# **CORN 101:** The Basics of Corn Production 2015 Edition



Published by the Corn Marketing Program of Michigan

### **Brief Contents**

Key Terms2
Chapter 1: What is Corn?3
<b>Chapter 2:</b> Growing Corn 4 - 5
<b>Chapter 3:</b> Machinery6
<b>Chapter 4:</b> Corn Production7 - 8
<b>Chapter 5:</b> How We Use Corn9 - 10
Frequently Asked Questions11
About the CMPM12

#### **Key Terms**

Acre - a unit of measure used to describe land area, it is approximately the size of a football field Bushel - a unit used to measure crop yields; one bushel of corn weighs 56 pounds which is approximately the size of a large bag of dog food Corn Belt - the area of high corn production in the United States (see map on page 8) Endosperm - the source of energy and protein used by the seed Ethanol - a fuel made from corn Farm - any place where \$1,000 or more worth of agricultural products were produced and sold in one year Germ - the embryo or living part of the kernel of corn Hybrid - a cross between any two corn lines that differ genetically Husk - a protective covering that surrounds the corn cob Kernel - the seed of a corn plant Pericarp - the protective outer covering of the kernel Polylactic acid (PLA) - a biodegradable polymer made from corn Roots - the lower part of the plant that anchors it to the soil and absorbs food and nutrients Silk - long fibers at the end of an ear of corn that catch pollen Stalk - the thick stem of a corn plant Tassel - branched flower at the top of a stalk of corn Tip cap - where the kernel attaches to the ear Yield - the amount of grain harvested from an acre

CORN 101: The Basics of Corn Production

### **Chapter 1:** What is Corn?

#### The History of Corn

Corn is a tall annual cereal grass which bears starchy kernels on large ears. Originally a wild tropical grass native to the Americas, corn (also known as maize) was domesticated an estimated 7,000 years ago by the indigenous tribes of Central America. A staple food in their diets, the crop continued to develop and adapt as it spread to the varying climates in both North and South America. Upon their arrival in the New World, Christopher Columbus and other European settlers learned to grow corn from the American Indians. Without that knowledge, many of the original colonizers would have starved to death. Columbus took corn and its cultivation methods with him when he returned to Spain. The crop quickly spread throughout Europe and eventually the rest of the world.

#### **Different Kinds of Corn**

Today, corn is grown on almost every continent and comes in five main varieties; field corn, popcorn, food-grade corn, sweet corn and seed corn. Ninety-nine percent of the corn grown in the United States is field corn, or dent corn. Field corn has many uses, from livestock feed, to fuel and industrial products. Popcorn is a special kind of corn that contains moisture inside; when heated that moisture "pops" and creates an edible treat. Food-grade corn encompasses an assortment of corn types which are used to make food products such as corn bread and tortillas. Sweet corn is the corn variety that you enjoy when eating corn on the cob or frozen and canned corn. Seed corn is corn grown specifically for the purpose of harvesting kernels to be planted for next year's crop. Other ornamental varieties of corn exist, such as Indian corn and broom corn, but they are grown in very small amounts.



### **Chapter 2:** Growing Corn



It all begins with a kernel planted in the early spring. Inside each kernel is the germ, which contains a miniature leaf and root. Surrounding the embryo are layers of starch, oil and protein that serve as food for the growing seed. The soil's moisture slowly softens the tough coating of the seed allowing a small root to push out of the seed and into the soil. At the same time a single leaf breaks through the top of the soil. The plant grows with the help of sunshine and the warmth, moisture and nutrients the roots take in from the soil. The plant soon becomes a tall stalk with several leaves. By the middle of summer, the cornstalk is more than five or six feet tall. Next a husk develops to protect the growing kernels. Inside the husk is a cob and long strands of corn silk. The corn silk looks like pale strands of hair. At the top of the stalk, a tassel grows. The pollen produced by the tassel floats in the breeze and when it lands on a strand of silk, the strand is fertilized. This means that a kernel can grow at the end of each fertilized strand. Kernels grow on the cob to make an ear of corn. Each ear has about 16 rows of kernels and 800 total kernels. About eight weeks after the silk is fertilized, the ear of corn is fully grown. Through the late summer and early fall, the corn plant dries down and turns from green to brown. By late fall, the corn is ripe. It is dry and hard and ready to be harvested. It has taken five to six months to grow from a seed into a ripe ear of corn.

