Tetranychidae. This particular predator does very well in the cooler months. Another mite predator is *Neoseiulus californicus*. Their bodies are pear-shaped and ivory color. This particular mite feeds on spider mites, broad mites, and cyclamen mites, and does much better in warmer and humid conditions. What I do during the summer months is mix the two together, *californicus* with *persimilis*, and it has done very well for me. Mealybug is another major problem for me. I use the mealybug destroyer- ***Cryptolaemus montrouzieri***, a small beetle with a body length of 4-5 mm. They have shiny black bodies with an orange head and tail. They will feed on aphids and soft scales, but are best known for their appetite for mealybugs. The only mealybug that I know of at this time that *Cryptolaemus* is not effective on is Longtail mealybug. ***Steinernema feltiae*** are nearly microscopic parasites and dwell in the soil and seek out and destroy insect larvae. This has been the most successful means of controlling "fungus gnats" for us. They are entomogenous, meaning that they develop on or within an insect. The first host death will occur within 24 to 48 hours of penetration.

Reduced risk chemicals –Biological products
BotaniGard–*Beauveria* excellent for Thrips, Aphids, and Whitefly problems. BotaniGard is a fungal spore that is actually living organisms that attack specific pest as a food source. The fungus pierces the body cuticle using enzymes, and invades the insect's body causing the insect to stop feeding and die several days later.
PlantShield-*Trichoderma* is a biological fungicide that protects roots, stems and leaves from many diseases. PlantShield contains this living fungus, which grows on roots surfaces, blocking pathogens and actively attacks pathogens, enhancing plant growth and quality.
Spintor-Active Ingredient Spinosad is biologically derived from the fermentation of *Saccharopolyspora spinosa*, a naturally occurring soil organism. Excellent for Thrips, when you mix it with an Insect Attractant and a Spray Adjuvant. Spinosad also works well on leaf miners, armyworms, and loopers. But follow resistance management guidelines.

Biorational environmentally-friendly products
OxiDate-Hydrogen Dioxide Broad Spectrum Bactericide/Fungicide is environmentally safe. It's a reduced risk chemical. It will control most soil borne and foliar diseases on a wide variety of herbs and spices, as well as fruit and vegetable crops. It can be used for curative as well as preventative application and is the only labeled fungicide capable of killing dormant spores – the source of crop disease. At the present time I'm working with the BioSafe System Co. in installing an Automated Dosing Pump & Controller that will inject OxiDate into my holding tank at a very low level to prevent Phythium, Phytophthora, Psuedomonas, Erwinia, Rhizoctonia and Fusarium from infecting growing mediums and root systems. In addition it also helps prevent Algae and Bacterial Slimes from forming on the perlite of my Hydroponic beds.
Neemix-Botanical Agricultural Insecticide has been found to be compatible when used in conjunction with most beneficial insects. I release predators after a few days of spraying for optimum effect, without taking any chances.
Trilogy-Broad Spectrum Fungicide/Miticide Will yield its best results when applied before adult insects, mites, or eggs are present in large numbers. When used in conjunction with beneficial insects, it's recommended that a trial be conducted to ensure compatibility before using on a large scale. Applications should be done early morning when it's cool to avoid leaf burn.

Packinghouse-The top ten five-star restaurant kitchens can't compare to the wonderful fragrant smell that comes out of our packinghouse. The blend of Tarragon, with its sweet anise fragrant, overlapping the fresh Mint and mixing with the Cinnamon Basil will leave an everlasting memory.

Global Competition, Greenhouse Production: Are They Something for Florida Vegetable Producers to Consider?

Daniel J. Cantliffe and John J. Vansickle

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. 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. 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 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 1990s. 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.

In Israel production the 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.

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, 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. In comparison, in 1998 there were approximately 8,000 acres of vegetables grown in greenhouses (mostly glass structures) in the Netherlands. Production of vegetables in greenhouses in Holland has not increased much in the past seven years. However, the value of Dutch vegetables and other high-value horticultural crops has increased significantly over the past two decades. 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.

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. 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.

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 (Lightfoot-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. 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. 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 rockwood 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 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.

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. 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. 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.

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.

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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New Greenhouse Vegetable Crops for the Southeast

Nicole L. Shaw, Dan Cantliffe and Juan Rodriguez

Greenhouse vegetable production has increased in Florida from approximately 55 acres in 1996 (Hochmuth, 1996) to greater than 80 acres in 2001 (Tyson et al., 2001). With the rapidly growing population in Florida, demands for land, water, and other natural resources are increasing. Much of the urban development occurs in areas traditionally devoted to agricultural production (Gordon, 1998). Because of increased plant densities and longer growing seasons, greenhouse vegetable production can provide greater yields than field-grown crops (Eversole, 1999; Johnson, B., 1999), thus, reducing the need for land, especially for crop rotation. Greenhouse vegetables are commonly grown in sterile media, such as perlite, which does not require fumigation, thus the need for crop rotation or chemical fumigation with methyl bromide is eliminated. Furthermore, protected agriculture structures or greenhouses provide an excellent place to produce consistent, superior quality produce that brings a higher price at the market than field-grown produce (Johnson, G., 1999).

As part of the Florida-Israeli Protected Agriculture Project, the Horticultural Sciences Department at the University of Florida and several Israeli agricultural companies are working together to promote and improve