ISAAA
INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS

GLOBAL STATUS & ECONOMIC BENEFITS OF BIOTECH MAIZE PRODUCTION BY 2015

INTRODUCTION

Maize is one of the most important food crops in the world. Together with rice and wheat, it provides at least 30% of calories to more than 4.5 billion people in 94 developing countries. It is also a key ingredient in animal feed and is used extensively in industrial products, including the production of biofuels. Increasing demand and production shortfalls in global maize supplies have worsened market volatility and contributed to surging global maize prices.
Climatic variability and change, and the consequent rise in abiotic and biotic stresses, aggravates the problem. Attention needs to be directed at the generation of high yielding, stress-tolerant and widely-adapted maize varieties through conventional breeding as well as by use of modern biotechnology.

Biotech or genetically modified maize has been engineered to express desirable traits such as resistance to pests, herbicide tolerance and drought tolerance. Herbicide tolerant maize was first commercialized in 1996. This crop had been incorporated with a gene that enables it to be tolerant to glyphosate herbicides such as Roundup® hence their name 'Roundup Ready' maize. It is worth noting that maize has also been modified to tolerate other herbicide active ingredients (a.i.)

The other key trait of biotech maize is insect resistance. These are maize varieties that have been modified with the bacteria *Bacillus thuringiensis* (Bt) gene to produce proteins that act in the alkaline guts of some lepidopteran insect pests like the stalk borer. These proteins are selective and only bind to receptors in the target insect gut.

More recently, biotech maize has been modified with more than one trait. This combination of traits is commonly referred to as stacked traits. Some examples are: herbicide tolerant / insect resistant (HT/Bt) and insect resistant and drought tolerant (Bt/DT) biotech maize.

IN 2015

of the **185 million hectares (ha)** of global maize planted, almost **one-third (29%) or 53.6 ha** were biotech maize.

17 countries globally grew biotech maize in the year.

The income benefits for farmers growing biotech maize during the **19 years** (1996 to 2014) was **US$50.6 billion** and **US$7 billion** for 2014 alone.

Africa grows 90% of its maize under rainfed conditions and up to 25% of the area suffers from frequent droughts. To mitigate this challenge, the first stacked biotech insect resistant/ drought tolerant (Bt/DT) maize hybrids are expected to be available to farmers as early as 2017, subject to regulatory approval. It is envisaged that the stacked Bt/DT maize hybrids will increase maize production by up to 2 to 5 million tons under moderate drought, to feed about 14 to 21 million Africans.

South Africa is expected to be the first country to deploy the technology through the Water Efficient Maize for Africa (WEMA) project. Kenya and Uganda, who were granted regulatory approval to conduct confined field trials of the stack in 2015, are expected to follow. The WEMA project is being coordinated by the African Agricultural Technology Foundation (AATF) in five African countries including, South Africa, Kenya, Uganda, Mozambique, and Tanzania.

Kenya, South Africa and Uganda have conducted confined field trials with drought tolerant maize for at least five seasons, with very encouraging results. In 2015, the Republic of South Africa's Executive Council of the GMO Act approved a drought tolerant maize trait under the WEMA project for conditional general release. In the same year, Kenya's National Biosafety Authority received an application for environmental release for insect resistant maize. A conditional approval was granted in February 2016. This conditional approval is part of a routine regulated research process in line with Kenya's national policies and laws.

During the period 1996 to 2015, the global increased revenue of planting biotech maize stood at US$50 billion. Ironically, over 300 million farmers in Africa (except South Africa), who depend on maize as a staple, suffered a huge opportunity cost. This is because they were denied the chance to adopt biotech crops due to lack of regulation and support for biotech crops.

This brief highlights the global status of biotech maize commercialization by 2015, as well as the economic benefits accrued from growing biotech maize in 2014.

Traits that have been commercialized for maize include:

- Herbicide Tolerant (HT) maize varieties that have been modified to tolerate a number of broad based, non-selective herbicides.
- Insect Resistant (IR) maize varieties - also commonly referred to as Bt maize - that have been modified with the *Bacillus thuringiensis* (Bt) bacterium gene to act against lepidopteran insect pests such as stalk borers.
- Stacked trait (Bt/HT) maize varieties that have both the herbicide tolerance and insect resistance genes in one plant.