#### The Sustainability of Growing Corn

Due to vast improvements in seed genetics, farming practices and technology, farmers grow nearly six times more corn today than they did in the 1930s – and they're doing it on ten percent less land. U.S. farmers have grown the 11 largest corn crops on record in the past 11 years, even during the drought of 2012, and the average yield has increased by more than 50 bushels per acre since 1980. Some would question if this kind of productivity is coming at the cost of our environment. The reality is that farmers are, and always have been, good stewards of the land. Corn farmers are leading the world to a more sustainable future by providing more than enough corn for all markets and they're doing it in the most innovative and environmentally friendly ways that exist today.

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#### Advancements in Sustainability

Water Use – In the United States, 89 percent of all corn is grown using only naturally occurring rainfall. From 1980 to 2011, the average amount of water applied per irrigated acre dropped from 16.8 acre inches to 12.0 acre inches. During the same time period the amount of water used per bushel has decreased by 28 percent. Corn plants also restore water to the environment at an average rate of 4,000 gallons per acre per day, through evaporation from the soil and transpiration of the plant. In fact, corn returns more moisture to the atmosphere than it withdraws from ground and surface water for irrigation.

*Chemical and Fertilizer Use* – New seed genetics and other technologies have helped farmers reduce the use of herbicides and insecticides to protect crops. From 1980 to 2007 the total quantity of pesticides applied in the U.S. declined at an average rate of 0.6 percent per year. Herbicide and insecticide application declined by 0.8 percent and 3.5 percent, respectively, per year from 1982 to 2007. Moreover, the use of satellite-based guidance and row-by-row input control technology has allowed farmers to place the right amount and concentration of chemicals to just the right places, minimizing waste and environmental impact.

*Conservation Practices* – In the last two decades reduced tillage has resulted in a 67 percent reduction in soil erosion. Several crop production systems fall under this heading, including no-till, ridge-till, low-till and minimum-till. Common to all of these is the practice of leaving crop residue, which is plant material left on the field after harvest, on the ground to provide a protective cover for the soil between seasons. This also improves soil fertility by maintaining nutrient-rich organic matter on the field. Additionally, conservation tillage allows organic matter to build up in the soil, absorbing carbon dioxide and helping to reduce greenhouse gases. In addition to changing tillage practices, farmers also plant cover crops and enroll land in many conservation programs in order to help the environment.

Other Advancements – A recent study conducted by the Field to Market Keystone Alliance for Sustainable Agriculture found that between 1980 and 2011, corn production made great progress in sustainability. In addition to the advancements already mentioned, the amount of land needed to grow one bushel of corn decreased by 30 percent; the energy used to grow a bushel of corn decreased by 44 percent; and corn production saw a 36 percent decrease in emissions per bushel.



#### **Production Costs**

As total corn production in the United States continues to increase, so does the cost of growing it. In 2013, the average cost to produce an acre of corn was \$677 and the projected costs for 2014 and 2015 are nearly \$700 per acre. In order to grow crops, farmers must invest money into many expenses including seed, fertilizer and soil inputs, fuel, machinery, labor, equipment repairs and land rental. All of these expenses affect the farmer's bottom line.

### Chapter 3: Machinery

#### Tractor

The tractor is the most frequently used machine on the farm. It has two large wheels at the rear that provide power and two smaller ones at the front for steering, with an engine in the middle. Some tractors have four-wheel drive with power to the front wheels as well as the back wheels. Tractors come in many sizes and have a shaft at the back that turns and provides power to other machines that it pulls. In corn production, tractors can be used to pull tillage equipment, planters, spreaders, sprayers and grain carts. The cab of the tractor protects the driver from the rain, cold, wind, dust and heat; some even have air conditioners and sound systems, just like a car.

#### **Tillage Equipment**

Tillage equipment is pulled over the field by a tractor in the spring to prepare the ground for planting seeds. The equipment can break up hard ground or help smooth out rough soil to make planting easier and allows crops to grow better. There are many different kinds of tillage equipment including disks, plows, rippers, tillers, cultivators and finishers.

#### Planter

In the spring, farmers use planters to put the seeds in even rows in the ground. Planters consist of boxes mounted over a set of disks. With a hose running from the box to each of the disks to carry the seeds. The disks cut small trenches in the soil that the seeds are dropped into and then a small wheel runs over the trench covering the seed up.

#### **Spreaders**

A spreader can either be self-propelled or pulled by a tractor and is used to put fertilizer on the field. Different types of spreaders can be used for either fertilizer or livestock manure. Farmers can add fertilizer and manure to the field to replace nutrients that have been used by the crop.



