

Greenhouse Tomatoes Change the Dynamics of the North American Fresh Tomato Industry

Roberta Cook and Linda Calvin¹

Introduction

As recently as the early 1990s, greenhouse tomatoes were a specialty product, and most came from the Netherlands. By the late 1990s, greenhouse tomatoes were being allotted sizable shelf-space in most U.S. and Canadian grocery stores. Now, the United States, Canada, and Mexico all produce greenhouse tomatoes, and suppliers outside North America play a diminished role. The rapid growth of the North American greenhouse tomato industry has caused greenhouse tomatoes to become more integrated into the fresh tomato industry, rather than operate as a separate niche. Now the greenhouse industry is large enough to impact industry dynamics for all fresh tomato growers. This report documents the emergence of the North American greenhouse tomato industry and assesses its impact on the fresh tomato sector as a whole.

The report begins with an overview of the North American fresh tomato industry, putting the emerging North American greenhouse tomato industry in context within an industry still dominated by field tomatoes. While the North American Free Trade Agreement (NAFTA) has contributed to greater integration in the fresh tomato industry, there are important regional differences which merit a country-by-country approach. We start with a discussion of the greenhouse tomato industries in Canada and Mexico, noting each country's fresh tomato trade profile. The structure of the entire fresh tomato industry is considered for Mexico, since unlike in the United States and Canada, many greenhouse growers also produce field tomatoes. The United States is discussed last because imports from Canada and Mexico have such an important impact on the U.S. greenhouse tomato industry. In addition to describing the evolution of the U.S. greenhouse tomato industry, this section consolidates all of the information on trade flows touched on elsewhere to estimate total U.S. greenhouse tomato supply, from domestic production and imports. This lays the groundwork for the next section analyzing the U.S. greenhouse tomato market, highlighting price trends in the principal consumer market in North America. Following is an analysis of the impact of greenhouse tomatoes on the fresh field tomato industry in the United States.

Because of the rapid increase in production, the North American greenhouse tomato industry has faced conflict, most notably two antidumping cases between the United States and Canada. A section on conflicts and efforts to cooperate highlights the stresses of an emerging industry. The report concludes with the outlook facing the greenhouse and fresh field tomato industries.

¹Roberta Cook is an extension marketing economist in the Department of Agricultural and Resource Economics, University of California, Davis; Linda Calvin is an agricultural economist with ERS.

Canada is the only country in North America with annual government statistics on greenhouse tomato area and production. Estimates of U.S. and Mexican area and production are based on interviews with growers, marketers, and leaders of industry organizations. While subject to error, they provide an important first step in understanding the industry. Limited price reporting also challenges analysis. There are no free-on-board (FOB) shipping-point prices for greenhouse tomatoes grown in the United States.² Daily prices by type of greenhouse tomato are available on imports from Mexico, but only those entering through Nogales, Arizona, and not for the whole year. Trade statistics from the U.S. Department of Commerce (DOC) provide monthly unit-value border prices for imports on all imported greenhouse tomatoes, by country of origin, but no information on price by type or size of greenhouse tomato. The findings of this report reflect the use of all available public information, supplemented by extensive primary data collection from industry sources.

Overview of the North American Greenhouse Tomato Industry

This overview discusses three factors that are critical to understanding the greenhouse tomato industry. It also provides a broad picture of the industry and perspective for the following individual country analyses. The first important factor is seasonality, which explains why there is a North American greenhouse tomato industry, not just three separate industries, and the role of trade. The structure of the North American fresh field tomato industry is also a function of seasonality, and the two fresh tomato industries are developing along similar lines. The second broad theme that will reappear throughout this study is product differentiation. Greenhouse tomatoes can be thought of as just one more type of tomato in the wide range of fresh tomatoes available to consumers. The existence of other tomato types influences the growth of greenhouse tomatoes and vice versa. Greenhouse and field tomatoes compete in some markets, but not in all. The third major factor affecting the greenhouse tomato industry is the rapid growth of production and the resulting decline in prices. Profitability and competitiveness will be an increasing challenge for growers. All of these factors will influence the future evolution of the North American greenhouse tomato industry.

