Sustainable Horticulture Production in Egypt

Megan Mathey

Undergraduate Student, Hort 3002W, Sustainable Horticulture Production (Greenhouse Management), Dept. of Horticultural Science, University of Minnesota, 1970 Folwell Ave., Saint Paul, MN 55108 U.S.A.

Introduction.

In contemplating a country to research for horticultural reasons Egypt was one of the first countries that came to mind. Not for its modern day plant research, growing or distribution methods, of which I knew nothing of at the time, but for its ancient history of agriculture in the fertile Mesopotamia region and the yearly flooding of the Nile. I found it intriguing and interesting to research a country with such history and see how past practices may influence modern day agriculture.

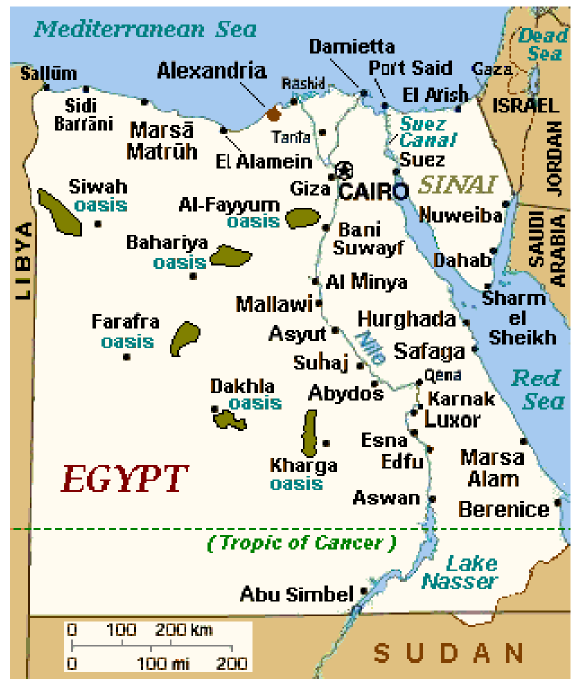

Figure 1. Map of the country of Egypt (http://www.solarnavigator.net/geography/egypt.htm)

Geography.

Egypt is located in the Northeast corner of Africa and is divided into four main geographic regions: the Western Desert, the Eastern Desert, the Sinai Peninsula and the Nile region. Most horticultural and agricultural production takes place in the Nile region. Phytogeographers recognized Egypt's as having six zones of vegetation. These zones include the northern glacial zone (having short growth period), second, the northern zone of cold winters (4-7 months of growth similar to Minnesota), third, the northern zone of hot summers, fourth the regions of the subtropics, fifth, the tropical zone (no seasonal change), and the sixth being the zone of hot summers, in southern Egypt (Zahra et al., 1992).

The total area of Egypt is one million square kilometers spanning from its northern border, the Mediterranean Sea, to the Republic of Sudan on the south, the Gulf of Aqaba and the Red Sea on the east and to the west the Republic of Libya. Spanning over 10 degrees of latitude, 22 N and 32 N, Egypt lies mainly in the temperate zone (Zahra et al., 1992). The average rainfall over the entire country is about 10 mm inland and 200mm around the Mediterranean coast providing proof of the extremely desert like conditions of this country (Zahra et al., 1992).

Land Use in Egypt.

Today, the current land use in Egypt is noted as only 2.92% arable or suitable for farming this is an extremely small amount as compared to the United States at 18.01% (CIA - The World Factbook, 2009). The permanent crop land is only 0.5% and the other 96.58% is used for business, residential, and desert (CIA - The World Factbook, 2009). There is 34,220 sq km of Egypt's land that is irrigated. The country's GDP (purchasing power parity) is $452.5 billion (2008 est.) and the GDP (official exchange rate) sits at a $158.3 billion (2008 est.). The GDP for agriculture is 13.4% and the labor force in agriculture is 32% (CIA - The World Factbook, 2009).