Tractor



Tillage Equipment



Planter



Spreader



Sprayer



Combine



#### Sprayer

A sprayer is a piece of equipment that puts herbicides, pesticides and fertilizers on crops. Sprayers come in various sizes and can be either self-propelled or pulled by a tractor or vehicle. Farmers use herbicides and pesticides to treat and protect their crops from weeds and bugs.

#### Combine

The combine is used to harvest crops when they are ripe. A combine cuts the stalk of the plant, separates the grain from the stalk and other debris, discards the debris out the back of the machine and stores the grain in the top. When the grain bin on top of the combine is full, an auger on the side of the combine unloads the grain. The grain can be unloaded into a wagon, a grain cart or a semi.

#### Semi

A semi is used to haul grain from one location to another. It can be used to haul from the field to an on-farm grain storage area or to a local elevator. One semi can haul about 1,000 bushels of corn.

#### **Precision Agriculture**

Precision agriculture is a management practice that uses technology to compile data for farmers so that they can operate more efficiently. It uses detailed, site-specific information to accurately control and manage inputs such as fertilizer, chemicals and seed. Precision ag technology uses Global Positioning Systems (GPS) to precisely geo-reference field boundaries and soil-sample locations. GPS-based applications in precision farming are being used for farm planning, field mapping, soil sampling, tractor guidance, crop scouting, variable rate applications and yield mapping.

(Photos courtesy of Case IH and John Deere)

**Precision Agriculture** 

CORN 101: The Basics of Corn Production

### **Chapter 4:** Corn Production



#### The Importance of Corn

Corn is America's largest crop and accounts for more than 90 percent of the total value and production of feed grains. In fact, the United States produces nearly 40 percent of the world's corn, more than any other country. Corn farmers across America endured very cool weather in 2014 but still harvested a record 14.4 billion bushels.

So who are the people growing corn? There are more than 300,000 corn farmers across the United States. Corn farmers represent 9,624 of the 25,285 Michigan residents for whom farming was their primary occupation in 2012. Michigan's farmland includes nearly 10 million acress making up more than 52,000 farms. Eighty-six percent of the principal operators of Michigan farms are male, with an average age of 57 years.

Michigan's corn farmers planted 2.5 million acres of corn in 2014 and harvested more than 360 million bushels. This was the largest corn crop ever with a value of nearly \$1.5 billion. The total economic impact on Michigan's economy from both direct and indirect uses of corn is more than two billion dollars. Corn's significant contribution to the economy is a result of the many uses of corn.

High corn producing areas Medium corn producing areas

Low corn producing areas

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## Chapter 5:

### **How We Use Corn**



#### Shipped out of Michigan

Roughly 37 percent, or 137 million bushels, of Michigan's 2013 corn crop was shipped out of state. The majority of the exports are used to feed livestock, predominantly poultry and pigs, in the southeastern United States.

#### **Ethanol and Distillers Grains**

In the 2013-14 marketing year, 27 percent of Michigan's corn crop was used in the production of ethanol and its co-products. Ethanol is 200-proof alcohol made from the fermentation of starch and used as a high-octane motor fuel. In the United States, the primary input for ethanol production is corn. As a renewable fuel, ethanol continues to grow in popularity and usage. Today, ethanol makes up ten percent of the U.S. gasoline supply and is currently blended into more than 96 percent of the nation's fuel supply. In 2013, the production of 13.3 billion gallons of ethanol reduced the need for 462 million barrels of imported oil, which is the equivalent of U.S. oil imports from Venezuela and Iraq combined. Co-products of the ethanol production process include dried distillers grains (DDGs) and carbon dioxide. DDGs are used as a high protein livestock feed. In 2013, Michigan produced 738,000 metric tons of DDGs, displacing approximately 18 million bushels of corn. Carbon dioxide can be used by the beverage and refrigeration industries, among others.

#### Livestock Feed

One of the traditional uses for corn has been, and continues to be, feed for livestock. In 2013, livestock consumed 20 percent of Michigan's corn crop. In addition, the majority of DDGs are fed to livestock.

#### Food Products and Other Uses

Other uses for corn include sweeteners, starches, cereals, alcoholic beverages and corn syrup.

#### **Corn-Based Products**

As corn production continues to increase, it is important to develop new uses for corn. Corn-based products typically replace traditional petroleum-based products, helping to reduce the United States' dependence on foreign oil. These corn-based products are also renewable and biodegradable or compostable.

