more pieces are rejects due to maggots
fresh, canned, or frozen	Rot (MPM-V48)	Average of 7% or more pieces are rejects due to rot
	Insect Filth (MPM-V48)	Average of 4% or more pieces are rejects due to insects other than maggots
Cherry Jam	Mold (MPM-V61)	Average mold count is 30% or more
Chocolate and Chocolate Liquor	Insect Filth (AOAC 44.007)	Average of 60 or more microscopic insect fragments per 100 grams when 6 100-gram subsamples are examined OR
		Any 1 subsample contains 90 or more insect fragments
	Rodent Filth (AOAC 44.007)	Average is more than 1 rodent hair per 100 grams in 6 100-gram sub samples examined OR
		Any 1 subsample contains more than 3 rodent hairs
	Shell (AOAC 44.012 - 13.026)	For chocolate liquor, if the shell is in excess of 2% calculated on the basis of alkali-free nibs
Citrus Fruit Juices, canned	Mold (AOAC 44.218)	Average mold count is 10% or more

Product	Defect (Method)	Action Level
	Insects and insect eggs (AOAC 44.095 & 44.096)	5 or more Drosophila and other fly eggs per 250 ml or 1 or more maggots per 250 ml
Cloves	Stems (MPM-V-32)	Average of 5% or more stems by weight
Cocoa Beans	Mold (MPM-V18)	More than 4% of beans by count are moldy
	Insect filth (MPM-V18)	More than 4% of beans by count are insect-infested including insect-damaged
	Insect filth and/or mold (MPM-V18)	More than 6% of beans by count are insect-infested or moldy
	Mammalian excreta (MPM-V18)	Mammalian excreta is 10 mg per pound or more
Cocoa Powder Press Cake	Insect filth (AOAC 44.007)	Average of 75 or more microscopic insect fragments per subsample of 50 grams when 6 subsamples are examined OR
		Any 1 subsample contains 125 or more microscopic insect fragments
	Rodent filth (AOAC 44.007)	Average in 6 or more subsamples is more than 2 rodent hairs per subsample of 50 grams OR
		Any 1 subsample contains more than 4 rodent hairs
	Shell (AOAC 44.13.012-13.026)	2% or more shell calculated on the basis of alkali-free nibs
Coffee Beans, green	Insect filth and insects (MPM-V1)	Average 10% or more by count are insect-infected or insect-damaged OR
		If live insect infestation is present, 1 live insect in each of 2 or more immediate containers, or 1 dead insect in each of 3 or more immediate containers, or 3 live or dead insects in 1 immediate container AND
		Similar live or dead insect infestation present on or immediate proximity of the lot OR
		1 or more live insects in each of 3 or more immediate containers OR
		2 or more dead whole insects in 5 or more immediate containers OR
		2 or more live or dead insects on 5 or more of cloth or burlap containers
	Mold (MPM-V1)	Average of 10% or more beans by count are moldy
graded green	Poor Grade	Beans are poorer than Grade 8 of the New York Green Coffee Association
Condimental Seeds other than Fennel Seeds and Sesame Seeds	Mammalian excreta (MPM-V32)	Average of 3mg or more of mammalian excreta per pound
Corn: Sweet Corn, canned	Insect larvae (corn ear worms, corn borers) (AOAC 44.109)	2 or more 3mm or longer larvae, cast skins, larval or cast skin fragments of corn ear worm or corn borer and the aggregate length of such larvae, cast skins, larval or cast skin fragments exceeds 12 mm in 24 pounds (24 No. 303 cans or equivalent)

Product	Defect (Method)	Action Level
Corn Husks for Tamales	Insect filth (MPM-V115)	Average of 5% or more pieces by weight of the corn husks examined insect-infested (including insect-damaged)
	Mold (MPM-V115)	Average of 5% or more pieces by weight are moldy
Cornmeal	Insects	Average of 1 or more whole insects (or equivalent) per 50 grams
	Insect filth (AOAC 048)	Average of 25 or more insect fragments per 25 grams
	Rodent filth (AOAC 048)	Average of 1 or more rodent hairs per 25 grams OR
		Average of 1 or more rodent excreta fragment per 50 grams
Cranberry Sauce	Mold (AOAC 44.200)	Average mold count is more than 15% OR
		The mold count of any 1 subsample is more than 50%
Cumin Seed	Sand and grit (AOAC 44.124)	Average of 9.5% or more ash and/or 1.5% or more acid insoluble ash
Currant Jam, black	Mold (MPM-V61)	Average mold count is 75% or more
Currants	Insect filth (MPM-V53)	5% or more by count wormy in the average of the subsamples
Curry Powder	Insect filth (AOAC 44.124)	Average of 100 or more insect fragments per 25 grams
	Rodent filth (AOAC 44.124)	Average of 4 or more rodent hairs per 25 grams
Date Material (chopped, sliced, or macerated)	Insects (MPM-V53)	10 or more dead insects in 1 or more subsamples OR
		5 or more dead insects (whole or equivalent) per 100 grams
	Pits (MPM-V53)	2 or more pits and/or pit fragments 2 mm or longer measured in the longest dimension per 900 grams
Dates, pitted	Multiple (MPM-V53)	Average of 5% or more dates by count are rejects (moldy, dead insects, insect excreta, sour, dirty, and/or worthless) as determined by macroscopic sequential examination
	Pits (MPM-V53)	Average of 2 or more pits and/or pit fragments 2 mm or longer in the longest dimension per 100 dates
Dates, whole	Multiple (MPM-V53)	Average of 5% or more dates by count are rejects (moldy, dead insects, insect excreta, sour, dirty, and/or worthless as determined by macroscopic sequential examination)
Eggs and other egg products, frozen	Decomposition (AOAC 46.003-46.012)	2 or more cans decomposed and at least 2 subsamples from decomposed cans have direct microscopic counts of 5 million or more bacteria per gram
Fennel Seed	Insects (MPM-V32)	20% or more of subsamples contain insects
	Mammalian excreta (MPM-V32)	20% or more of subsamples contain mammalian excreta OR
		Average of 3 mg or more of mammalian excreta per pound
Fig Paste	Insects (AOAC 44.092-44.093)	Over 13 insect heads per 100 grams of fig paste in each of 2 or more subsamples

