

Competitiveness of the Spanish and Dutch Greenhouse Industries With the Florida Fresh Vegetable Industry¹

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Imports of fresh peppers, tomatoes, cucumbers, and melons into the United States from Mexico declined in 1999. Imports from other regions of the world increased, with imports from European countries almost double in such commodities as tomatoes and peppers what they were in 1996. In Europe and Israel, essentially, all of these crops are produced in greenhouses and increasing returns through the 1997/98 season led to further increases in production. Productivity in European greenhouses is nearly three fold, and in some cases ten-fold, comparable to Florida field production. Product quality is generally much higher from greenhouse versus field-produced vegetables. Competitive cost structures for greenhouse production and greater product quality have allowed producers from Holland and, more recently, Spain to increase their presence in U.S. markets, creating greater demand by consumers for their produce.

Introduction

In the past, fresh-market vegetables were supplied to U.S. consumers predominantly from Florida and Mexico. Both areas have, for many years, been in direct competition because of the overlap in production and marketing seasons.

Tomatoes. Imports of fresh tomatoes have increased significantly over the last decade as imports from Mexico increased from 352,312 metric tons in 1990 to 615,069 metric tons in 1999 (Table 1). Imports from Mexico increased the most after 1994 when the North American Free Trade Agreement (NAFTA) was implemented giving Mexican producers easier access to U.S. markets and a flow of investment capital into the Mexican vegetable production sector.

Increases in imports from Mexico resulted in the filing of an antidumping case with the U.S. International Trade Commission and the U.S. Department of Commerce that was suspended when producers of more than 85 percent of Mexican production agreed in December, 1996 not to sell fresh tomatoes for less than a reference price of \$5.17 per 25 pound carton equivalent. That agreement slowed the increase in imports from Mexico, but there has been a significant increase in imports from other countries.

In recent years, a greater percentage of retail sales of tomatoes showing up in retail markets and supermarkets throughout the U.S. has been produced

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from greenhouses. Initially, some of this production was from local market areas in proximity to the retail outlet. More recently, and especially in the last two to three years, a greater percentage of tomato sales have come from greenhouse tomatoes, especially cluster-type tomatoes produced in Holland, Israel, Canada, and Spain. Of these four countries, Israel was the first to begin shipment of red-ripe tomatoes into U.S. markets during the 1990's. There has been a tremendous conversion of much of the Dutch industry to higher-value crops such as cluster tomatoes during that same period. The Dutch are not so limited by season, and can, in fact, deliver tomatoes to the U.S. market essentially 12 months of the year.

More recently, greenhouse acreage has increased dramatically in Canada, especially southwest Ontario; much of that area has been devoted to tomato production. Canada increased as a source of imports from 21,774 metric tons in 1996 to 79,554 metric tons in 1999. Spain increased as a source from no imports in 1996 to 5,715 metric tons in 1999. The Netherlands also increased as a source of imports from 23,473 metric tons in 1996 to 34,202 metric tons in 1999. Most of the tomatoes imported from Canada and Europe are greenhouse grown tomatoes competing against field grown tomatoes produced in the United States and Mexico. Increases in imports of tomatoes, especially greenhouse tomatoes, have had significant impacts on Florida growers of field grown tomatoes. There is growing concern about the impacts of greenhouse grown tomatoes on U.S. growers.

The Israeli production area is limited by both seasonality and cost of transportation, thus reducing its impact on competition with the Florida tomato industry. Canada, on the other hand, has proximity to market, especially the midwest and northeastern markets. Distance seemingly would impinge upon profitability from Dutch-produced tomatoes, especially if they are air-freighted; however, the price and demand at the retail level, especially by the consumer and the grocery store, has retained high returns for Dutch producers.

Other Vegetables. The Mediterranean region of Europe has one of the largest concentrations of

protected crop production in the world with around 247,000 acres (2.471 acres/hectare) of vegetable production grown in greenhouses and 741,000 acres grown with low tunnels and mulching. This 968,000 acres compares with 1.9 billion acres of total fresh vegetable production in the U.S. in 1999 and 193,000 acres of winter fresh vegetable production.

