Agriculture and the Future of Food:
The Role of Botanic Gardens

United States Botanic Garden

Introduction by

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The more than 320 million Americans alive today depend on plants for our food, clothing, shelter, medicine, and other critical resources. Plants are vital in today's world just as they were in the lives of the founders of this great nation. Modern agriculture is the cornerstone of human survival and has played extremely important roles in economics, power dynamics, land use, and cultures worldwide. Interpreting the story of agriculture and showcasing its techniques and the crops upon which human life is sustained are critical aspects of teaching people about the usefulness of plants to the wellbeing of humankind. Botanical gardens are ideally situated to bring the fascinating story of American agriculture to the public — a critical need given the lack of exposure to agricultural environments for most Americans today and the great challenges that lie ahead in successfully feeding our growing populations. Based on a meeting of the nation's leading agricultural and botanical educators organized by the U.S. Botanic Garden, American Society of Agronomy, Crop Science Society of America, and Soil Science Society of America, this document lays out a series of educational narratives that could be utilized by the U.S. Botanic Garden, and other institutions, to connect plants and people through presentation of the American agricultural experience.

Horse-drawn reaper, Circa 1837

2100 BC

The future United States' agricultural history starts with American Indians growing corn

1493

Christopher Columbus introduces old world crops such as wheat and sugarcane to the New World

1607

English settle in Jamestown, VA where American Indians teach them to grow corn, pumpkin, and squash

Tobacco becomes the cash crop of colonial America

1775-1783

AMERICAN REVOLUTIONARY WAR

1790

93% of Americans are farmers

1815-1830

Cotton replaces tobacco as the main crop in the South

America's Evolving Success Story—

American Success is Predicated on Agriculture

Growing a Nation, Nourishing a Nation

America's "founding farmers" were passionate about agriculture and saw it as integral to building a strong, healthy nation. George Washington believed "Nothing... would contribute more to the welfare of these States, than the proper management of our Lands;" similarly Thomas Jefferson wrote "Agriculture is our wisest pursuit, because it will in the end contribute most to real wealth, good morals & happiness."

When Washington and Jefferson shared these thoughts just after the founding of our nation, 93 percent of Americans were farmers. These early American farmers experimented with food and fiber crops to meet the demands of a growing nation. Farmers today follow these same basic tenets — they continue to test and expand the limits of agriculture. However, with less than 2 percent of Americans working in production agriculture today, most Americans have all but lost their connection to this essential enterprise. Our Founding Fathers, especially Presidents Washington, Jefferson and Monroe, believed the establishment of a federal botanical garden was critical to our burgeoning nation based on their appreciation of the importance of plants to our well-being. Today, with so few Americans in contact with modern agriculture, the role of botanical gardens in educating the public about agriculture's importance is perhaps even more pronounced than in the earliest years of our country's founding.

200 years ago, a vast majority of Americans worked in agriculture; today, less than 2 percent do.

1820

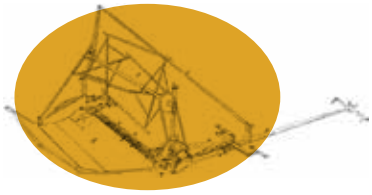
U.S. House of Representatives establishes Agriculture Committee

1825

U.S. Senate establishes Agriculture Committee

1834

Cyrus McCormick's horse-drawn grain reaper is patented



1837

John Deere begins manufacturing steel plows

1849

Mixed chemical fertilizers are selling commercially

1850

64% of Americans are farmers

United States Food Administration, ca. 1918

Agriculture and America's Defining Moments

Even when exploring the history of America's most significant events, agriculture is a central element. Starting with the basic causes of our country's founding, the American narrative has been driven by farms, farming communities, and agricultural consumers. The British stance on taxing the colonies' exported agricultural products led, in part, to the American Revolution. America's Civil War was similarly driven by agricultural concerns; the North wanted to preserve the Union and the authority of the Federal government to govern the states, and the South wanted to preserve state independence and a slave-dependent agricultural economy based on cotton, tobacco, rice, and other crops. Though the South was more dependent on agriculture, the North also understood its critical importance to the nation. In 1862, a few years before the war's end, President Lincoln formed the Department of Agriculture to "acquire and to diffuse... useful information on... agriculture." America rebuilt the agricultural systems that were decimated by the Civil War, and by the early 20th century, at the start of the world wars, the United States was managing domestic food surpluses when global food shortages arose. Our allies and their soldiers overseas were starving, and America responded with massive food aid: an important determinant of allied victory. After the Japanese struck Pearl Harbor, a poster read, "Food Will Win the War and Write the Peace," illustrating