Confined to the Nile Valley and delta is Egypt's main location of agriculture. Due to this factor, only three million hectares, a small portion of Egypt's land is able to be cultivated. All crop areas require irrigation, except for some rain-fed areas along the Mediterranean coast (EI-Sherif, 2009). Relying completely on irrigation due to the minor rainfall is a scary thing when water is a valuable resource running short and in high demand especially in desert countries.

Irrigation and conservation of water is major aspect of sustainability for Egypt. The average size of an Egyptian farm is 1.05 hectares (EI-Sherif, 2009).

Sustainability.

I have not been able to find an explicit definition of sustainability in Egypt Sustainability for the country is mainly based around water systems and how to conserve and save water. Egypt has such an arid climate that the water that they have is a very important resource for them. There has been research in water conservation ways (Sowers, 2008).

Historic Horticulture Production .

Egypt has a vast history in agriculture relating as far back to the Paleolithic-Neolithic age (10,000–4000 BCE). In 4000 to 3000 BCE the people of the Nile valley formed a government, constructed the first pyramids, and established an advanced agricultural technology (Janick, 2004).

Egypt had many ancient names all of which relating to the land, people and agriculture. These names include:

> "*Ta-meri*, the beloved land cultivated by the hoe, *Ta Akht*, the land of flood and fertile soil, *Kmt*, the black soil, *Tamhi*, the land of the flax plant, *Nht*, the land of the sycomore fig tree, and *Misr*, the safe and civilized country. The name, Egypt, was derived from the name of the Earth God, *Ge*, or from *Agpt*, referring to the land covered with flood waters" (Khattab, 2000).

By looking at Egyptian art it is evident that ancient Egyptians loved flowers and them being an important aspect of their life. Murals display court ladies wearing Egyptian lotus blossoms as well as showcasing container-grown plants and garlands of flowers for funeral ceremonies. Pharaoh Rameses III (1198–1166 BCE) founded public gardens showing the recognized importance of horticulture (Huxley, 1978, 1998) Throughout this garden, small shrubs and flowers were grown in large earthenware pots, perhaps a beginning to modern day potted plant production (Huxley, 1978, 1998).

Egyptian Pharaohs enjoyed plant collecting and during foreign campaigns they brought home with them exotic trees and other plants for their temple gardens. Organized plant collection expeditions took place as well. Queen Hatshepsut acquired a collection of living myrrh-trees from Punt (Northeastern Africa) for her terraced gardens at her Temple at Deir el-Bahri in 1500 BCE (Huxley, 1978,1998).

Plants weren't only grown for their beauty and enjoyment, a number of necessity crops were grown in Ancient Egypt as well. Castor bean (*Ricinuscommunis*), flax (*Linum usitatissimum*), henna (*Lawsonia inermis*), papyrus (*Cyperus papyrus*), aquatic lotus (*Nymphaea lotus* and *N. caerulea*), and acacias (*Acacia* spp.) were other crops used for medicinal purposes and everyday life (Janick, 2004).

Vegetables of this era included a number of root crops, leafy greens, legumes, and various cucurbits. Root crops included the alliums, garlic (*Allium sativum*) and onion (*A. cepa*), as well as radish (*Raphanus sativum*) and still to this day continue to be popular in modern Egypt. Among the vegetable greens, lettuce, *(Lactuca sativa)* and parsley (*Petroselinum crispum*) were the most common. Legumes were popular and various including, cowpea (*Vigna sinensis*), fava bean (*Vicia fava*), chickpea (*Cicer arietinum*), and lentils (*Lens culinaris*). The cucurbits included cucumber (*Cucurbita sativa*), melons and gourds (*Cucumis melo*), and later watermelon (*Citrullus lanatus*). Fruits included dates and doum palms as well as the sycamore figs. The jujube, fig, and grape have been recognized since the Old Kingdom; the carob and pomegranate were introduced in the Middle Kingdom; the olive and apple appeared in the new

Kingdom; while the peach and pear, were introduced in the Graeco-Roman period (Janick, 2004).