Seasonality and Structure of the Industry

Seasonality is a major force affecting the North American fresh tomato industry, both greenhouse and field tomatoes. In the winter, field tomatoes are only available from Florida and Mexico. Over time, the industry has developed relationships that cross national borders and provide a relatively seamless supply of field tomatoes from different regions across the seasons (fig. 1). While greenhouse tomatoes can be grown anywhere at any time of the year, issues of profitability still impose seasonality. Even in a greenhouse, growers ignore Mother Nature at their peril. Increasingly, greenhouses are carefully situated to minimize the cost of achieving the ideal tomato growing conditions for the targeted market window. Following the pattern established by the field tomato industry, the greenhouse tomato industry has also developed a web of business relationships that provide

² FOB price is the average, unweighted unit price received at the shipping point in the production region. FOB prices exclude freight and insurance costs.

Figure 1

North America greenhouse tomato and fresh field tomato shipping seasons by region

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Field grown	California											
	Florida											
	Rest of U.S.											
	Sinaloa, Mexico											
	Baja California, Mexico											
	Canada											
Greenhouse	Canada											
	U.S. ¹											
	Sinaloa, Mex.											
	Imuris, Sonora, Mex.											
	Central Mexico											
	Baja California, Mexico ¹											

¹Many U.S. and Baja California, Mexico, greenhouse industry locations do not produce year-round, but there is year-round production in the aggregate.

Source: U.S. Department of Agriculture, Agricultural Marketing Service; estimates by Cook and Calvin.

greenhouse tomatoes from various regions in different seasons. In an increasingly integrated industry, national borders pose few barriers.³ Marketing firms use marketing agreements, joint ventures, and, to a lesser extent, foreign direct investment to ensure smooth supplies across seasons.

Canada was the first big greenhouse tomato producer in North America and is still the leader, with an estimated 42 percent of North American production in 2003 (table 1). The Canadian industry is centered in Delta, British Columbia, and Leamington, Ontario (fig. 2). Long, relatively mild, summer days in these regions are ideal for growing greenhouse tomatoes, and Canadian production is a market force during the March to December period. The Achilles heel of the Canadian greenhouse tomato industry is its lack of winter supply. As greenhouse tomatoes have become a mainline commodity, retailers are increasingly demanding consistent year-round volumes from their suppliers.

The principal U.S. greenhouse tomato growers produce year-round and the U.S. industry accounted for 30 percent of North American production in 2003. The four largest greenhouse tomato firms in the United States are now located in Arizona, Texas, Colorado, and coastal southern California, and account for 67 percent of domestic production. It is difficult to find a location that provides both profitable winter and summer production. With such high investment costs for greenhouses, growers are reluctant to consider using them for only part of a year. The profitable winter market helps the year-round U.S. producers withstand the very low prices during the summer season when Canadian volume inflates supplies. However, expanding winter production in Mexico will likely reduce prices and increase competitive pressure on year-round U.S. growers.

Mexico's major advantage in the greenhouse tomato industry is its ability to produce during the winter months—the same edge it holds in field tomato production. Some growers only produce in the winter but there are also important year-round suppliers. Mexican greenhouse tomato production

³ With NAFTA, tariff barriers no longer exist, but nontariff barriers can still affect the market (Calvin and Barrios, 1998). Growers have several trade protection remedies at their disposal, chief among them protection under anti-dumping laws. The Fresh Tomato Suspension Agreement between the Mexican and the U.S. tomato industries is a prime example of a nontariff barrier. It establishes a price floor on U.S. imports of fresh tomatoes from Mexico.