STATUS OF BIOTECH MAIZE CONFINED FIELD TRIALS IN AFRICA IN 2015

COUNTRY	TRAIT	STAGE BY END OF 2015
Kenya	Drought tolerance (WEMA) Insect resistance (WEMA) Insect resistance/Drought tolerance (Bt/HT)	CFT - 6th season completed Review for environmental release 1st CFT approval granted
Uganda	Drought tolerance Insect resistance	CFT - 6th trail terminated in May CFT - 4th trial planted in August
South Africa	Drought tolerance Stacked traits (2-3 events) Drought tolerance Herbicide tolerance/Insect resistance Stacked traits (5 events) Insect resistance/herbicide tolerance Stacked traits (4 events) Insect resistance/herbicide tolerance	Approved for conditional general release Approved for multi-location trials 3 events in 3rd year; 1 event in 1st year Total - 4 events) Approved for multi-location CFTs 3 events in 3rd year; 2 events in 1st year Approved for multi-location CFTs 3 events in 1st year; 1 event in 4th year

AFRICA

South Africa

- Has grown biotech maize for **18 years** since **1998**.
- Of the total **1.8 million hectares** of biotech maize planted, **31% was Bt, 53% stacked Bt/HT**, and **16% HT**.
- Farm income gain from biotech maize was **US $ 238.8 million** in **2014**.

ASIA

Philippines

- Has grown biotech maize for **13 years** since **2003**.
- Of the total **702,000 hectares** of biotech maize planted, **8% was HT,** and **92% was stacked Bt/HT**.
- Farm income gain from biotech maize was **US $ 89 million** in **2014**.

Vietnam

- Grew biotech maize for the **first year** in **2015**.
- Of the total **35,000 hectares** of biotech maize planted, **100% was Bt/HT**.
- Became the **29th country globally** and **7th in Asia** to commercialize biotech crops.

THE AMERICAS

USA

- Has grown biotech maize for **20 years** since **1996**.
- Of the total **33.1 million hectares** of biotech maize planted, **2.4% was drought tolerant (DT)**. Stacked Bt/HT was the dominant trait. The other preferred traits were Bt and HT.
- Farm income gain from biotech maize was **US $ 3,712 million** in **2014**.

Brazil

- Has grown biotech maize for the **8 years** since **2008**.
- Of the total **13.1 million hectares** of biotech maize planted, **25.2% was Bt, 7.2% was HT and 67.6% was stacked Bt/HT**.
- Farm income gain from biotech maize was **US $ 852.7 million** in **2014**.

Argentina

- Has grown biotech maize for **18 years** since **1998**.
- Of the total **2.9 million hectares** of biotech maize planted, **21% was Bt, 8.4% was HT and 70.6% was stacked Bt/HT**.
- Farm income gain from biotech maize was **US $ 330.6 million in 2014**.

Canada

- Has grown biotech maize for **20 years** since **1996**.
- Of the total **1.4 million hectares** of biotech maize planted, **3% was Bt, 13% was HT and 84% was stacked Bt/HT**.
- Farm income gain from biotech maize was **US $ 177 million in 2014**.

Paraguay

- Has grown biotech maize for **3 years** since **2013**.
- Of the total **305,000 hectares** of biotech maize planted, **80% was stacked Bt/HT, 17.4% was Bt, and 2.6% was HT**.
- Farm income gain from biotech maize was **US $ 5.35 million in 2014**.

Colombia

- Has grown biotech maize for **7 years** since **2009**.
- Of the total **73,000 hectares** of biotech maize planted, **around 94% was stacked Bt/HT, and 6% was HT**.
- Farm income gain from biotech maize was **US $ 18.6 million in 2014**.

Honduras

- Has grown biotech maize for **14 years** since **2002**.
- Of the total **27,000 hectares** of biotech maize planted, **92.6% was stacked Bt/HT , and 7.4% was single trait HT**.
- Farm income gain from biotech maize was **US $ 1 million in 2014**.

Uruguay

- Has grown biotech maize for **12 years** since **2003**.
- Of the **88,000 hectares** of biotech maize planted, about **98% was the stacked Bt/HT and 2% was HT**.
- Farm income gain from biotech maize was **US $ 0.45 million in 2014**.

Chile

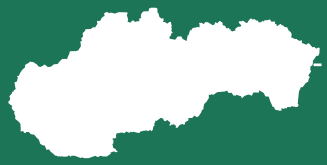
- Has grown biotech maize for **20 years** since **1996**.
- In **2015**, the country grew **5,000 hectares** of biotech maize exclusively for seed export.
- Was the fifth largest producer of export seed in the world in 2012, with a value of **US $ 388 million**.

EUROPE

Spain

- The leading biotech country in Europe has been growing biotech maize for **18 years** since **1998**.
- Of the total **107,749 hectares** of biotech maize planted, **100% was HT**.
- Farm income gain from biotech maize was **US $ 26 million in 2014**.

Slovakia



- Has grown biotech maize for **11 years** since **2005**.
- Of the total **104 hectares** of biotech maize planted, **100% was Bt**.
- Farm income gain from biotech maize was **US $ 0.01 million in 2014**.

Romania

- Has grown biotech maize for **9 years** since **2007**.
- Of the total **3 hectares** of biotech maize planted, **100% was HT**.
- Farm income gain from biotech maize was **US $ 0.01 million in 2014**.