The largest greenhouse producing areas in Europe are Spain (113,667 acres), Italy (61,775 acres), France (23,475 acres) and Greece (9,390 acres). Around 10,000 acres of the greenhouse production in Europe is soilless, mainly using inert substances such as sand, perlite, rockwool, puzolanes and volcanic gravels. The soilless crop area is increasing with Spain and France the largest Mediterranean countries with 3,950 acres and 2,500 acres each in soilless culture in 1996. Production of these crops has increased because of several factors. Changes in diet have contributed to an increase in vegetable consumption in Europe, opening windows of opportunities for vegetable growers. Improvements in transportation also have increased production by improving quality and lowering costs in shipping vegetables. The European Union is considered self-sufficient in vegetable production for most fresh vegetable crops.

Among these four European vegetable producing countries is what some regard as the sleeping giant B Spain. Much of the Spanish greenhouse industry centers around Almeria, along the coast of the Mediterranean, as well as Murcia to the east. In the Almeria area, there are some 90,000-100,000 acres of greenhouse crops grown predominantly in Spanish-style flat-roof greenhouses (Table 2). In comparison, in 1998 there were approximately 8,000 acres of vegetables grown in greenhouses (mostly glass structures) in the Netherlands (Table 3). Production of vegetables in greenhouses in Holland has not increased much in the past seven years (Table 3). However, the value of Dutch vegetables and other high-value horticultural crops has increased significantly over the past two decades (Table 4). The commodities that dominate in Almeria are tomatoes, peppers, eggplants, cucumbers, muskmelons, and to some degree, watermelons. The area is known for its extremely arid climate, its available sunshine, and a large influx of new growers to the area. Almeria is

potentially the next and possibly the greatest threat to Florida tomato producers for mid-winter competition.

Production Practices in Greenhouse Production

Almeria is located in the region of Andalucia in southeastern Spain. It has an average temperature of 68° F and about 3000 hours of annual sunshine. Besides the crops already mentioned, Almeria produces some 30 different vegetable species. Most of the producers are family-owned greenhouse operations and have low capital investments, generally producing on the average of about 2.5-3.5 acres (Fig. 1). Approximately 90% of the cultivation for tomato production is still being done by sand culture. This culture utilizes sand, gravel, and manure and most growers use drip irrigation. There is, to some degree, a scarcity of water and growers tend to use a lot of pesticide, especially against whiteflies and thrips both which spread various viral diseases.



Figure 1. Typical view of the vegetable greenhouse industry in the Almeria vicinity. Note proximity to the Mediterranean Sea.

Some producers are switching to more modern greenhouse types, including Dutch glass as well as plastic houses. Most of the vegetable seed companies in the world have experiment stations (10) somewhere in the vicinity. Production has increased dramatically in the past 25 years, increasing from approximately 600,000 metric tons in 1975 to 2.7 million metric tons in 1997-98. Produce from Almeria is sold via auction or through cooperatives. At present, approximately half of the total production from this area is exported to the European Union, especially Germany, France, and the Netherlands.

For these reasons, quality control, food safety, and pesticide residues are major concerns for producers from these regions, and for these reasons quality certification has become a priority for producers in these regions. As such, Almeria has become very competitive because it is relying on selling via high quality and not on low prices.

Because of location, climate, and lack of water, Almeria is not being rapidly urbanized, although it is rapidly developing as an agricultural area (Light foot-Brown, 2000). Throughout Andalucia the major sources of income are from agriculture, tourism, and white marble. Agriculturally, citrus and greenhouse vegetable production are most important. Previously, agricultural production was based solely on grapes and citrus. Originally, table grapes were produced on wire trellis systems. They were covered with plastic to induce earliness for the table grapes to be shipped to the European markets. Some growers began growing vegetables, and because of the greater profitability in growing and shipping vegetables, most, if not all of the grape acreage quickly dissipated during the 1970s and 1980s. In addition, a large amount of new acreage has been devoted to vegetable production. By 1997-98, 90% of the total agricultural production of Almeria was from vegetables.

In the Netherlands, similar changes were taking place. Between 1980 and 1998 the value of fruits and vegetables almost doubled, reaching approximately \$2.5 billion (Costa and Heuvelink, 2000). This figure represents 37% of the total Dutch horticultural production.