Table 1—North American fresh tomato industry—greenhouse and field grown comparison, 2003¹

Item	Units	United States	Canada	Mexico	North America
Greenhouse tomato production	Metric tons	159,664	220,114	148,300	528,078
Greenhouse tomato area	Hectares	330	446	950	1,726
Average greenhouse tomato yield	Metric tons/hectare	484	494	156	378
Fresh field tomato production	Metric tons	1,594,241	26,882	1,804,000	3,425,123
Fresh field tomato area	Hectares	50,304	1,813	63,300	115,417
Average fresh field tomato yield	Metric tons/hectare	32	15	28	25
Greenhouse share of total fresh production, by country	Percent	9	89	8	13
Greenhouse share of total fresh area, by country	Percent	1	20	1	20
Estimated U.S. greenhouse imports from: ^{2, 3}	Metric tons	n.a.	130,154	125,970	256,124

¹ Excludes processing tomato area and production in all three countries.

² Official imports of greenhouse tomatoes are thought to be underreported for Mexico due to tariff code misclassification; 58,357 metric tons of greenhouse tomato imports from Mexico were reported by the U.S. Department of Commerce in 2003. The figure shown here includes estimated additional miscoded imports, based on information from industry sources obtained by Cook and Calvin.

³ Imports of greenhouse tomatoes from outside North America totaled 24,093 metric tons.

n.a. = Not applicable

Sources: Statistics Canada, Ontario Greenhouse Vegetable Growers, British Columbia Vegetable Marketing Commission, U.S. Department of Commerce, interviews by Cook and Calvin, USDA, National Agricultural Statistics Service.

Figure 2

Selected North American greenhouse tomato production areas



• Dot = greenhouse production.

Source: Interviews by Cook and Calvin.

totaled 28 percent of North American production in 2003, and the industry is growing rapidly. The seasonal pattern in Mexico is still in flux as growers experiment with various levels of technology in different regions. While U.S. and Canadian greenhouse growers use relatively homogeneous production systems, Mexican producers are experimenting with a range of protected culture methods (see box, “What Is a Greenhouse Tomato?”). The choice of technology often depends on the length of the potential production season in a particular location.

In Mexico, large field tomato grower-exporters in Sinaloa on the northwest coast and the Baja California peninsula are experimenting with protected culture, either shade houses or greenhouses, near their field operations. Because of its hot, humid summers, Sinaloa, the principal fresh field tomato-exporting region in Mexico and a leading greenhouse exporter, is a winter producer only. Humidity often raises the costs of cooling to unprofitable levels. Growers there have less incentive to invest in the highest technology greenhouses because the limited shipping season reduces the return on investment. Nevertheless, the technology levels and yields used in coastal areas are improving, with more growers moving into midlevel technology systems to improve yields, quality, and marketing.

Several clusters of greenhouses are also emerging in temperate, higher altitude areas in central and north central Mexico, and in Imuris in northern Sonora, near the U.S. border. In these areas, growers have the potential to produce year-round, and, as a result, more growers are investing in high-technology greenhouses similar to those in Canada and the United States. As greenhouse production in temperate, noncoastal areas expands, Mexico will become more of a competitive force in all seasons.

Trade is an important component of the North American greenhouse industry because of seasonality. Trade is also critical because of the uneven size of the consumer markets in the three North American countries. The United States, the largest consumer market in North America for greenhouse tomatoes, imports more greenhouse tomatoes than it produces. In 2003, about 36 percent of the domestic U.S. supply of greenhouse tomatoes was produced in the United States, 30 percent was imported from Canada mostly during the summer, and another 29 percent from Mexico mostly during the winter (with the remainder extra-NAFTA imports). In recent years, imports have increased more rapidly than domestic production. Exports to the United States are very important for both Canada and Mexico. Sixty percent of Canada’s production is exported and virtually all to the United States. Almost all marketable greenhouse tomatoes in Mexico are sold to the United States or Canada. There is limited Mexican demand for greenhouse tomatoes at this time, although it will undoubtedly grow. Neither the United States nor Canada exports greenhouse tomatoes to Mexico.

