Food Researched: Tomato
Focus of Research:
Name: Sarah Stadler
May 18, 2010

Growing Tomatoes in the US and the Environmental Consequences

Objective(s)
As they are a major food crop in the United States, growing tomatoes doubtlessly has a correspondingly large ecological impact. This research explores how tomatoes are grown and for what purposes, and the historical and biological reasons for today’s methods. It goes on to discuss the influence that commodity agriculture is having on one ecosystem in California.

Summary of Findings

Agricultural History

In the United States, tomatoes are the fourth most consumed vegetable (Nix), but their status as staple produce is remarkably recent. The tomato plant has its origins in western South America, where wild species produced fruit the size of a modern cherry tomato. Archaeological evidence suggests that the plant was first used as a food source not in its original home, but farther north in Mesoamerica after seed dispersal had increased its range. It was in Central America and southern Mexico that tomatoes were domesticated and bred to produce larger fruit. With the onset of Spanish conquest, the tomato was introduced to Europe and integrated into the ornamental gardens and eventually the cuisines of some countries, one notably being Italy. Colonization in the southern US by the Spanish during the 1600s brought tomatoes to the North American for the first time, and from there familiarity with the tomato as food moved northward into the British colonies (Long).

However, the tomato belongs to the Nightshade family of plants, of which many members are poisonous. As such, widespread consumption of tomatoes in the United States began quite gradually, increasing the early 1800s as people were convinced by celebrity publicity from such figures as Thomas Jefferson that the tomato and toxicity connection was untrue (Boswell).

Tomatoes for all purposes at first were cultivated by hand, and just before the turn of the century machinery was used early in planting, but the growing process remained much as it had been during this time. It was with the invention of the mechanical harvester that the tomato industry was drastically changed. Starting in the 1960s, some tomato farmers began to switch from production dependent on high numbers of laborers to mechanical harvesting. The new technology made harvesting less time-consuming, especially in bigger fields, but also failed
To collect all of the fruit, leaving a sizeable proportion behind. The losses made it profitable for only large farmers to make the switch, and growing tomatoes shifted toward large-scale production. Harvesters also worked better in the dry soils of California than they did in the Midwest, causing a geographical shift in production as well (Fox). 75% of tomatoes eaten in the United States are processed, and 90% of those processing tomatoes are now grown in California (Smith).

To make harvesting by machine as efficient as possible, tomatoes have been specifically bred to have a tough skin that can handle the process. In addition, plants were bred for “square” shape so that they could be easily stacked in shipping boxes and so as to not roll off conveyor belts (DavisWiki).

More recently as genetic engineering has become possible, plants are designed to grow at a shorter, uniform height, which makes for easier harvesting. The Flavr Savr tomato of 1994 was engineered to ripen and soften more slowly than normal to increase shelf life, but ultimately failed on the market because of an ironically unappealing taste (Comm Tech Lab). Current endeavors in engineering and breeding of tomatoes include increasing the content of specific nutrients, improving flavor, and increasing yield per plant (NSF).

To-may-to, Not To-mah-to—Farming for Industry

Before getting into the details of farming, it’s important to note that tomatoes are grown in the United States in two separate industries, for the fresh and processing tomato markets. While cultivation methods are largely the same, the divergence in what will be done with the fruit does create some major differences in what producers must consider.

*Fresh Tomatoes*

Nearly half of commercial fresh tomatoes are grown in Florida, and more than two-thirds are grown in Florida and California together. Fresh tomatoes account for about a tenth of all tomatoes produced in the US annually. In breeding, a greater emphasis is placed on taste than in the processing industry, although shelf life and shape are still important considerations. Conventional tomatoes are picked by hand at the mature green stage to allow for durability during transportation, and later treated with an ethylene gas to induce ripening before sale, which is usually directly through the market (USDA). The largest buyers of fresh tomatoes—and indeed all fresh produce—in Florida are fast food and grocery corporations, including Subway, McDonald’s, and Walmart. Very poor working conditions have been reported for farm laborers in this industry, and such big buyers are being pushed to take an active role in promoting workers’ rights through economic pressure (see Katie Powell’s research for more on this).

Tomatoes have been field-grown for most of human history. Farmers had to learn to work with an array of unpredictable and uncontrollable environmental factors in coaxing their
plants to produce. Despite the wide range and adaptability that common opinion grants them, tomatoes are quite vulnerable to climate extremes, especially to low temperature. One of the most damaging and yet most easily avoidable dangers is planting too early, which may leave crops with nutrient deficiencies, blossom end rot, and fruit with physical deformities. Plants grown in soil are susceptible to fungal infection, insects, viral attacks, competition from weeds, and nutrient depletion. They can be scorched by the sun, and over or under-watered (Cook).

