An enormous number of mechanical advances are inherent in the development of agriculture. In addition, the power driving these mechanical advances have shifted from humans, to animals, to water, to steam, and to oil-derived fuels.

Development of Hand Weeders

Two primitive Egyptian hoes form the Middle Kingdom

Soil preparation by hoeing; from a Tomb at Ti at Saqqara, ca. 2400 BCE

January

Wielding primitive hoes, a couple cultivates its fields in the rain.
Another farmer sits before a fire and keeps a sharp eye out for crop robbers.
In a symbolic ceremony, the Inca emperor and noblemen turn over the first earth in a sacred field, while three women bow and the empress offers cora beer.

**August**

**Egyptian Plows**

Plowing and hoeing; from a tomb at Beni Hasan, ca. 1900 BCE.

Note that the plow is essentially a large hoe dragged through the soil.

Two handled Egyptian plow

The symbol above the plow is the ancient pictorial word symbol for the plow.
Mesopotamian Plows

Plow from Assyrian bas-relief, 670 BCE. Note the funnel which allowed seed to be added to the furrow during plowing.

Babylonian scratch plow with seed drill

Greek Plows

Cretan plow

Scratch plow, a sharp pointed hard-wood pulled by oxen.
A = draught pole, B = draught beam, C = stock, D = stilt, E = handle

Medieval Plows

Light plow with mould-board from an English 14th century bible. Note the donkey in the plow team of oxen.
Woodcut of an early English heavy plow with mould-board from the 14th century.

Plough with iron ploughshare and coulter, in a 14th Century Flemish miniature.

De Limbourg Brothers: The Month of March (detail) from Les Très Riches Heures du Duc de Berry.

Farming in France, 1735. Plowing, broadcast sowing by hand, and harrowing in the seed.
Symmetrical wooden plough with an iron ploughshare in use in 1787

Ilia Repin: *The Ploughman* *Tolstoy in the Fields*
Note how closely the 19th century Russian plows resemble the plows of antiquity

Horse-drawn plow 1933

Tractor drawn three-bottom Oliver plow, 1918

Irrigation Technology

Egyptian
Hand watering of cabbage seedlings in Sumatra 1973

Assyrian Dam of rough masonry and mortared rubble, curved to withstand the flow of the river Khosr about Nineveh

Assyrian

Raising water from the river with shaduf by Assyrians

Three men operate a double lift.
The shadufs, on mud uprights, stand at two levels on the river bank, and in front of each a brick platform is built out into the river for the men who fill and empty the buckets.

From the palace of Sennacherib at Nineveh, Mesopotamia 7th century BCE.
An Egyptian terracotta figurine from about 30 BCE showing a man driving an Archimedes screw as a treadmill

A fresco recovered from a villa in Pompeii showing a man driving an Archimedes screw as a treadmill.

An Egyptian farmer turning an Archimedes screw by hand to irrigate a field.
Archimedes screws pump wastewater in a treatment plant in Memphis, Tennessee, USA. Each of these screws is 96 inches (2.44 m) in diameter and can lift 19,900 gallons per minute.

A Persian water wheel powered by a man’s legs.

Three water-lifting technologies, water-wheel, Archimedes screw, and shaduf in a park in Düsseldorf, Germany.
The hydraulic ram is an interesting pump that uses water power to move water to a greater height.

Roman Aqueducts

Caesaria, Israel

Acco

Furrow Irrigation

Furrow irrigation from an Inca garden

Furrow irrigation from a Renaissance garden
Furrow Irrigation, Persian miniature

Furrow irrigation using a pump, 1571

Pinto beans furrow-irrigated with water from a feeder canal lined with concrete. Note siphons.

Contour furrows (potato) can be used if slopes are carefully controlled.
Sprinkler irrigation is practical as a result of portable, lightweight, aluminum pipe. The sprinkler pattern must be overlapped by about 40% in order to achieve uniform application of water.
Concept of drip irrigation from Louis XI garden of 1470

The Chapin System of trickle irrigation for greenhouse watering uses weighted valves (left) to deliver water to individual pots (right)

Trickle irrigation systems used in the field
The wet zone around the roots of a tree or a plant irrigated by the drip method

Emitters have been designed to equalize water distribution under different water pressures

Paleolithic representation of honey gathering

Women gathering grain 5000-6000 BCE, Tassili n’ Ajjer, Algeria

Modern reconstruction of a Neolithic sickle
Harvesting in Ancient Egypt

Tending vines, from a XIII century miniature

Cutting grain with scythes

Hand Harvest

Harvesting wheat with a cradle
The woman binder the sheaves, twisting the stalks of wheat like twine
The 1851 reaper

Cyrus McCormick’s first reaper, 1831

The twine binder (1881) reaped and tied sheaves of grain in one operation

Wheat harvest in El Centro, California

Hand picking cotton. A family of 11 harvests a bale of cotton (500 lb) in a day. With a modern four-row, mechanical cotton picker, one person can now harvest 80 bales a day.
The mechanical cotton picker is the most sophisticated present day farm machine.
Milling
Saddle quern and rubbing stone
Basalt and limestone, 7000 BCE

Mortar and pestle
Basalt, 1500 BCE

Circular millstones
Basalt, 1500 BCE

Using a grindstone in a Bedouin village in the Syrian Jezireh

Presses
Egyptian Wine Presses
History of Horticulture: Lecture 32

Cider press, 1900s

Rack and cloth press, late 20th century

Continuous cider press, 1990s

Packing Fruit

Packing Figs, 1900 BCE

Packing apples in a barrel, ca 1900
History of Horticulture: Lecture 32

Grading and packing oranges, California

Automatic box filler

Spraying Orchards

1900s

Orchard speed sprayers use a blast of air as the carrier for highly concentrated sprays
Specularium of The Roman Emperor Tiberius

Glass cloche 1718  Growing peach on wall, John Innes, Hertford England 1962

Orangery

Orangery, 17th century Dutch “stove” for protecting oranges  Moving pot plants from orangery, 1730
Cold frames and Greenhouses

- Cold frame for protecting plants, Gohelin tapestry 18th century
- Humphrey Reptan’s forcing garden for Woburn Abbey, 18th century

Greenhouses

- The Wardian case made transport of live plants by ship safer and easier
- Climatron, Shaw Botanical garden, St. Louis, Missouri

Plastic Greenhouses and Tunnels

- Inside plastic greenhouse 1980s
- Muskmelons grown under plastic tunnels, Lower Galilee, Israel
Abu Dhabians and their camels stroll by controlled environment greenhouses, which use seawater for heating, cooling, and irrigation.

Growing lettuce in a phytotron researching the growth of plants in space.

Moving Plants

Tree spade, 1960s

Turf Cutting

Colonial lawn mower

First lawn mower, 1830
1920s Conventional home gasoline lawn mower

Greens mower

Rolling Turf 1757

Rolling Turf
Cutting Sod

Newly developed liquid mulch sod planter (LMSP), 2000

Robotics

Transplanter

Grafting