#### Polymers

One of the most exciting new opportunities for corn is corn-based polymers, which are clear biodegradable chemical compounds that can be used to create plastics, fibers and other products. These products include plastic food service items such as cups, plates and utensils; corn-based plastic bags; clothing; blankets; fiberfill for pillows and comforters; and even carpet. Made from an abundant renewable resource, these types of corn-based items are not only biodegradable and compostable, but they are becoming more and more desirable to consumers.

#### Other Products

Corn is also a component in more than 600 products in our every day lives and new uses for corn continue to be developed. For example, biodegradable cornstarch packing peanuts are currently available in the market. There are even diapers and baby wipes made from corn. Different variations of alcohol made from corn can be found in many household cleaners, hand sanitizers and medicines. Corn has even been used to create a salt substitute and children's toys!

#### **National Surplus**

Though the uses for corn are seemingly endless, farmers are confident they will continue to provide enough corn to meet all of these demands. In fact, despite the growing demand, nationally more than one billion bushels of corn were left over and carried forward to be used in 2014. In Michigan, 25 million bushels were left over. Improving farming practices and new biotechnologies will enable farmers to grow more corn on the same amount of acres and maintain the trend of increasing yields. Food for the world, feed for our livestock, fuel for our vehicles and everything in-between; today's corn farmers are really showing us what they can do.





### **Frequently Asked Questions**

#### 1. Does using corn for ethanol cause a significant increase in food prices?

No. In fact, according to World Bank, "most of the food price increases are accounted for by crude oil prices." Only 12 cents of every dollar spent on food goes back to the farmer. There is also very little corn in most food products *(see chart)*. In addition, there is more than enough corn to produce ethanol and feed not only animals, but also people.

#### 2. How does ethanol impact fuel prices?

Ethanol helps to reduce the price you pay for fuel at the pump. Blending ethanol into gasoline helps

increase the fuel supply and therefore creates a downward pressure on fuel prices. Ethanol represents approximately 10 percent of the nation's gasoline supply today and can be found in more than 96 percent of all gasoline sold. A study by Iowa State University and the University of Wisconsin found that in 2012, domestic ethanol production lowered gasoline prices by \$1.09 per gallon.

Product

Chicken

**Corn Flakes** 

Milk

Eggs

Pork

Beef

Unit

1 gal.

18 oz.

1 pound

1 dozen

1 pound

1 pound

#### 3. How is corn made into polymers?

Corn is harvested and the kernels are sent to a milling plant, where they are cooked and ground, converting the starch into sugar. Microorganisms then break down the sugar, forming lactic acid. The lactic acid is heated and treated with a chemical, which causes it to form a polylactic acid (PLA) polymer. PLA can then be formed into cups, cutlery, clothing and many other products.



**Grocery List** 

Corn

Required

1.8 lbs.

2.6 lbs.

12.9 oz.

4.0 lbs.

3.6 lbs.

2.6 lbs

Value of corn

at \$4.00/bu

\$.13

\$.19

\$.06

\$.29

\$.26

\$.19

#### 4. Are GMOs safe?

Absolutely; GMOs are more thoroughly tested than any product produced in the history of agriculture. In all the risk assessments in over 15 years of field research and 30 years of laboratory research, there hasn't been a single instance where there was a health risk associated with a GMO product. The primary body that regulates the commercialization of GMOs is the USDA's Animal and Plant Health Inspection Service. This is a lengthy and expensive process which usually takes several years to complete. This process has actually inhibited the development of many crops that could replace older, less safe, less environmentally friendly techniques. The Food and Drug Administration and Environmental Protection Agency also regulate GMOs.



### 5. Is high fructose corn syrup the cause of obesity and diabetes?

There is no scientific evidence that high fructose corn syrup is to blame for obesity and diabetes. In fact, consumption of high fructose corn syrup (HFCS) has actually been declining while obesity and diabetes rates continue to rise (see chart). Around the world, obesity levels are also rising even though HFCS consumption is limited outside of the U.S. Many other factors contribute to rising obesity levels including changes in lifestyle, diet and exercise, and are unrelated to HFCS.

CORN 101: The Basics of Corn Production







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#### About the Corn Marketing Program of Michigan

Headquartered in Lansing, the Corn Marketing Program of Michigan (CMPM) is a legislatively established statewide program that invests in research, education, market development, and finding new uses for corn in an effort to enhance the economic position of Michigan corn producers. The CMPM works cooperatively with the Michigan Corn Growers Association (MCGA), a grassroots-membership association representing the state's corn producers' political interests. For more information on the CMPM and the MCGA, visit their web site at www.micorn.org.