1861-1865

CIVIL WAR

1862

Lincoln creates the USDA

Morrill Land-Grant College Act supports agricultural education

Homestead Act gives free public land to people willing to farm it

1862-1875

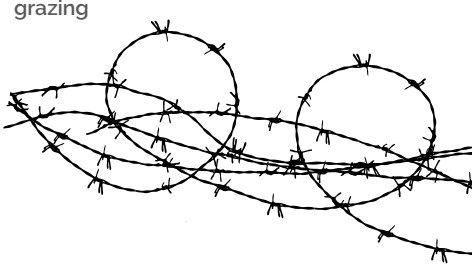
The First American agricultural revolution. Horse power replaces hand power

1865-1870

Sharecropping replaces slavery-based plantation system

1874

Glidden barbed wire is patented, ending open-range grazing



1880

49% of Americans are farmers

the importance of agriculture and food production in America's ascent to the status of superpower.

Astounding Technological Advancement

The American agriculture story is a great case study of the virtues of technology; it exemplifies progress, knowledge application, and the ability of technology to increase efficiency. Human ingenuity, technological advances, and both public and private research continue to stimulate America's agricultural enterprise. Over time, production has steadily increased while labor needs have greatly decreased. Before mechanization, a farmer could harvest 100 bushels of corn a day; today a farmer operating a combine can harvest 7,200 bushels a day! These advances freed farm labor to transition the U.S. to a manufacturing and modern service-based economy, thereby raising living standards across the country. However, modern agriculture has come with some costs including increased chemical and energy inputs, environmental degradation, and unique labor challenges. And yet, agriculture continues to improve and progress, leveraging sustainable technologies and advances in genetics to combine production gains with decreased environmental impacts.

Before mechanization, a farmer could harvest 100 bushels of corn a day; today a farmer operating a combine can harvest 7,200 bushels a day!

1881

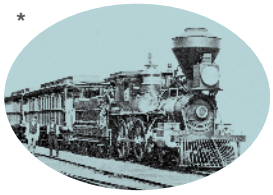
Hybridized corn is produced

1887

Hatch Experiment Station Act gives states federal grants for agricultural experimentation

1888

The first refrigerated freight car travels from California to New York



1890

Second Morrill Act passes to fund historically black land-grant colleges and universities

1890s

Scientists discover that plants can be selectively bred for disease resistance

1900-1910

Agricultural scientist George Washington Carver promotes crop rotation and introduces new crops to replace cotton: peanuts, sweet potatoes, and soybeans

From Plant to Plate:

America's Cornucopia Relies on Vast and Diverse Systems of Agricultural Production

Tapestries on a Vast Landscape

Sometimes when driving in the country, where silos and barns dot the rolling hills and corn or wheat sways in the wind, it is easy to idealize agricultural work and overlook the sheer complexity of and requirements for producing healthy plants and food. Each geographic zone is endowed with differing soil quality and composition, climate patterns, geology, and available water resources. These variables—individually and collectively—determine the profitability and efficiency of crop production in each area. They explain why the United States is an agricultural mosaic, with different regions suitable for different crops; Florida is known for citrus and strawberries; California grows a medley of fruits, vegetables, and nuts; and the Midwest produces corn and soy for the world. The environmental requirements of plants are often invisible to the public who see a cornucopia of food in their local market and may not think about the origins of that food and the seasonality of its production. Educating people about agriculture connects them to the plants and people who grow our food.

Mitchell Postcard, Circa 1910

Moving Plants from Field to Plate

All food plants originated in the wild and were selected for some beneficial, aesthetic, or delicious attribute. The original plants may

* Photo Courtesy Historic American Buildings Survey (Library of Congress)

1906

Pure Food & Drug Act passes requiring clean agricultural goods

1914-1918

WORLD WAR I

1914

WWI creates an American agricultural explosion to meet the need to feed the world