Trade is complicated by the fact that during parts of the year, growers in all three countries are in the market simultaneously. Seasonal overlaps have at times led to turbulent relationships between some groups of producers. In March 2001, six U.S. greenhouse tomato firms brought a dumping suit against the Canadian greenhouse industry. Canadian growers reciprocated in November 2001 with a case against the entire U.S. fresh tomato industry—greenhouse and field. The U.S. growers lost their case against Canada—the

What Is a Greenhouse Tomato?

To take a broad view, tomato production can be divided into open field and protected agriculture. Protected agriculture is a wide category of production methods providing some degree of control over various environmental factors. There is a continuum of control and cost starting with simple shade-house structures and ending with high technology greenhouses. Growers have choices with respect to the type of structure to protect their production, the degree of environmental control to adopt within the structure (passive or active), and whether to grow in soil or use hydroponics. A shade house is a temporary structure that supports shade cloth, a type of screen, that provides passive control of the environment by shading the plants from excessive sunlight and wind. A shade house can also provide a barrier to insect vectors, such as white fly, that carry viruses. A greenhouse provides opportunities for active environmental control such as controlling light, air temperature, humidity, and carbon dioxide levels to achieve higher yields. Hydroponics is a production system where plants are grown in a nutrient solution with an artificial medium to provide mechanical support to the root system. Artificial growing mediums include rockwool, coir, sawdust, tezontle (a ground volcanic rock used in Mexico), and perlite. Within protected agriculture there is a wide range of technologies that can be combined depending on a grower's environmental and financial considerations, as well as risk preferences.

There is no official USDA or other Federal definition outlining the requirements for a tomato to be labeled as "greenhouse." With the rapid growth of greenhouse tomato production has come serious industry debate regarding whether tomatoes produced with any type of protected agriculture can be labeled as greenhouse. In September 2004, the State of California adopted a definition requiring tomatoes labeled as greenhouse to be grown in "a fixed steel structure using irrigation and climate control, in an artificial medium that substitutes for soil." This means that any tomatoes labeled as greenhouse and marketed in California must be grown hydroponically. No other such restrictive regulations exist elsewhere in North America.

In this report, we break protected agriculture into two broad categories: shade house and greenhouse, the latter not limited to hydroponics but requiring a fixed, permanent structure (see appendix 1). There is a range of greenhouse technologies that can be loosely defined as low-, medium-, and high-technology greenhouses. Here, we define a low-technology greenhouse as involving only a fixed, permanent structure with limited or passive environmental control. A medium-technology system involves greater environmental control and/or the addition of hydroponics. A high-technology system requires both fully active environmental control and hydroponics.

Much of the U.S. and Canadian greenhouse industries favor defining greenhouses as high-technology systems only; all the large commercial U.S. and Canadian firms fit this definition. However, the full continuum of protected agriculture exists in Mexico. So, for the purposes of this report, a narrow definition would ignore an important and growing segment of the North American industry. To summarize, we discuss all of protected tomato production where appropriate, but we focus primarily on greenhouses, defined to include all fixed structures, regardless of technology level and growing medium, but to exclude shade houses.

DOC found dumping but the U.S. International Trade Commission (ITC) did not find injury to the U.S. industry, which it broadly defined as all fresh tomato products, not just greenhouse tomatoes. The Canadian growers withdrew their allegation before the Canadian government officials reached a final negative determination in the case. More recently, growers in all three countries have sought greater coordination to meet demand for year-round supply.

Greenhouse Tomatoes as Part of a Trend Toward More Differentiated Products

The increasing interest of U.S. consumers in produce variety is one factor behind the growth of the greenhouse tomato industry. Product differentiation is now the norm in the fresh tomato industry, for both field and greenhouse tomatoes, with variation based on shape (round, roma, grape, pear), size (large to very small), degree of ripeness, color (red, orange, yellow, and green), and variety. Development of new types of tomatoes is faster for greenhouse production than open field production, which allows greenhouse growers more opportunity to target growing consumer interest in variety. The first producers of a popular new tomato product can garner substantial profits, at least for a few years. The popular tomato-on-the-vine (TOV), or cluster tomato, is only grown in greenhouses, which gives greenhouse producers a competitive edge (see box, “Tomato Variety Expands”). It is not clear that consumers always recognize TOV as a greenhouse product, but they do recognize it as something new and appealing. Almost every other type of tomato can be grown in either greenhouses or in open fields.