Present Day Production.

Cotton is the number one agricultural crop in Egypt in terms of export and production. Cotton is followed in second by rice which is grown and produced on roughly 210,000 hectares. Wheat is third in the catagoy of agriculture. It is the major winter cereal crop in terms of hectares planted which is about 252,000 hectars (EI-Sherif, accessed 2009).

Another present day crop is sugar cane. It is used about 90 percent for sugar extraction. Egypt produces a number of bean crops such as broad beans and soybeans. There are many forage plants in production including: clover and berseem. Berseem is the major winter forage crop cultivated in the Nile Valley and delta. It is the most widely grown field crop and occupies an area which totals 504,000 hectares (EI-Sherif, accessed 2009).

Horticultural crops include citrus, consisting of oranges which represent 85 percent of total citrus production, making up 50 percent of Egypts total fruit production. Land devoted to fruit plantations has expanded over the last 30 years currently reaching about 84,000 hectares (EI-Sherif, accessed 2009).

Egypt at present has approximately 17,238 hectares planted to mangos (Zahran, 1992). The 1992 harvest reached 174,371 metric tons (MT), about 10 MT per ha and making it about half the production per ha compared to Israel (Zahran, 1992). Most Egyptian mango production is consumed within the country, although a portion is exported to the Persian Gulf states. (Zahran, 1992)

Current day production of crops is done mainly in fields. The main growing regions for Egypt include Giza, South Tahrir and Sharkia regions as well in the Ismalia region of north eastern Egypt (Sutherland, 2000). However, there are a few greenhouses, information on production practices are slim. Many are used for plant breeding purposes, but there are reports of strawberry and banana high tunnel production (ICA Japan – Egypt, 1995)

Integration of Historical and Current Production Practices

Egypt has been very successful in the past at irrigation techniques and finding opportune ways of harvesting water from the Nile. There are many problems in irrigation systems that this area poses. First of all the Nile is the only water source flowing through a dessert and therefore a lot of water is constantly being evaporated off (Ancient Irrigation, 1999). As the river flows it is constantly accumulating salts and minerals. This type of water overtime will have a negative effect on plants due to high salts.

Different styles of irrigation were developed very early in ancient Egypt, depending on the natural land form. The first types of crops grown along the river were winter crops and planted after the annual floods of the Nile. Large, flat-bottomed basins for growing crops were built along the river banks, along with long sluices to collect and transport water at the peak of the flood. The water that was delivered to the crops was aloud to sit for 40-60 days and then was drained off at the critical moment in the crops life-cycle (Ancient Irrigation, 1999).

In the dry hilly areas irrigation is different due to the rivers and springs being smaller and there fact that they don't have consistent flow. In this case, diversion dams and storage devices had to be built (Ancient Irrigation, 1999)

In the flat plains of Mesopotamia current day Iraq and Iran, there are massive soil problems due to poor drainage. Here canals were built to tap into the water supply of the Tigris River (Ancient Irrigation, 1999).

Ranking of Production Strategies .

The simplest and perhaps most sustainable in the form of no fossil fuels is field production. However, water in this production is not conserved. Citrus, mangos, tomatoes, and other horticultural crops all are produced in the field and have been produced this way for centuries. In an effort to overcome disease, and water conservation Egypt has researched high tunnels. High tunnels are a half way point when it comes to sustainability it is a give a take situation. Negatives to high tunnels are the intense fossil fuel inputs, but the positives are the 60 percent water loss reduction (Baker, 2008).

Sustainable Production of Tomatoes.

Vegetable production in Egypt consist of three seasons for tomatoes, winter, summer and autumn representing three percent of Egypt's available planting land. Tomato leaf curl virus, early and late blight, and nematodes have been a large part of production loss (EI-Sherif, accessed 2009). After tomatoes, potatoes are the second most important vegetable, both in terms of cash value and total tonnage produced. (EI-Sherif, accessed 2009).