Smith-Level Extension Act passes and sets up national extension service

1920

30% of Americans are farmers

1929

The Great Depression begins

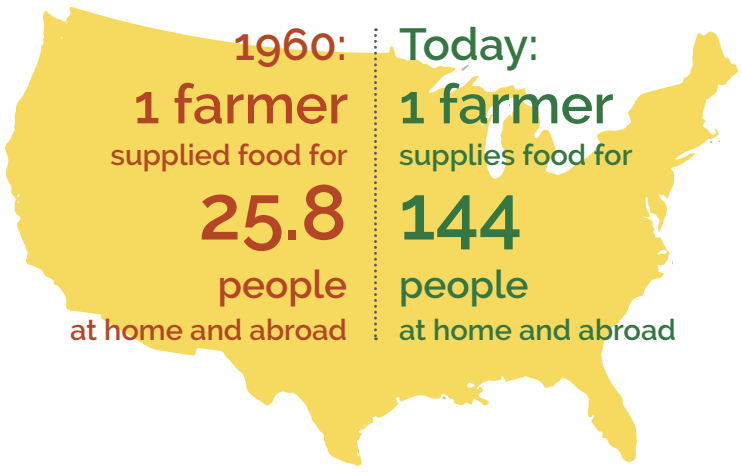
1920-1932

Crop prices fall; severe drought and floods wreak havoc on America's farm lands

*

have been dug from a prairie, had cuttings taken in a forest, or had seeds collected in a swamp. These were planted and cared for, and often bred with other individuals that had different characteristics of interest (maybe bigger or tastier fruits). Once a plant has a set of desirable qualities, it may be introduced into larger scale production. Its seeds are planted, and the seedlings harvest light, water, air, and soil nutrients. If the right plant has been chosen for the location, provided the necessary nutrients, and tended to properly, a viable crop may be produced.

However, as gardening hobbyists know, sometimes best intentions are met with failure. Disease, poor soils, weather, and many other factors can disrupt plant growth before a crop is even produced. Once a crop is harvested, the farmer still must determine how to get the product to consumers before spoilage occurs. Every part of the plant-to-plate process is complicated, and all parts of the system have to operate effectively and efficiently. We cultivate plants because they use energy from the sun to convert air, water, and minerals in the soil into the food we need to power the human body. As our populations have increased and diversified, so have our tastes. With the help of science and technology, farms are producing a greater diversity of food, fiber, and fuel to



* Photo Courtesy U.S. Farm Security Administration

1932-1936

Drought and dust bowl conditions develop

1933

Franklin D. Roosevelt's New Deal and Agricultural Adjustment Act are designed to help rural America

Farmers were paid NOT to plant crops to reduce crop surpluses

1935

Black Sunday — the "black blizzard" of the Dust Bowl

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1939-1945

WORLD WAR II

Roosevelt asks farmers to increase production to feed the world

Hybrid corn commercialized

The National Victory Garden program urges Americans to grow their own food

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1945-1970

The second American agricultural revolution! Tractors replace horses, commercial fertilizers and large-scale irrigation become widespread; productivity per acre sharply rises

1950

12% of Americans are farmers

meet a growing and savvier consumer base using fewer employees and fewer inputs.

Plants ARE the Food Supply

Scientists' understanding of plant-based nutrition is advancing and consumers want healthy food choices. The public's growing curiosity about food and healthy eating has led to a learning resurgence in cooking, with home chefs developing tastes for diverse ingredients. The United States Department of Agriculture devised the MyPlate icon (formerly the Food Pyramid) to help Americans choose their food wisely. With a glance at the plate that is nearly filled by "vegetables," "fruits," and "grains," one sees the importance of plants in our lives and the great diversity of agricultural products that find their way onto our tables. Even the animal products on the plate are derived from plants; all domesticated farm animals are raised on plant-intensive or exclusively plant-based diets. Aside from seafood, virtually everything in the American food supply comes from plants grown on farms. Getting that message to the American public is an important step in helping them understand the importance of plants in their daily lives and the complexity of our agricultural system.

MyPlate icon

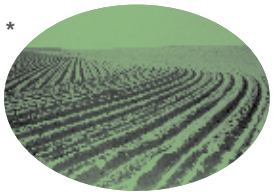
Thank a honey bee today! Bees pollinate more than 100 agricultural crops in the U.S. and contribute to more than $15 billion worth of crops every year.

*Photo Courtesy U.S. Farm Security Administration **Poster Courtesy U.S.D.A.

1950s

Mechanization affects farming practices: small farms cannot compete with large-scale commercial enterprises

Supermarkets replace the corner store, TV dinners are introduced, and McDonald's emerges