Product	Defect (Method)	Action Level
Figs	Insect filth and/or mold and/or dirty fruit or pieces of fruit (MPM-V53)	Average of 10% or more pieces by count are rejects Average of more than 10% of pieces are insect-infested and/or moldy dirty fruit or pieces of fruit
Fish, fresh or frozen (applies to fish or fillets weighing 3 pounds or less)	Decomposition	Decomposition in 5% or more of the fish or fillets in the sample (but not less than 5) show Class 3 decomposition over at least 25% of their areas OR 20% or more of the fish or fillets in the sample (but not less than 5) show Class 2 decomposition over at least 25% of their areas OR The percentage of fish or fillets showing Class 2 decomposition as above plus 4 times the percentage of those showing Class 3 decomposition as above equals at least 20% and there are at least 5 decomposed fish or fillets in the sample Classes of Decomposition 1. No odor of decomposition 2. Slight odor of decomposition 3. Definite odor of decomposition
Tullibees, Ciscoes, Inconnus, Chubs, and Whitefish	Parasites (cysts) (MPM-V28)	50 parasitic cysts per 100 pounds (whole or fillets), provided that 20% of the fish examined are infested
Blue Fin and other Fresh Water Herring	Parasites (cysts) (MPM-V28)	60 cysts per 100 fish (fish averagin 1 pound or less) or 100 pounds of fish (fish averaging over 1 pound), provided that 20% of the fish examined are infested
Red Fish and Ocean Perch	Parasites (cysts) (MPM-V28)	3% of the fillets examined contain 1 or more copepods accompanied by pus pockets
Ginger, whole	Insect filth and/or mold (MPM-V32)	Average of 3% or more pieces by weight are insect-infested and/or moldy
	Mammalian excreta (MPM-V32)	Average of 3 mg or more of mammalian excreta per pound
Greens, canned	Mildew	Average of 10% or more of leaves, by count or weight, showing mildew over 1/2" diameter
Hops	Insects (aphids) (AOAC 44.008)	Average of more than 2,500 aphids per 10 grams
Macaroni and Noodle Products	Insect filth (AOAC 44.069)	Average of insect fragments equals or exceeds 225 per 225 grams in 6 or more subsamples
	Rodent filth (AOAC 44.069)	Average of rodent hairs equals or exceeds 4.5 per 225 grams in 6 or more subsamples
Mace	Insect filth and/or mold (MPM-V32)	Average of 3% or more pieces by weight are insect-infested and/or moldy
	Mammalian excreta (MPM-V32)	Average of 3 mg or more of mammalian excreta per pound
	Foreign matter (MPM-V32)	Average of 1.5% or more of foreign matter through a 20-mesh sieve
Mushrooms, canned and dried	Insects (AOAC 44.115 & 44.116)	Average of 20 or more maggots of any size per 100 grams of drained mushrooms and proportionate liquid or 15 grams of dried mushrooms OR Average of 5 or more maggots 2mm or longer per 100 grams of drained mushrooms and proportionate liquid or 15 grams of dried mushrooms

Product	Defect (Method)	Action Level	
	Mites (AOAC 44.115 & 44.116)	Average of 75 mites per 100 grams drained mushrooms and proportionate liquid or 15 grams of dried mushrooms	
	Decomposition (MPM-V100)	Average of more than 10%, by weight, of mushrooms are decomposed	
Nutmeg	Insect filth and/or mold (MPM-V41)	Average of 10% or more pieces by count are insect-infested and/or moldy	
Nuts, tree	Multiple defects (MPM-V81)	Reject nuts (insect-infested, rancid, moldy, gummy, and shriveled or empty shells) as determined by macroscopic examination at or in excess of the following levels	
		Unshelled(%)	Shelled(%)
Almonds		5	5
Brazils		10	5
Cashew		-	5
Green Chestnuts		5	-
Baked Chestnuts		10	-
Dried Chestnuts		-	5
Filberts		10	5
Lichee Nuts		15	-
Pecans		10	5
Pili Nuts		15	10
Pistachios		10	5
Walnuts		10	5
Olives:			
Pitted	Pits (MPM-V67)	Average of 1.3 or more by count of olives with whole pits and/or pit fragments 2mm or longer measured in the longest dimension	
Imported Green	Insect damage (MPM-V67)	7% or more by count showing damage by olive fruit fly	
Salad	Pits (MPM-V67)	Average of 1.3 or more by count of olives with whole pits and/or pit fragments 2 mm or longer measured in the longest dimension	
	Insect damage (MPM-V67)	9% or more by count showing damage by olive fruit fly	
Salt-cured	Insects (MPM-V71)	Average of 6 subsamples is 10% or more olives by count with 10 or more scale insects each	
	Mold (MPM-V67)	Average of 6 subsamples is 25% or more olives by count are moldy	
Imported Black	Insect damage (MPM-V67)	10% or more by count showing damage by olive fruit fly	
Peaches, canned and frozen	Moldy or Wormy (MPM-V51)	Average of 3% or more fruit by count are wormy or moldy	
	Insect damage (MPM-V51)	In 12 1-pound cans or equivalent, one or more larvae and/or larval fragments whose aggregate length exceeds 5 mm	
Peanut butter	Insect filth (AOAC 44.037)	Average of 30 or more insect fragments per 100 grams	
	Rodent filth (AOAC 44.0354)	Average of 1 or more rodent hairs per 100 grams	
	Grit (AOAC 44.034)	Gritty taste and water insoluble inorganic residue is more than 25 mg per 100 grams	