In Almeria, Spain, vegetables are generally grown as two types of crops which are called winter crops, such as tomato, pepper, cucumber, and certain squashes, and summer crops, such as various muskmelons, watermelons, and green beans. The production peaks are December-January wherein tomato, cucumber, green beans, and pepper are harvested, and then again in May-June where many of melons, especially Galia-type melons are harvested. Tomatoes and sweet pepper represent the greatest acreage and are followed by watermelon and muskmelon (Galia melon). Presently, for tomatoes the most important cultivar is long-shelf-life tomato "Daniella" which represents about 80% of the total

production. In the Netherlands, tomato, sweet pepper, and cucumber are the most important vegetable crops.

In comparing production per square meter of crops such as tomato, sweet pepper, and cucumber, yields from the Almeria area are still considered quite low when compared to the Netherlands (Table 5). For example, Almeria in 1998 produced approximately 20,000 acres of tomato or about 770,000 metric tons. In comparing productivity of tomatoes in Almeria, they are producing approximately 22-26 lbs per square meter, whereas in the Netherlands they are producing approximately 90 lbs per square meter.

During the 1980s, due to low market prices, many growers in Almeria producing pot plants and cut flowers went bankrupt. For this reason, there is presently very little area devoted to such crops. This is not so in the Netherlands where cut flowers and pot plants exceed \$3 billion (Costa and Heuvelink, 2000).

Approximately 90% of the greenhouse area in Almeria produces vegetables on an artificial soil called Enarenado (Fig. 2). The soil mix has been created in order to overcome extremely poor indigenous soils of the region. This is a soil mix drawn up by the local growers that sits on top of the original soil base wherein they put approximately 10-12 inches of new soil, which is partly clay, about an inch of manure and then about 4 inches of special sand, on top which is actually a gravelly bed sand. The remaining 10% of the area is using either perlite or rockwool as soilless media. Potentially, production on soilless media will increase in the future.

Dutch producers mostly are on hydroponic systems which use rockwool for a media. Some producers do well with the nutrient film technique.

Water quality is a prime factor in determining the price of land in Spain (Costa and Heuvelink, 2000). Presently, water scarcity does not seem to be a major issue for area growers in Almeria but may in the future as more demands are placed on the existing water supplies (Lightfoot-Brown, 2000). There are about 200 mm of rain per year in the Almeria area, however, there is a requirement of 800-1000 mm for greenhouse production. Water efficiency has improved dramatically, especially with the use of



Figure 2. Typical Spanish soil mix 'Enarenado', which is used as a base in 90% of the vegetable greenhouses in the Almeria region. Approximately 12 inches of a new soil, which is partially clay, is placed on top of the original soil in the region, then an inch of manure then 4 inches of sandy gravel is placed on top of the manure. Methyl bromide is not used for fumigation and the 'manufactured' soil can be used for several years without major pest problems.

drip irrigation, however, because of high EC water, sometimes drainage may exceed 60% of the irrigation water.

As previously mentioned, production is generally through family companies of small area, 2.5-3.5 acres. The family companies generally retain low labor costs and have a strong motivation for work. Since the area is new to this type of agricultural production, second and third generation growers are now coming into the business. Because production becomes seasonal so do the labor requirements. Producers use a lot of temporary labor, especially from African countries (Lightfoot-Brown, 2000). Spain has one of the highest unemployment rates in the European Union, however, most of the labor is brought from Morocco, various African countries, and Central and South America (Costa and Heuvelink, 2000). Certain eastern European groups are also migrating to south Spain for work. Recently there have been clashes between growers and especially the Moroccan immigrants, due to poor working and living conditions for the foreign laborer. Several growers have faced strikes, and labor issues appear to be some of the greatest problems facing producers in the area. Dutch producers generally must look to workers from outside the country. Wages are high, generally exceeding U.S. costs for hourly labor. Also, the Dutch government tightly controls wages and worker rights.