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1954

The number of tractors exceeds the number of horses and mules for the first time

1964

Food Stamp Act passes

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1970

First Earth Day

Environmental Quality Improvement Act passes

1970s

No-tillage agriculture becomes popular

*

1970

5% of Americans are farmers

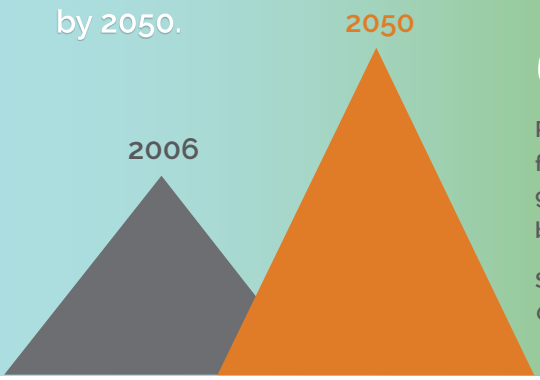
Choosing Our Future—

American Well-Being Will Require Agricultural Success

Tomorrow's Agricultural History

Agriculture's future will be as amazing as its history. The United Nations predicts the world's population will reach 9.6 billion by 2050—a daunting challenge indeed for the agricultural community who will need to more than double food production—and many are thinking about how to feed, clothe, and fuel people around the globe. In the United States and elsewhere, several factors complicate the necessity to further intensify agricultural practice. Issues include environmental concerns, such as topsoil depletion, groundwater and soil pollution, loss of biodiversity, global climate change, and drought, as well as socioeconomic challenges such as farm labor concerns and the migration of the workforce to urban areas. As fewer people interact directly with agriculture, an infusion of agricultural education will be needed, especially in urban areas, to cultivate an informed citizenry. There are exciting movements afoot in agriculture. Farmers and scientists recognize the need to increase the sustainability of the agricultural enterprise, and they are working to increase productivity and food access while decreasing inputs, environmental degradation, and the land area needed for farming. This is being done primarily through

The world must achieve a "great balancing act" in order to sustainably feed 9.6 billion people by 2050.



69%

Required increase in food calories to feed 9.6 billion people by 2050

Source: Winne, M. (2008). *Closing the food gap.*

*Photo Courtesy U.S.D.A.

1980s

Biotechnology becomes a viable technique for improving crop products

1985

Food Security Act lowers government farm supports, promotes exports, and sets up the Conservation Reserve Program

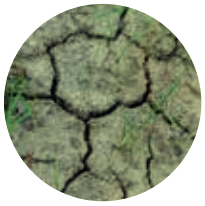
Community Supported Agriculture (CSA) begins

1996

Biotechnology produces first commercially available herbicide- and insect-resistant crops—soybeans, cotton, corn, and canola

2010

California drought begins



2015

UN Food and Agriculture Organization names 2015 as International Year of Soils

2015

2% of Americans are farmers

the development of improved crop plant varieties that can be cultivated in formerly unplantable lands, require less fertilizer, produce more food, and withstand pests, diseases and greater climate variability. Agriculture is becoming an increasingly holistic, interdisciplinary endeavor that simultaneously manages environmental health, economic prosperity, and social and economic health. Systemic approaches need many players including farmers, scientists, engineers, NGOs, multinational companies, consumers, and government entities. Complicated problems often require a great variety of solutions, which in this case may include stronger alignment between agriculture and ecological processes, advanced technologies, improved transport, genetic improvements, and increased public awareness and interest in agriculture. Most likely, solutions will incorporate a mixture of strategies generated by diverse stakeholders that will be appropriate for each farm's location. The goal is improving yields and farmers' profits and reducing the negative environmental impact of farming, while also reconnecting the public with food production.

The future is now, and today's students—whether interested in technology, social issues, or plant sciences—can contribute knowledge gained from a range of disciplines to the agricultural challenge of feeding a growing population while safeguarding the health of the planet.

Farmers can use computerized systems to help them chart the different soils and moisture on their farmland to decide what crops to plant, what seeds to use, and how much fertilizer to apply.

*Photo Courtesy of U.S.D.A

Plants Make Our Lives Possible—

We Must Improve Public Education About Agriculture

What Will You Do to Make a Difference?

Because we will always need food, timber, medicine, clothing, and plant-based fuel, we need to care and learn about the agricultural production system. Losing awareness of our connection to and dependence on plants and the agricultural system that provides them is detrimental to our ability to choose our future paths wisely and to ensuring the sharpest minds are advancing agriculture.

All sectors of society need to learn about agriculture and sustainability—and there is no time like the present given the public's growing interest in gardening, food, and urban agriculture. With the decrease in plant science education at colleges and universities nationwide, botanical and horticultural organizations have become crucial centers for botanical education. Accordingly, they are ideally equipped to display and interpret agriculture and crop food plants, and are well-suited to initiate public discourse about the growing need to produce more food to feed the human population. Public gardens, like farms, dot the country and they have the knowledge needed to grow crop plants so that visitors can experience and begin to understand agricultural ecosystems. K-12 educators can also play a critical role by taking students on field trips to botanic gardens that present agriculture. Gardens' interpretive exhibits about crop plants are powerful tools for teaching American history and environmental science through an agricultural lens. Public gardens in the United States welcome more than 100 million visitors every year, presenting hundreds of thousands of opportunities to connect people to plants, agriculture and our food system.

Public Gardens Can Lead the Way

If public gardens lead the charge in agricultural education for the general public, people from around the country will have opportunities to learn about our nation's heritage, agricultural practices, environmental stewardship, and sustainable food practices. Best of all, they will be thinking about the challenge of their lifetime—feeding, clothing, housing, healing, and fueling our growing population—and considering how each of us can make a difference. Furthermore, public gardens will serve as a shining example for other institutions to engage an excited citizenry in the wonders of agriculture, thereby realizing the full vision of our Founding Fathers to create national cultural institutions that fully elucidate the relationships between plants and human well-being.

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