Product	Defect (Method)	Action Level
Peanuts, shelled	Multiple defects (MPM-V89)	Average of 5% or more kernels by count are rejects (insect-infested, moldy, rancid, otherwise decomposed, blanks, and shriveled)
	Insects (MPM-V89)	Average of 20 or more whole insects or equivalent in 100 pound bag siftings
Peanuts, unshelled	Multiple defects (MPM-V89)	Average of 10% or more peanuts by count are rejects (insect-infested, moldy, rancid, otherwise decomposed, blanks, and shriveled)
Peas: Black-eyed, Cowpeas, Fieldpeas, Dried	Insect damage (MPM-V104)	Average of 10% or more by count of class 6 damage or higher in minimum of 12 subsamples
Peas, Cowpeas, Black-eyed peas (succulent), canned	Insect larvae (MPM-V104)	Average of 5 or more cowpea curculio larvae or the equivalent per No. 2 can
Peas and Beans, dried	Insect filth (MPM-V104)	Average of 5% or more by count insect-infested and/or insect-damaged by storage insects in a minimum of 12 subsamples.
Pepper, whole	Insect filth and/or mold (MPM-V39)	Average of 1% or more pieces by weight are insect infested and/or moldy
	Mammalian excreta (MPM-V39)	Average of 1% or more mammalian excreta per pound
	Foreign matter (MPM-V39)	Average of 1% or more pickings and siftings by weight
Pineapple, canned	Mold (AOAC 44.199)	Average mold count for 6 subsamples is 20% or more OR The mold count of any 1 subsample is 60% or more
Pineapple Juice	Mold (AOAC 44.199)	Average mold count for 6 subsamples is 15% or more OR The mold count of any subsample is 40% or more
Plums, canned	Rot (MPM-V51)	Average of 5% or more plums by count with rot spots larger than the area of a circle 12 mm in diameter
Popcorn	Rodent filth (AOAC 44.099)	1 or more rodent excreta pellets are found in 1 or more subsamples, and 1 or more rodent hairs are found in 2 or more other subsamples OR 2 or more rodent hairs per pound and rodent hair is found in 50% or more of the subsamples
	Field corn	5% or more by weight of field corn
Potato chips	Rot (MPM-V113)	Average of 6% or more pieces by weight contain rot
Prunes: dried and dehydrated, low-moisture	Pits (MPM-V53)	Average of a minimum of 10 subsamples is 5 % or more prunes by count are rejects (insect-infested, moldy or decomposed, dirty, and/or otherwise unfit)
Prunes, pitted	Pits (MPM-V53)	Average of 10 subsamples is 2% or more by count with whole pits and/or pit fragments 2 mm or longer and 4 or more of 10 subsamples of pitted prunes have 2% or more by count with whole pits and/or pit fragments 2 mm or longer
Raisins	Mold (MPM-V76)	Average of 10 subsamples is 5% or more raisins by count are moldy
	Sand and Grit (MPM-V76)	Average of 10 subsamples is 40 mg or more sand and grit per 100 grams of natural or golden bleached raisins