Greenhouse tomatoes generally have better cosmetic appearance and redder color than field tomatoes; but some field tomatoes may be just as attractive to many consumers. Some consumers seem to perceive greenhouse tomatoes as having superior flavor to field grown tomatoes; however, flavor is a subjective attribute and not all consumers agree. Flavor can vary substantially depending on varieties, seasons, maturity level at harvest, handling practices, and time in the distribution system, for both field and greenhouse tomatoes. While greenhouse tomato growers may be most recognized for striving to improve flavor as a point of differentiation, the number of field growers emphasizing this attribute today is growing. However, the consistency of production and quality, including flavor, can more easily be maintained in climate-controlled greenhouse production than in open field conditions.

Greenhouse tomatoes are grown with few if any pesticides, although many field tomatoes are also grown with integrated pest management techniques and some are certified to be pesticide-residue-free. Greenhouse tomatoes are exposed to fewer environmental hazards than open-field tomatoes, reducing the chance of microbial contamination. These characteristics appeal to some of the increasingly affluent North American consumers concerned with food safety issues.

While it is not always clear whether most consumers can distinguish between greenhouse and field tomatoes, retail buyers are probably more interested in the differences. Most greenhouse tomatoes are sold in retail markets, which represent about half of U.S. tomato consumption. Greenhouse tomato growers provide greater consistency than field growers in

Tomato Variety Expands

The North American greenhouse tomato industry began with the beefsteak tomato, which is a round tomato, with larger sizes generally preferred and receiving the highest prices. It looks similar to a field tomato, except that the calyx (stem) is left attached as a marketing strategy to differentiate it from its field equivalent.

TOVs are rapidly becoming the dominant tomato type in U.S. greenhouses. TOV varieties were developed in Italy in the early 1990s and then taken up by growers in the Netherlands. North American growers began producing TOVs in the late 1990s. These tomatoes, four to six in a cluster, are smaller than beefsteaks and are still attached to the vine. The stem imparts a strong tomato smell that appeals to consumers as being indicative of good flavor and freshness. These tomatoes also have a longer shelf life than beefsteak tomatoes since they are smaller and have a thicker skin. Greenhouse growers initially positioned TOVs in the marketplace as having superior taste.

Greenhouse growers are trying to distinguish themselves and discover the next blockbuster greenhouse tomato product. There has been an explosion in offerings for TOVs with respect to size and shape. Cherry TOVs, sometimes called cocktail tomatoes, have become an important category. One U.S. company, with all its production in Mexico, pioneered this small tomato product and has dominated the category. Other companies, encouraged by the popularity of cherry TOV, have begun to develop competing products. Campari tomatoes, a type of cocktail tomato, which is midway in size between a traditional TOV and cherry TOV, are a growing component of greenhouse supply. The seed company that owns the variety only licenses it to three firms. Similar tomato varieties known by different names are available from other growers, as well as roma and mini roma TOV. In general, there is active experimentation with specialty varieties, including small beefsteak tomatoes. Growers in Canada are also experimenting with heirloom tomatoes, as well as a few small growers in the United States.

There are two types of round field tomatoes—mature green and vine ripe. Mature green tomatoes are the backbone of the U.S. fresh field tomato industry and are the major type of tomato grown in Florida and California, with minimal production in Mexico. They are harvested at an early stage; while still green, they are sufficiently mature to ripen after harvest when treated with ethylene gas, the plant's natural ripening agent. Some shippers both treat and pack tomatoes at their packinghouse. But mature green tomatoes are often sent to repackers near consumption centers where they are treated and then repacked according to color just before marketing. This introduces another link in the marketing chain and increases the transaction costs for mature green tomatoes. Mature green tomatoes are firm, have a long shelf-life, and slice well. They are also one of the lower cost tomatoes. Mature green tomatoes are the dominant tomato in food service, particularly in the fast food industry.