Egypt has a few environmental issues that need to be dealt with. Agricultural land is being lost to urbanization and windblown sands. The soil salination below Aswan High Dam is increasing which is negative for many crops especially since there is little rainfall to lower the soil pH. Water pollution from agricultural pesticides, raw sewage, and industrial effluents are affecting the limited natural fresh water resources. The Nile River is the only perennial water source and the rapid growth in population is overstraining the Nile and its natural resources. With the problems that Egypt is facing, they will have to develop a definition of sustainability (CIA - The World Factbook, 2009).

The most important problem Egyptians face is water conservation. Over 96% of Egypt is desert therefore making their irrigation needs very imminent. Greenhouse structures could help make this process more sustainable. If plants are grown and watered in the greenhouse, irrigation recycling systems can be set up. In general, if plants are placed in a high tunnel evaporation is greatly decreased, another perhaps ideal way to conserve water.

Finalized Sustainable Development Strategy.

I feel it would be beneficial for the country to implement high tunnel production. Irrigation in this type of system can be accomplished by using drip tape, an efficient system developed in Israel that sends water only to the roots. Drip tape nearly eliminates plant disease since many diseases begin with moisture problems. It also reduces water loss by 60 percent, making a drip system far more cost effective than any others on the market (Baker, 2008).

Research.

Research performed during 1975-1984 at the Tanta University Experimental Farm tested the tomato production under the influence of different size plastic tunnel systems in order to allow for winter production.

Figure 2. Shade grown tomatoes in Egypt (Berkel, 2007).

These high tunnels proved to be statistically beneficial, however, temperatures in the summer reach extremes and tomato crops can be damaged by heat stress. To over come this, plants were tested under different shade coverings. Plants that were grown under 40 percent shading proved to have the best fruit production, and plants growing in the shade conditions also tended to produce higher fruit yields (El-Aidy, 1986).

In an added effort for cooling a new trial should be tested by adding mist nozzles above the plants under the shade to see if this extra added cooling can increase the production of tomatoes enough to out weigh the costs.

In the research proposed above neither study conducted a sustainability test. These should be repeated and test results of production and irrigation usage should be reported.

Cost Effectiveness.

Based on the found research projects a continuation should be done looking toward building a structure that encompass both aspects for winter that is easily changed to shading in the summer while integrating sustainability aspects. Tomato production is an important horticultural crop year round in Egypt, however, due to increased temperatures in the summer, September-October production is slowed and due to decrease in temperature, April production is therefore decreased as well (Abou-Hadid. et. al., 1986). In an effort to increase production ability during those periods of time, a high tunnel structure will be built with polycarbonate covering. Wooden posts will be installed for the extreme highs in the hot months for and installation of 40% shade cloth can be added. Both of these methods have been tried and the results have proven to have a positive significance in the production of tomatoes. If production is prevented from coming to a slump in these months profits can be kept at more constant rate throughout the year. Therefore the cost benefits of the installation of these structures will be out weighed by the increase in production.

Advantages and Disadvantages.

There are many advantages to this proposed system, including increase yield throughout the year. With the increase in yield increase in profits follow. As well as the increased production, Egypt would be one step closer to providing a consistent yield of tomatoes year round helping fight food shortages. A decrease in disease and pest problems are note in the controlled environments and less water usage is gained.

Disadvantages include high dust which may accumulate on the high tunnel block light

Future Sustainable, Controlled –Environment Production Location.

The test location will be Cairo, Egypt due to access to the Nile River for irrigation and. possible support from The University of Cairo. Cairo is located at a latitude of 30°2N' 31°21E'.

Production Schedules.