Product	Defect (Method)	Action Level
	Insects and insect eggs (AOAC 44.097 & MPM-V76)	10 or more whole or equivalent insects and 35 Drosophila eggs per 8 oz. of golden bleached raisins
Salmon, canned	Decomposition	2 or more Class 3 defective cans, regardless of lot or container size OR
		2 to 30 Class 2 and/or Class 3 defective cans as required by sampling plan based on lot size and container size
Sesame seeds	Insect filth (MPM-V32)	Average of 5% or more seeds by weight are insect-infested
	Mold (MPM-V32)	Average of 5% or more seeds by weight are decomposed
	Mammalian excreta (MPM-V32)	Average of 5 mg or more mammalian excreta per pound
	Foreign matter (MPM-V32)	Average of 0.5% or more foreign matter by weight
Shrimp: fresh, or frozen, raw, headless peeled or breaded	Decomposition	5% or more are Class 3 or 20% or more are Class 2 decomposition as determined by organoleptic examination OR
		If percentage of Class 2 shrimp plus 4 times percent of Class 3 equals or exceeds 20% (See Fish product listing for definition of decomposition classes)
Shrimp: imported, canned or cooked/frozen	Decomposition	Indole levels in two or more subsamples equal or exceed 25 micrograms per 100 grams for both original and check analysis
Spices: leafy, other than bay leaves	Insect filth and/or mold (MPM-V32)	Average of 5% or more pieces by weight are insect infested and/or moldy
	Mammalian excreta (MPM-V32)	Average of 1 mg or more of mammalian excreta per pound after processing
Spinach, canned or frozen	Insects and mites (AOAC 44.110)	Average of 50 or more aphids and/or thrips and/or mites per 100 grams OR
		2 or more 3 mm or larvae and/or larval fragments of spinach worms (caterpillars) whose aggregate length exceeds 12 mm are present in 24 pounds OR
		Leaf miners of any size average 8 or more per 100 grams or leaf miners 3 mm or longer average 4 or more per 100 grams
Strawberries: frozen, whole, or sliced	Mold (AOAC 44.206)	Average mold count of 45% or more and mold count of at least half of the subsamples is 55% or more
	Grit	Berries taste gritty
Tomatoes, canned	Drosophila fly (AOAC 44.119)	Average of 10 or more fly eggs per 500 grams; or 5 or more fly eggs and 1 or more maggots per 500 grams; or 2 or more maggots per 500 grams, in a minimum of 12 subsamples
Tomatoes, canned with or without juice (based on drained juice)	Mold (AOAC 44.206)	Average mold count in 6 subsamples is more than 15%, and the mold counts of all of the subsamples are more than 12%
Tomatoes, canned, packed in tomato puree (based on drained liquid)	Mold (AOAC 44.206)	Average mold count in 6 subsamples is more than 29% and the counts of all the subsamples are more than 25%
Tomato Juice	Drosophila fly (AOAC 44.119)	Average of 10 or more fly eggs per 100 grams; or 5 or more fly eggs and 1 or more maggots per 100 grams; or 2 or more maggots per 100 grams, in a minimum of 12 subsamples

Product	Defect (Method)	Action Level
	Mold (AOAC 44.207)	Average mold count in 6 subsamples is 24% or more and the mold counts of all of the subsamples are more than 20%
Tomato Paste, Pizza, and other sauces	Drosophila fly (AOAC 44.119)	Average of 30 or more fly eggs per 100 grams; or 15 or more fly eggs and 1 or more maggots per 100 grams; or 2 or more maggots per 100 grams, in a minimum of 12 subsamples
Tomato Puree	Drosophila fly (AOAC 44.119)	Average of 20 or more fly eggs per 100 grams; or 10 or more fly eggs and 1 or more maggots per 100 grams; or 2 or more maggots per 100 grams, in minimum of 12 subsamples
Tomato paste or puree	Mold (AOAC 44.207)	Average mold count in 6 subsamples is 45% or more and the mold counts of all of the subsamples are more than 40%
Pizza and other sauces (mold)	Mold (AOAC 44.209)	Average mold count in 6 subsamples is more than 34% and the counts of all of the subsamples are more than 30%
Tomato Sauce (undiluted)	Mold (AOAC 44.207)	Average mold count in 6 subsamples is 45% or more and the mold counts of all of the subsamples are more than 40%
Tomato Catsup	Mold (AOAC 44.207)	Average mold count in 6 subsamples is 55% or more
Tomato powder (except spray-dried)	Mold (AOAC 44.211)	Average mold count in 6 subsamples is 45% or more and the mold counts of all of the subsamples are mold than 40%
Tomato Powder, spray-dried	Mold (AOAC 44.211)	Average mold count in 6 subsamples is 67% or more
Tomato soup and tomato products	Mold (AOAC 44.208)	Average mold count in 6 subsamples is 45% or more and the mold counts of all of the subsamples are more than 40%
Tuna, canned: albacore, skipjack, and yellowfin	Histamine (AOAC 18.067)	Histamine content per subsample equals or exceeds 20 mg per 100 grams in both original and check analysis (tow subsamples minimum)
Wheat	Insect damage (MPM-V15)	Average of 32 or more insect-damaged kernels per 100 grams
	Rodent filth (MPM-V15)	Average of 9 mg or more rodent excreta pellets and/or pellet fragments per kilogram
Wheat Flour	Insect filth (AOAC 44.052)	(As of February 1989, has been changed to "Average of 75 or more insect fragments per 50 grams in 6 subsamples")
	Rodent filth (AOAC 44.052)	Average of 1 or more rodent hairs per 50 grams in 6 subsamples

Notes

Introduction

[1] Jean Kinsey, "Food Quality and Prices," in *Agricultural and Food Policy Issues for the 1990s*, #10, summary of a paper presented at the National Agricultural and Food Policy Workshop held on November 16-17, 1989 in Washington, D.C.

[2] 1990 Farm Bill, §1351 (7 USC 1622 note).

[3] Van den Bosch, Robert, et al. *Investigation of the Effects of Food Standards on Pesticide Use*. Prepared for the USEPA, NTIS #PB-278-976, 1978; A. Ann Sorensen, *AFBF Survey on Cosmetic Standards and Pesticide Use: A Narrative Summary of Results* (Park Ridge, IL: American Farm Bureau Federation, 1991).(Hereafter cited as *AFBF Survey*)

[4] USEPA, Science Advisory Board, *The Report of the Ecology and Welfare Subcommittee: Relative Risk Reduction Project*, EPA SAB-EC-90-021A, 1990.