Greenhouse and hydroponic technology provide solutions to most of these problems, allowing crops to be raised in a tightly controlled environment with conditions that are close to ideal. Hydroponic plants are grown close together in a temperature-controlled setting, with their roots bathed in a circulating bath of nutrient water, and are sheltered from pests. Yields, however, increase in proportion to the level of technology used. Controlled environments can be as simple as a backyard hoop house, but the advanced technologies typical of the industry can allow for yields up to fifteen times greater than the field gives. They are also extremely expensive to build and heat, and require a great deal of expertise to be run properly.

**Processing Tomatoes**

Processing tomatoes are grown in fields, allowed to ripen on the vine, and mechanically harvested. Harvesting is done only once, when more than 90% of the crop is ripe, because the machines pull up all of the plants and sort vine from fruit. By necessity, varieties are chosen to produce fruit with thick skins that can withstand the process (Boriss).

Virtually all growers contract directly with processing companies. Contracts are made before the growing season begins. Growers must choose the varieties that they grow from a preapproved list made by the processing firm, which selects primarily for resistance to pests and disease, expected yield, and time to reach harvest readiness. At the time of harvest, tomatoes have been left without irrigation for several weeks so that they are more concentrated with solids than water. About six hours after harvest, initial processing at a plant yields tomato paste, which is then sold to different companies that may continue manufacturing to make sauces, ketchup, and other tomato products (Hartz).

**Tomatoes and Irrigation**

All processing tomatoes in California are irrigated. After transplanting from greenhouses, as is common practice, sprinkler irrigation is used until plants are established. For the majority of the growing season, furrow irrigation is used, in which long trenches are carved parallel to the rows of plants for the length of the field. Water from a long canal at the edge of the field is pumped into each of the furrows by a series of spiles or siphons. The type of soil and
slope of the land are important in determining the spacing of the rows and of the amount of water required to keep roots sufficiently wetted. Much of the water introduced is lost to evaporation.

Drip irrigation, which accounts for close to 20% of tomato irrigation in California, is much more water efficient. Water is delivered directly to plant roots by tubing that either rests on the surface or is buried several inches down. Small holes, called emitters, allow the pressurized water to trickle out and wet the soil. The issue with drip systems is that they can be difficult to install and maintain. Emitters tend to become plugged by sediments, minerals, and algae. They must be replaced often, or the water must be kept very pure, which is expensive. Drip systems are most practical and profitable when the crop grown highly valuable, or in dry areas where other methods aren’t viable (Brouwer).

Worldwide, agriculture is responsible for 70% of the water used by people. As risk of drought in key agricultural regions increases with climate change in the coming decades, it may be beneficial for growers to consider shifting their production to include more water efficient methods.

The Sacramento-San Joaquin River Delta

The San Joaquin Valley is an extremely agriculturally productive region of central California. It is there that the majority of processing tomatoes—as well as many other vegetables, fruits, and nuts—in the United States are grown. Near the valley is a delta through which the joined Sacramento and San Joaquin rivers flow west toward the San Francisco Bay. Naturally a marshland, it has been controlled since the mid-1800s with levees meant to allow for farming in its rich peat soil with decreased risk of flooding (Ingebritsen). Interest in the delta as a water source have been around almost as long, and building to divert water began with the Central Valley Project, an undertaking funded as part of the New Deal in 1935 (Stene). Today, about twenty million people, or two-thirds of the state’s population, draw on water pumped from the delta. Impressive as that sounds, 83% of the water transported from the delta is used for agriculture (Ingebritsen).

The delta’s ecosystem, however, is strongly impacted by the transfer of so much water. The delta smelt and Chinook salmon are endangered fish species that live in the waterways. Increasing salinity levels and decrease flow rate of the river have adversely affected the annual life cycles of the smelt. Many have been found dead near pumps, which are strong enough to reverse the direction of the water’s flow in some places. Concerns for these species’ survival have resulted in court-imposed pumping decreases during migration season. The order has not been calmly accepted by agricultural interests. In early 2010, the irrigation districts of the San Joaquin valley filed suit against the government in an effort to get the limits removed. With much of the state facing a drought going into its third year, a steady supply of fresh water is essential for growers in the region to maintain yields (Boxall, Feb. 11).
In addition, the delta is vulnerable to inflow of seawater from the San Francisco Bay. The delta is already below sea level, and lower flow rates are a risk for increased infiltration of salt water. If the sea level were to rise, or if the weakened levees surrounding the delta broke down, the influx from the sea would make the water useless for agriculture and undrinkable, as well as cause damage to an already sensitive ecosystem.

One proposed solution is the building of a canal that would divert fresh water to be used around the delta instead of through it. Its merits are on the environmental front, and the proposals, which have been discussed and dismissed for over four decades, have been too expensive and promised benefits too uncertain and intangible to be seriously considered (Zimmerman). The most recent attempt to create such a policy, Huber’s Bill, was passed out of the California Legislature’s Assembly Water, Parks and Wildlife Committee at the end of April 2010 with almost no support (Breitler). Whether the issue is to be solved politically or otherwise, the growing imbalance surrounding the state’s water use demands to be addressed.
Sources


<http://legacy.lclark.edu/~soan221/01wlc/AgTechnology/harvester.htm>.