Production Costs

Productivity in European greenhouses is more than 3 times the productivity in Florida field production. Data reported by Calatrava-Requena et al. (2000) indicate that Spanish greenhouses growing fresh tomatoes in the Almeria region averaged 5,081 and 4,607 cartons (25-pound equivalents), respectively, in the 1996/97 and 1997/98 production seasons (Table 6). These yields compare to yields in the Manatee Ruskin production area of 1,785 cartons in 1996/97 and 1,554 in 1997/98. Preharvest costs for Spanish greenhouse tomatoes totaled \$10,339.85 per acre in 1996/97 and \$9,192.84 in 1997/98. Gross margins for paying for fixed costs and packing and marketing costs totaled \$13,249.91 per acre in 1996/97 and \$20,313.32 per acre in the 1997/98 season. These gross margins compare to \$9,436.41 per acre for field production in the Manatee Ruskin area in Florida in the 1997/98 production season.

Costs of production between Almeria and the Netherlands differ somewhat. Broken into the three areas of production costs, marketing costs, and total costs, it takes approximately \$0.12 per pound to produce tomatoes in Almeria and \$0.25 per pound in the Netherlands. Marketing in Spain costs another \$0.13 per pound, while in Holland it is only \$0.07 per pound, leaving total costs for production and marketing of \$0.26 per pound in Almeria versus \$0.32 per pound in the Netherlands. As previously stated, Almeria exports most of its produce to Germany, France, and the Netherlands. It also exports fair amounts to Poland, Hungary, and Russia. In going overseas, Canada and U.S. are main areas of export, although at present these attribute to very small amounts.

The major difference between Almeria and the Netherlands relates to the fact that in Spain energy costs are low and production costs are low, primarily due to the natural climatic conditions of good temperature and good light. Also, greenhouse production costs in Spain are considerably lower than those of the Netherlands, since many of the greenhouses are homemade and all are primarily made of plastic. In the Netherlands, energy costs are considerably higher because of the inherently poor conditions of light and temperature in the winter

season as well as the greater costs in the Netherlands for labor and the higher costs for the much more sophisticated greenhouse production systems, where glass, computerization, as well as soilless media are the norm. The main issue for Florida growers is that Spain has managed to acquire a large market share in Europe and will now try to improve its export position by increasing its market share in other parts of the world, especially the United States. Not only are prices competitive from Spain, but also the quality of Spanish produce is excellent.

Presently, the marketing scheme of auctions and/or cooperatives is not as efficient in Spain as it is in other areas such as the United States or the Netherlands. Also transportation costs have increased dramatically, especially in the last year due to the increase in fuel prices. For production from Almeria to continue to increase, it will continually need to be more sophisticated in both production and marketing practices. There are several growers, especially over in the Murcia area, that produce approximately 300 hectares of tomatoes, which equates to over 750 acres of greenhouse tomatoes for a single producer (Fig. 3). These growers are well educated, seem to be financially sound, and have new and exciting tomato products that they will be introducing into the U.S. marketplace this year, such as 'Baby Sweetheart' cluster tomatoes which could be a high impact commodity for Spanish producers to break in heavily into the U.S. tomato market.



Figure 3. Internal view of a modern plastic 'Dutch' style greenhouse in the Murcia area of Spain (Duran Brothers). Tomatoes are grown using hydroponic culture, bumblebees for pollination, and additional heat in winter months.

In the Netherlands, rapid innovations have kept Dutch producers competitive. They are strongly vertically integrated and they look to consumer- and retail-driven types of production. They thrive on producing high-quality products under environmentally-sound production techniques. Unfortunately, the Dutch have the disadvantage of expensive raw materials, labor, and a high demand for fuel in the winter season. Technologically, the Dutch are very quick to adapt and innovate as any needs demand to improve their efficiency and effectiveness of production. The Dutch also have developed what they call organizations of grower groups, which are small groups of growers with the same specific crop and in the same area, wherein they visit each others' greenhouse and discuss matters related to production. These groups along with groups at the national level operate under LTO, an organization of farmers and growers. LTO develops programs for producers and sets priorities for research. There is no effectively run Extension service at this time in Spain. There are several public and private research stations in Almeira. The Dutch privatized what they call their governmental advisory (Extension) service several years ago, whereas the Spanish have never had an effective Extension type of service that cooperated both with research center and university research programs.