[5] Agricultural Marketing Act of 1946 (60 Stat. 1087, as amended; 7 U.S.C. 1621-1627).

[6] Agricultural Marketing Agreement Act of 1937, § 10, 48 Stat. 37, as amended (7 U.S.C. 610; found in 7 CFR sections 900 and sequential).

[7] Food, Drug, and Cosmetic Act (FDCA), § 402 (a)(3).

[8] The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and Food, Drug, and Cosmetic Act, §408 and §409.

[9] Robert Weaver, et al, cites seven recent willingness-to-pay studies that indicate between 71% and 94% of consumers are concerned about pesticide use in fresh produce. D. Weaver, et al, *Pesticide Use in Tomato Production: Consumer Concerns and Willingness-to-Pay*, Staff Paper #200 (University Park, PA: College of Agriculture, Pennsylvania State University, 1991).

[10] See John P. Hoehn and Eileen van Ravenswaay, *Consumer Willingness to Pay For Reducing Pesticide Residues in Food: Results of a Nationwide Survey*, staff paper no. 91-18 (East Lansing, MI: Michigan State University, 1991). Also see other studies by Hoehn and van Ravenswaay listed under references.

Chapter I: Economic Factors Affecting Grower Behavior

[1] *1987 Census of Agriculture*, Bureau of the Census, U.S. Department of Commerce, (Washington, 1988).

[2] In 1978, 91% of apple and 72% of citrus acreage were treated with insecticides. David Pimental, et al, "Benefits and Costs of Pesticide Use in U.S. Food Production," *Bioscience* 28, no. 12 (1978): 778. (hereafter cited as "Benefits and Costs of Pesticide Use") Approximately 95% of grape hectarage is treated with fungicides. (David Pimental, et al, 1991, p 403) In 1987, the National Research Council suggested that "virtually all perishable fresh fruits and vegetables. . . depend heavily on pesticides. Some are treated a dozen or more times each year with six or more active ingredients." (National Research Council, 1987, p. 49)

[3] Robert L. Shewfelt, "Quality of Fruits and Vegetables: Scientific Status Summary" (Chicago: Institute of Food Technologists, 1990), 1-3; Weaver, et al.

[4] Douglas D. Parker, et al, "How Quality Relates to Price in California Fresh Peaches," *California Agriculture* 45, no. 2 (March-April 1991): 14. In the case of California fresh peaches, this survey suggests that sugar content is relatively unimportant at the producer level while at the retail level a higher sugar content can "increase price over $2 per lug."(p. 16)

[5] Personal communication with farmers and major commodity organizations in the fruit and vegetable industry.

[6] Both Ray Harris' and Tony Hall's comments were taken from C. McCarthy, "Thanks for Potatoes," *The Washington Post* (22 November 1990): A31.

[7] See Gail Feenstra, *Who Chooses Your Food: A Study of the Effects of Cosmetic Standards on the Quality of Produce* (Los Angeles: CALPirg, 1988). Premium fruit receives premium prices. In the citrus market, for example, oranges which Sunkist stamped with its brand name (its highest quality oranges) received $5/carton more than did oranges at the second highest quality level in 1986. Juice oranges that year received only $2/carton.

Prices for the juice market were so low that packers would not pay for shipping or hauling to the point of processing. (Feenstra, 17-18) Fruit used for even lower-value uses, such as animal feed, may command prices as low as $2 to $5 per *ton*. Also see James F. Thompson, "Preparation for Fresh Market: IV. Cull Utilization," in *Postharvest Technology of Horticultural Crops* (University of California, Cooperative Extension Service, 1985), 26.

[8] While such produce may be salable in the fresh market, fresh produce distributors and retailers may be unable to accommodate it at a point in time, preferring to handle produce with a higher profit margin.

[9] Steve Wood, New Hampshire apple grower, personal communication, 29 March 1989.

[10] Michael Reid, "Product Maturation and Maturity Indices," in *Postharvest Technology of Horticultural Crops* (University of California, Cooperative Extension Service, 1985), 9.

[11] Dr. Hempler, Director, German Fertilizer Institute, Telephone interview with Andrew Manale, 7 April 1990.

[12] Commission on California State Government Organization and Economy, *Control of Pesticide Residues in Food Products: A Review of the California Program of Pesticide Regulation*, 1985, 37-53.

[13] For an example regarding the growth regulator Alar, see Philip Shabecoff "Apple Sales Rise After Scare of '89," *The New York Times* (13 November 13, 1990): A28.

[14] James K. Hammitt, *Estimating Consumer Willingness to Pay to Reduce Food-Borne Risk* (Santa Monica, CA: Rand Corporation, 1986), 63.

[15] NutriClean, Inc. is an independent lab which certifies fruits and vegetables as residue-free at the time of harvest. (Steel, p. 12-13) Many health food stores and some direct marketing retailers label non-certified produce (such as 'transitional' organic) or provide information concerning growing practices (such as pesticides used or not used).

[16] For a summary of recent willingness-to-pay studies, see Weaver, et al. Also see, Eileen van Ravenswaay, "How Much Food Safety Do Consumers Want? An Analysis of Current Studies and Strategies for Future Research," in Katherine L. Clancy, ed., *Consumer Demands in the Marketplace: Public Policy in Relation to Food Safety, Quality in Human Health* (Washington, D.C.: Resources For the Future, 1988).