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Vine ripe tomatoes are harvested at a slightly riper stage and ripen fully without ethylene treatments. During the winter, most of the vine ripe tomatoes consumed in the United States come from Mexico, with Florida as a minor supplier. During the summer, southern California and Baja California are the main suppliers. Mexican round tomato exports are almost entirely vine ripe. While the vine ripe tomato may appeal to some high-end foodservice firms, most sales have traditionally been to the retail market, in part due to a generally higher cost than mature greens. However, with short supplies of mature green tomatoes in the fall of 2004, foodservice buyers were more willing to try other types of tomatoes as substitutes. This may lead to some shift in foodservice preferences over time.

Fresh roma tomatoes (also known as plum tomatoes) grew rapidly in the 1990s, in part due to retail demand from the expanding Mexican consumer segment, and more recently due to their expanding use in foodservice menus. They are grown primarily in Mexico, with California and Florida also garnering part of this market.

Other types of field tomatoes growing in popularity include such specialties as cherry, grape, pear, organic and heirloom tomatoes (older, often misshapen, varieties recognized for their flavor). While some of these tomatoes are grown in greenhouses, most are field grown. Grape tomatoes, in particular, represent a very important new product offering in field tomatoes.

volume, pricing, and product quality, since they are less subject to weather-induced variation.⁴ These attributes are highly valued by retailers. Retailers are also interested in products with less risk with respect to food safety. In addition, retailers are concerned about lowering transaction costs by reducing the role of middlemen, and large greenhouse tomato firms increasingly sell directly to retailers. Unlike mature green field tomatoes, greenhouse tomatoes can readily bypass repacking facilities for ripening or quality control. Direct sales are facilitated by offering consumer-ready and retail-ready packs. Year-round greenhouse shippers are offering retailers brands with promotional support, stable pricing via forward contracts, and other marketing services. Retailers tend to view them more as partners in implementing supply chain management goals, compared with fresh field shippers marketing via intermediaries.

Despite the rapid growth in the greenhouse tomato industry, in 2003, it was still a small share of total fresh tomato production in the United States and Mexico, just 9 and 8 percent, respectively. In Canada, however, greenhouse tomatoes now completely dominate fresh tomato production with an 89-percent share. The greenhouse share of U.S. fresh tomato consumption, 17 percent, is almost double the production share due to imports. Even though greenhouse tomatoes still constitute a minority share of the U.S. fresh tomato market, their influence is concentrated and growing in retail channels. Around 37 percent of all fresh tomatoes sold in U.S. retail stores are now greenhouse, compared with negligible amounts in the early 1990s.

⁴ Greenhouse supply may fluctuate with the level of solar radiation, the only factor growers cannot control unless they use lights.

The foodservice industry is not yet an important market for greenhouse tomatoes. Mature green field tomatoes dominate the foodservice market, which represents about half of U.S. fresh tomato consumption, where their firmness, excellent slicing characteristics, and long shelf life are highly prized. Other types of field tomatoes are increasing sales to food service, including roma and grape tomatoes. While greenhouse growers would like to develop a product more appropriate for the foodservice market, it has not happened yet. Greenhouse tomatoes have too high of a water content for many foodservice applications. Also, much of the foodservice market is focused on ingredient cost control, and prices are generally higher for greenhouse tomatoes than for field tomatoes.