Conclusions

Greenhouse production of vegetable crops has increased throughout the world resulting in increased imports of greenhouse-produced vegetables from Canada, Mexico and Europe into the U.S. These vegetables compete with field-grown crops in U.S. supermarkets and institutional outlets. Higher productivity and competitive cost structures allow greenhouse vegetables to enter the U.S. and compete with field-grown tomatoes. It is critical that Florida growers develop new technologies to compete with the quality and cost of greenhouse-grown tomatoes. Increased imports from European sources are likely to continue and will force the U.S. industry to adapt to changes in consumer tastes that are being developed by these greenhouse grown tomatoes.

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Table 1. Imports (metric tons) of fresh tomatoes from Mexico, Spain, The Netherlands, Canada and the World. 1990 to 1999.

Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Mexico	352,312	353,576	183,115	400,494	376,032	593,064	685,681	660,609	734,053	615,069
Spain	15	1	2	0	21	0	0	4,440	6,498	5,715
Netherlands	1,194	2,410	2,532	7,044	7,547	12,401	23,473	33,718	36,804	34,202
Canada	3,075	2,671	5,214	4,733	7,673	11,658	21,774	37,504	61,729	79,554
World	360,995	360,829	196,028	418,394	395,974	620,933	737,157	743,205	856,852	740,656

Source: Costa and Heuvelink, 2000

Table 2. Area and production for the main vegetable crops in Almeria, Spain (1998).

Crop	Acreage	Production (tons)
Tomato	20,250	769,500
Pepper	19,250	465,850
Watermelon	16,000	339,200
Melon	14,500	261,000
Snap beans	12,750	64,000
Lettuce	10,610	100,795
Cucumbers	7,750	294,000
Source: Costa and Heuvelink, 2000		

Table 3. Acres of glasshouse vegetables in the Netherlands.

Crop	1994	1996	1998
Tomato	3,103	2,645	3,268
Cucumber	2,185	1,960	1,775
Strawberry	298	313	343
Pepper	2,450	2,530	2,525
Total	8,036	7,448	7,911
Source: Costa and Heuvelink, 2000			

Table 4. Values of Dutch horticulture (millions of dollars).

Commodity	1980	1990	1998
Vegetables	992	1,723	2,000
Fruits	169	279	270
Cut flowers	996	2,163	2,888
Bulbs	226	344	474
Nursery stock	134	312	488

Table 4. Values of Dutch horticulture (millions of dollars).

Commodity	1980	1990	1998
Seeds	---	---	270
Total	2,518	4,821	6,128

Source: Costa and Heuvelink, 2000

Table 5. Productivity (kg/m²) of various vegetables.

Crop	Almeria, Spain	The Netherlands
Tomato	10-12	42
Pepper	6-7	26
Cucumber	8-9	58
Snap beans	5	32

Sources: Smith and Taylor, 1999 and Calatrava-Requena et al., 2000

Table 6. Preharvest costs and marketing margins for fresh tomatoes produced in Spanish greenhouses, 1996-1997 and 1997-1998, compared with fresh tomatoes grown in the Manatee Ruskin producing area in 1997-1998.

	Manatee/Ruskin 1997-1998	Spain 1996-1997	Spain 1997-1998
Yield (25#/acre)	1,554	5,081	4,607
Average price (\$/25#)	\$9.15	\$4.64	\$6.40
Total revenues	\$14,219.10	\$23,589.77	\$29,506.16
Preharvest costs (\$/acre)			
Fertilizers	\$326.22	\$2,395.50	\$2,124.46
Pesticides	\$1,143.18	\$993.66	\$767.20
Seeds	\$224.00	\$889.81	\$683.22
Water		\$653.20	\$709.89
Labor	\$462.64	\$4,778.85	\$4,319.48
Other	\$1,217.55	\$628.84	\$588.59
Total Preharvest Costs	\$3,373.59	\$10,339.85	\$9,192.84

Table 6. Preharvest costs and marketing margins for fresh tomatoes produced in Spanish greenhouses, 1996-1997 and 1997-1998, compared with fresh tomatoes grown in the Manatee Ruskin producing area in 1997-1998.

	Manatee/Ruskin 1997-1998	Spain 1996-1997	Spain 1997-1998
Gross Margin (\$/acre)	\$9,436.41	\$13,249.91	\$20,313.32
Sources: Smith and Taylor, 1999 and Calatrava-Requena et al., 2000			