[17] For example, with proper information and labeling, produce grown under a certified level of IPM practices (and possibly with lower cosmetic standards) may increase consumer and retailer demand for such produce (priced more competitively with conventional produce than organic) offering an affordable alternative for the average consumer. A recent survey of growers, suggests many growers are interested in IPM certification (Sorensen, *AFBF Survey*). However, some have suggested that such a system would be avoided by retailers since it may erode confidence in conventional produce safety. (Steel, p. 13) Withstanding these concerns, in the current trend of environmentally oriented marketing, adding more consumer choices would be beneficial for those retailers catering to the environmentally conscious consumer as a way to profit by selling more environmentally sound products.

[18] J.C. Headley, "Estimating the Productivity of Agricultural Pesticides," *American Journal of Agricultural Economics* 50, no.1 (Feb 1968): 13-15; Pimental, et al, "Benefits and Costs of Pesticide Use", 772, 778-784.

[19] *Alternative Agriculture* (National Academy Press, Washington D.C., 1989), 342; A. Ann Sorensen, *IPM and Growers: An Evolution in Thinking, American Farm Bureau Federation* (Park Ridge, IL: American Farm Bureau Federation, 1991), p. 3. (hereafter cited as *IPM and Growers*)

[20] Sorensen, *IPM and Growers*, p. 4.

[21] A number of organic growers with whom we have spoken insist that they can meet existing federal grading standards *in season*, though their costs do tend to be higher than for conventional farmers. In a survey (Bunn, et al, 1990) of 229 supermarket shoppers there was initially low acceptance of cosmetically scarred oranges, but acceptance rose substantially after information was provided about reduced pesticide use. In a 1990 State of Florida Department of Citrus fresh oranges commercial, consumers were told how different colored orange skins (yellow or green) do not determine how oranges taste inside; based on marketing research, consumers changed the way they perceive cosmetic quality in oranges. (*Report on the Performance of the Fresh Florida Oranges Commercial `As Orange as They Get*, 1990)

Chapter II: Government Programs Affecting Produce Quality and Their Implication for Pesticide Use

[1] Commission on California State Government Organization and Economy, *Control of Pesticide Residue in Food Products*, 1985, 143-152.

[2] United States General Accounting Office, *Food Safety and Qaulity: Who Does What in the Federal Government*, GAO/RCED-91-19B (Washington, 1990), 63.

[3] See tables in Appendix B for a list of the attributes included in the grading standards for various fresh and processing fruits, vegetables and tree nuts.

[4] See David Bunn, et al, "Consumer Acceptance of Cosmetically Imperfect Produce," *The Journal of Consumer Affairs* 24, no. 2 (1990): 268-279. For an analysis of changes in consumer behavior resulting from the Florida Citrus Association's 1990-1991 campaign to educate consumers regarding the relationship between citrus appearance and quality, see *Report on the Performance of the Fresh Florida Oranges Commercial 'As Orange as They Get'*, prepared for the State of Florida, Department of Citrus, (Princeton: Mapes and Ross, Inc., 1990). For a brief summary of both of these citations, refer to endnote 30, Chapter II.

[5] Approximately 80% of consumers in a nationwide survey considered residues to constitute a serious hazard. In the past two years, almost 20% of consumers have altered their purchasing patterns to include the purchase of organic or certified `residue-free' produce. Marciel A. Pastore and Christine M. Bruhn, "A Shopper's Survey: California Nuts and Produce, Food Quality, and Food Safety," *California Agriculture* 45, no. 1 (January-February 1991): 25-27.

[6] U.S. General Accounting Office, *The Role of Marketing Orders in Establishing and Maintaining Orderly Market Conditions*, July 31, 1985, GAO/RCED-85-57, p. 26. For a specific example, see the marketing order for Tomatoes Grown in Florida (7 Code of Federal Regulations, Chapter IX, Section 966.10, January 1988 edition) to see how the marketing orders adopt existing grading standards.

[7] A. Ann Sorensen, *IPM and Growers*. Also, personal communications with consultants and growers.

[8] van den Bosch, Robert, et al, p. 11.

[9] See § 402 (a)(3) of the Act from van den Bosch, et al., p. 13.

[10] The majority of Defect Action Levels affect canned, bottled, frozen, or dried food products, including spices. See Food and Drug Administration, *The Food Defect Action Levels*, 1989, for a complete listing of all established DALs.

[11] van den Bosch, et al, p. 13.

[12] Paris Brickey, Microanalytic Branch, U.S. Food and Drug Administration, Telephone interview with Doug Koplow, 18 September 1989.

[13] For example, in the 1930s, the DAL for aphids in spinach was 110 aphids in 100 grams; in 1977 it was 50 aphids/100 grams. The allowable level for leaf miners in spinach was 40 per 100 grams in 1930; in 1978 it was 8 per 100 grams. Pimental, et al, "Pesticides, Insects in Foods, and Cosmetic Standards," *BioScience* 27, no. 3 (March 1977): 179.

[14] Faye Gibson, Division of Regulatory Guidance, U.S. Food and Drug Administration, Letter to Andrew Manale, 20 April 1990.