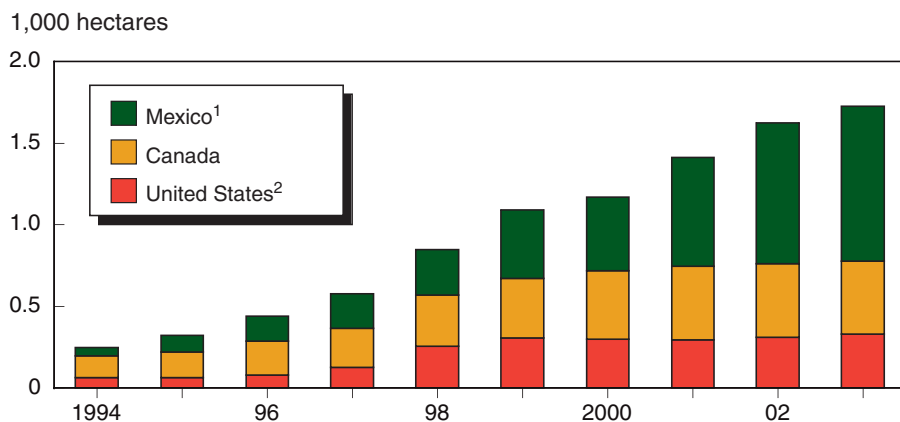
Rapid Growth and Declining Prices— Commoditization of the Industry

In the early days of the industry, greenhouse tomatoes were a rather insulated market niche that garnered high prices. However, between the early 1990s and 2003, greenhouse tomato area is estimated to have grown by 596 percent to 1,726 hectares (ha), starting from a negligible base—this despite the high cost of greenhouse construction (fig. 3).⁵ The flip side of rapid growth in the greenhouse industry has been the rapid decline in prices. Beefsteak prices hit a low in 1999, which had an important impact on the industry. TOV prices hit a low in summer 2004, which will affect future growth of this type of greenhouse tomato throughout North America. Growth in Canada and the United States is stabilizing, in part due to lower prices, and likely due to industry members keeping a watchful eye on Mexico, where rapid growth continues (fig. 4). Lower prices will affect profits of those who remain in this growing industry.

⁵ One hectare equals 2.471 acres.

As the industry has grown, greenhouse tomatoes have become closer to a commodity, subject to the same market pressures affecting other produce commodities. Commoditization is a common phenomenon in the world of

Figure 3
Estimated trends in North American greenhouse tomato area



¹ Excludes most shade house area.

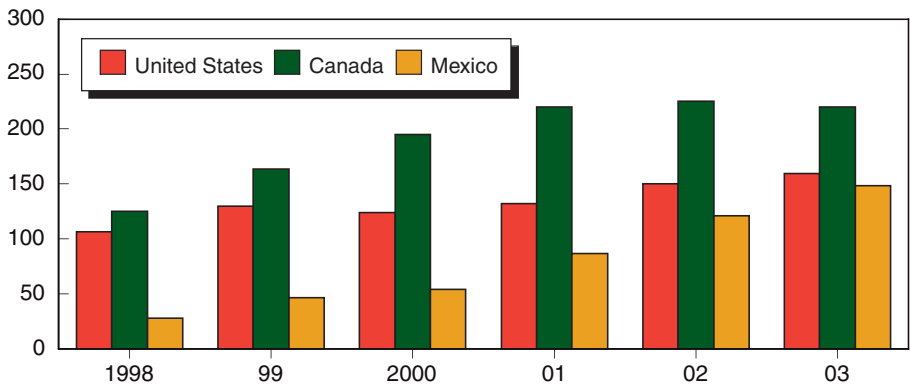
² Only large- and medium-size growers until 1998.

Sources: U.S. International Trade Commission; Asociación Mexicana de Productores de Hortalizas en Invernaderos (AMPHI); Statistics Canada; and estimates by Cook and Calvin.

Figure 4

North American greenhouse tomato production growth

1,000 metric tons



Sources: Statistics Canada; Ontario Greenhouse Vegetable Growers; British Columbia Vegetable Marketing Commission; and estimates by Cook and Calvin.

fresh produce as a new product transitions from a specialty product status to mainstream. For specialty niche products with limited supply, it is generally easier to command consistently high prices, in part because buyers place less emphasis on aggressive price negotiations with products that are not major contributors to the bottom line. With greenhouse tomatoes now a critical component of overall tomato category profitability, price plays a more important role in making the sale. This is particularly true in the summer when both greenhouse and field tomato supply are typically abundant. As greenhouse tomato volume increases, there is more potential to influence field tomato prices and vice versa.