It has been reported that a two to three crop harvesting of tomatoes is possible in Egypt (EI-Sherif, accessed 2009). For this test seeds should be sown of week 46 (roughly November 15) and transplanted in the high tunnel at roughly one foot intervals on week 1 (roughly January 1st). Begin harvesting in week 14 (about April 5th). Finish and remove crop in week 25 (about June 15th) this completes round one. Round two should be seeded in week 7 (February 15) transplanted in shade structure during week 13 (about April 1st) begin harvesting in week 27 (about July 1st) and finish harvesting in September. Third round of tomatoes should be seeded on week 20 (May 10th) get transplanted in June about week 24 and begin harvesting week 37 about (September 6th). Keep rotating this schedule for year long production.

Literature Cited:

Abou-Hadid, A.F., Maksoud, M.A. and El-Abd, S.O. 1986. Protected cultivation for winter production of tomato. Acta Hort. (ISHS) 191:59-66 http://www.actahort.org.floyd.lib.umn.edu/books/191/191_5.htm

Ancient Irrigation. 1999. The geology department, university of California, Davis. Mar. 2009 <https://www.geology.ucdavis.edu/~cowen/~GEL115/115CH17oldirrigation.html>.

Baker, M. High tunnel farming. 2008. MinotDailyNews.com. News, sports, business, jobs - minot daily news. Mar. 2009 <http://www.minotdailynews.com/page/content.detail/id/516927.html?nav=5562>.

Berkel L.V. 2007. Import season for Egyptian vegetables started in Europe. FreshPlaza: Global Fressh Produceand Banana News.May2009 <http://www.freshplaza.com/news_detail.asp?id=11028>.

CIA - The World Factbook -- Egypt. 2009 Welcome to the CIA web site — Central Intelligence Agency. 2009 <https://www.cia.gov/library/publications/the-world-factbook/geos/eg.html>.

EI-Sherif, M. Egypt. FAO: FAO Home. 18 Feb. 2009 <http://www.fao.org/docrep/v9978e/v9978e0e.htm>.

El-Aidy, F. 1986. Tomato production under simple protective tunnels in Egypt. Acta Hort. (ISHS) 190:511-514 http://www.actahort.org.floyd.lib.umn.edu/books/190/190_58.htm

Egypt. Solar navigator homepage information portal marine world electric navigation challenged. May 2009 <http://www.solarnavigator.net/geography/egypt.htm>.

FAO - Fertilizer use by crop in Egypt. 2003 FAO: FAO Home. 25 Mar. 2009 <http://www.fao.org/docrep/008/y5863e/y5863e07.htm

ICA Japan – Egypt. 1995. Welcome to ICA Japan. May 2009 <http://www.icajapan.org/virtualtoure/96BayadE.html>.

Janick, J. 2004. Ancient Egyptian agriculture and the origins of horticulture. Department of horticulture & landscape architecture, Purdue University. Purdue University. 17 Feb. 2009 <http://www.hort.purdue.edu/newcrop/history/egypt/egyptpaper.pdf>.

Fleury, Jean-Marc. 1986. International development information databases. 25 Mar. 2009 <http://idrinfo.idrc.ca/Archive/ReportsINTRA/pdfs/v15n1e/111042.pdf>.

Knight, R. 2004. Report on the Egyptian mango industry. Tropical Visions 1. University of Florida. 17 Feb. 2009 <http://www.quisqualis.com/egyptmanknight.html>.

Sowers, J. 2008. Water sustainability and authoritarian rule in Egypt and the Middle East. 2009 <http://www.allacademic.com/meta/p253112_index.html>

Sutherland, D. 2000. RONCO: RONCO in the News: Archives. RONCO Consulting Corp. - Humanitarian Demining. 25 Mar. 2009 <http://www.roncoconsulting.com/news/archives/egyptian_strawberries.html>.

Taha, M.M. 1989. Marketing and feasibility of cut flower project in Egypt. Acta Hort. (ISHS) http://www.actahort.org/books/246/246_4.htm. 246:53-64

Zahra, M. A., and A. J. Willis. 1992. The vegetation of Egypt. London: Chapman & Hall.