[15] David Pimental, et al, "Pesticides, Insects in Foods, and Cosmetic Standards," p. 180. Article cites over 15 studies concluding that ingesting herbivorous insect fragments poses insignificant health risks. Also see, Feenstra, p. 7.

[16] Terry Troxell, Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration, Telephone interview with Doug Koplow, 15 September 1989; Paris Brickey, Microanalytic Branch, U.S. Food and Drug Administration, Telephone interview with Doug Koplow, 18 September 1989.

[17] Except for information concerning note 16, information for this paragraph is from van den Bosch, et al, pp. 17-18.

[18] *Ibid.*, p. 21.

[19] John P. Hoehn and Eileen van Ravenswaay, "The Impact of Health Risk Information on Food Demand: A Case Study of Alar and Apples," in Julie A. Caswell, ed., *Economics of Food Safety* (New York: Elsevier Science Publishing Co., Inc., 1991), 156-157.

[20] Shabecoff, p. A28.

[21] van den Bosch, et al, p. 6.

[22] Marketing order components are from Edward V. Jesse and Aaron C. Johnson, Jr., *Effectiveness of Federal Marketing Orders for Fruits and Vegetables*, USDA, National Economics Division, 1981; Glenn Zepp and Nicholas Powers, ``Marketing Orders: Industry Self-Regulation,'' *Agricultural Outlook* (September 1987): 16-18.

[23] Zepp and Powers, p. 18.

[24] Jesse and Johnson, p. 12.

[25] van den Bosch, et al, p. 5.

[26] Jesse and Johnson, p. 12.

[27] Zepp and Powers, p. 24.

[28] AMS/USDA, comments on the January 1992 draft version of this report, 10 February 1992.

[29] Jesse and Johnson, pp. 44-45.

[30] For example, since Sunkist has 50% of the representation, it has the power to influence decisions reached by the citrus marketing board. (Feenstra, pp. 19-20) In the Summer of 1991, Sunkist exercised its block vote to continue the marketing order for naval oranges; many Sunkist and independent growers and packers disagreed with the move since it restricts their domestic sales of navel oranges during the harvest season, but lacking a

majority, they could not stop it. Growers and packers who do not comply with the orders (by selling on the black market or cheating) face stiff fines. (Taylor and McGraw, "Rural Rebellion Simmers Under Marketing Rules", p. 14)

[31] If consumers perceive a lower health and environmental risk from fruits and vegetables that look less than perfect (minimally scarred or with a different color), consumer demand might change. In a survey (Bunn, et al, 1990) of 229 supermarket shoppers there was initially low acceptance of cosmetically scarred oranges, but acceptance rose substantially after information was provided about reduced pesticide use. In a 1990 State of Florida Department of Citrus fresh oranges commercial, consumers were told how different colored orange skins (yellow or green) do not determine how oranges taste inside; based on marketing research, the commercials changed the way some consumers perceive cosmetic quality in oranges. (*Report on the Performance of the Fresh Florida Oranges Commercial 'As Orange as They Get*)

[32] Feenstra, p. 51.

Chapter III: Market-based Factors Affecting Cosmetic Appearance

[1] van den Bosch, et al, p. 2.

[2] For example, Very Fine Apple Juice (Littleton, MA) developed formal contracts stipulating that growers could not use Alar in the production of their apples. The contract was in effect until 1989 (the company determined that none of its growers were considering Alar use following the 'Alar Scare') and was enforced by extensive testing of shipments. This trend seems to be growing. (Ron Green, apple buyer, Very Fine, Inc., personal communication, September 18, 1989).

[3] Feenstra, p. 21.

[4] *Ibid.*

[5] Wood, 1989.

[6] Feenstra, pp. 2-3.

[7] David Bunn, CALPirg, Telephone interview with Doug Koplow, 9 February 1989.

[8] Dr. Ted Wilson, as quoted in Feenstra, p. 45.

[9] William Quarles, V.P. Government Affairs, Sunkist Growers Inc., Telephone interview with Mark Liniado, 16 April 1992.

[10] Feenstra, p. 20.

[11] William Quarles, 1992.

[12] van den Bosch, et al, p. 76.

[13] *Ibid.*, p. 7.

[14] van den Bosch, p. 100.

[15] *Ibid.*

[16] For example, IPM and organic methods require more intensive monitoring of pest populations, weather, and soil fertility, as well as more attention to crop rotation patterns.

[17] Bryan Jay Bashin, "The Freshness Illusion," *Harrowsmith* (January/February 1987): 43.

[18] Surety of supply and lower shipping losses from unripe tomatoes than from transport of ripe tomatoes, has resulted in the current situation where about 95% of fresh market tomatoes are harvested at a stage referred to as "mature green," and ripened artificially at the local market. (Feenstra, p. 41). Though the fruit appears ripe, it will never develop the natural sugars that help to give vine-ripened fruit its flavor. (Bashin, p. 43; Feenstra, p. 41) According to the "U.S. Standards of Grade of Fresh Tomatoes", maturity is defined as a "stage of development which will insure a proper completion of the ripening process, and that the contents of two or more seed cavities have developed a jelly-like consistency and the seeds are well developed." (7 CFR 51, 1973 and 1991)

[19] Bashin, p. 43.

[20] There have been some suggestions that post-harvest chemicals are currently being used as a substitute for post-harvest refrigeration due to lower cost.

[21] Bashin, p. 44.

[22] National Research Council of the National Academy of Science, 1987.

[23] Bashin, p. 46; Pimental, et al, 1991, p. 403.

[24] See Sorensen, *AFBF Survey.*

Chapter IV: Case Studies

[1] These case studies represent a snapshot in time, we do have information that the manner of producing tomatoes has changed since the sources for this chapter were compiled in 1989 resulting in significant reductions in the use of pesticides, in California for example. The sources have not been updated except in the case of van Ravenswaay and Hoehn in endnote 24 (a draft version was cited in 1989).

[2] USDA/AMS, "US Standards for Grades of Fresh Tomatoes" (7 CFR 51, 1973 and 1991).

[3] Tomatoes Grown in the Lower Rio Grande Valley in Texas (7 CFR 965); Tomatoes Grown in Florida (7 CFR 966).

[4] USDA/AMS, "US Standards for Grades of Fresh Tomatoes" (7 CFR 51, 1973 and 1991). Although 15 percent are allowed not to meet tolerances, only a total of 5 percent can be affected by decay, a total of 10 percent can damaged by shoulder bruises or discolored or sunken

scars on any parts of tomatoes, a total of 10 percent can be otherwised defected, and a total of 5 percent can be seriously damaged by any cause.

[5] Feenstra, p. 36.

[6] K. Pohronezny, as quoted in National Research Council, *Alternative Agriculture*, p. 341.

[7] Bashin, p. 43.

[8] Feenstra, p. 38. Pesticide use on fresh tomatoes in California has greatly falled off since the adoption of drip irrigation. (See Jane Eickhoff and Barbara Petersen, *Survey of Pesticide Use on Fresh Market Tomatoes in California*, prepared for the California Fresh Tomato Advisory Board, 1989)

[9] *Ibid.*, p. 40.

[10] See endnote number 16, Chapter III, for the definition of "mature green."

[11] Bashin, p. 44.

[12] van den Bosch, et al, p. 108.

[13] Pimental, et al, 1977.

[14] van den Bosch, et al, p. 114.

[15] *Ibid.*, p. 111.

[16] Feenstra, p. 44.

[17] See, for example, Robert Metcalf, "The Ecology of Insecticides and the Chemical Control of Insects," in Marcos Kogan, ed., *Ecological Theory and Integrated Pest Management Practice* (New York: John Wiley & Sons, 1986), pp. 251-297.

[18] Feenstra, p. 46.

[19] Wilson, cited in Feenstra, p. 45.

[20] Feenstra, p. 45.

[21] In addition, some states have apple standards that are more stringent than Federal standards. These affect growers within the state, as well as out-of-state growers who want to sell within the state. The purpose of such standards is to help develop a state brand name that consumers will recognize and associate with quality.

[22] Wood, 1989.

[23] Pest damage was measured as the amount of surface area on an apple in a photograph.

[24] Eileen van Ravenswaay and John P. Hoehn, *Consumer Willingness to Pay for Reducing Pesticide Residues in Food: Results of a Nationwide Survey*, Staff Paper no. 91-18 (East Lansing, MI: Depart. of Ag. Economics, Michigan State University, 1991).

[25] Arthur Kelly, Maine apple grower, personal communication, 3/28/89.

[26] *Ibid.*

[27] *Ibid.* Two researchers estimate that most apple growers have attempted some level of IPM, especially for mite control. (M. Whalon and B. Croft, "Apple IPM Implementation in North America," *Annual Review of Entomology* 29 (1984): 462.

[28] Bethell, 1989.

[29] Wood, 1989.

[30] Such as work by Dr. Carolyn Pickle of the U.S. Cooperative Extension Service in California.

[31] Bethell, 1989.

[32] Between 5 and 10 percent of one apple grower's budget (Kelly, 1989).

Chapter V: Conclusions

No references cited.

Appendix A

[1] Sources for altering food grading standards are: Ken Mizelle, USDA Agricultural Marketing Service, Fruit & Vegetable Division, Fresh Products Branch, Standardization Section, Telephone interviews with Doug Koplow, 31 March 1989 and 3 April 1989; USDA, AMS/F&VD/FPB "Procedures for Revision of U.S. Grading Standards," August 7, 1986; USDA, "Guidelines for Developing New or Changing Existing U.S. Standards for Fruits, Vegetables, and Nuts."

[2] Mizelle, 1989.

[3] USDA, "United States Standards for Grades of Fresh Tomatoes," p. 2.

[4] Process is from *Federal Register*, 16 April 1989, p. 12931; *Federal Register*, 21 September 1982, p. 41638; Brickey, 1989; and Troxell, 1989.

[5] For example, a 1982 DAL for cabbage was requested by the National Kraut Packers Association because sauerkraut processors were refusing to accept cabbage infested with thrips (Federal Register, September 21, 1982, p. 41638).

[6] Brickey, 1989.

[7] Troxell, 1989. The 95th percentile is determined at a 99% confidence level.

[8] Source for steps to change a marketing order is Walter Armbruster and Edward Jesse, "Fruit and Vegetable Marketing Orders" (East Lansing, MI: Cooperative Extension Service, 1984), unless otherwise noted.

[9] Zepp and Powers, p. 17.

[10] Armbruster and Jesse, p. 8.

Appendix B

See table footnotes within the appendix for relevant citations.

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