Portugal

- Has grown biotech maize for **11 years** since **2005**.
- Of the total **8,017 hectares** of biotech maize planted, **100% was Bt**.
- Farm income gain from biotech maize was **US $ 1.4 million in 2014**.

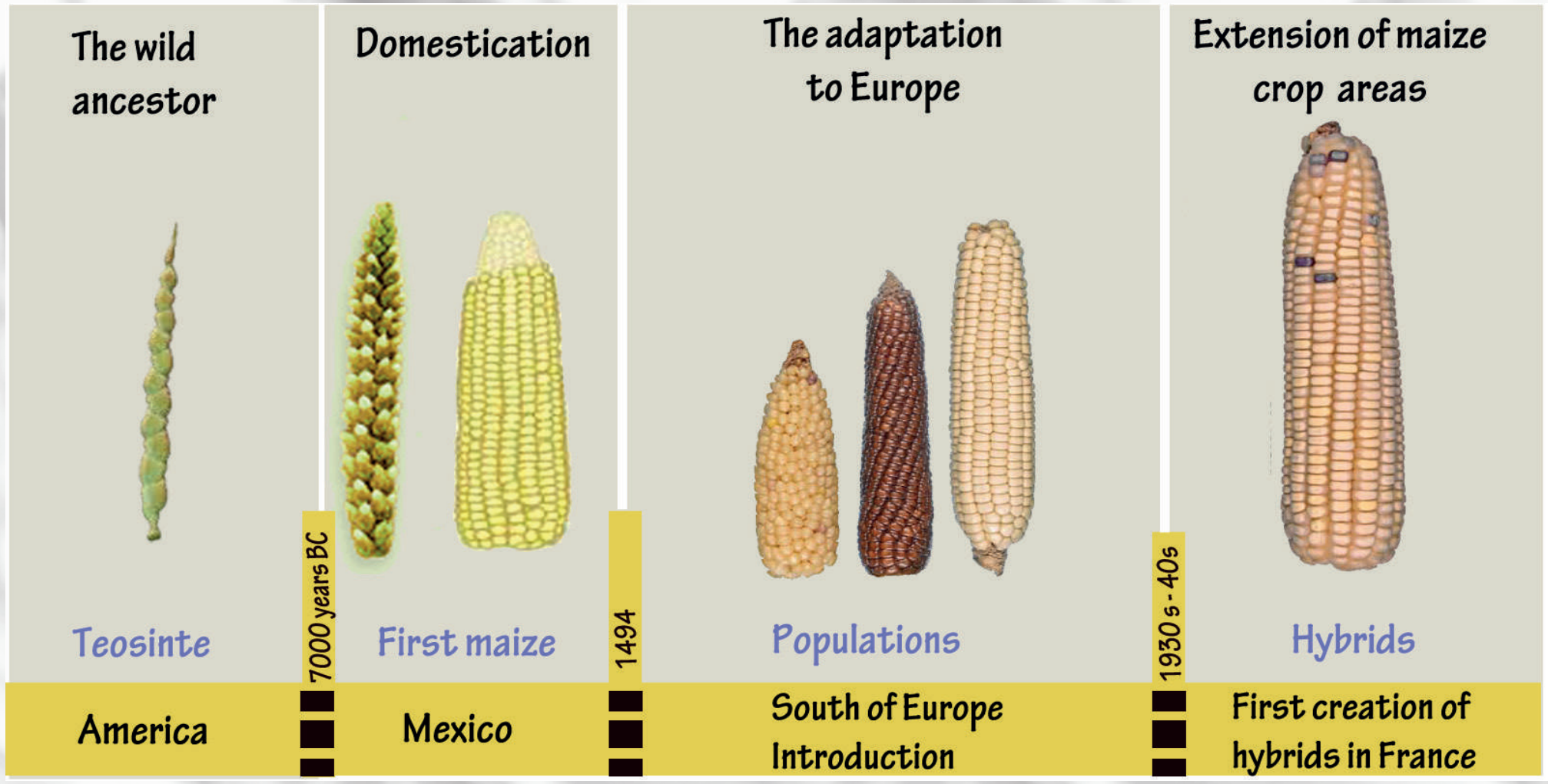
Czech Republic

- Has grown biotech maize for **11 years** since **2005**.
- Of the **997 hectares** of biotech maize planted, **100% was Bt**.
- Farm income gain from biotech maize was **US $ 0.3 million in 2014**.

Taabu Mwarumba, a maize farmer from Kenya, displays the damaging effects of stem borers. In Kenya, stem borers are known to reduce maize production by an average of 13 percent or 400,000 tonnes, equivalent to the normal yearly amount of maize the country imports. This damage is valued at more than USD 90 million per year. The loss can increase to 100 percent during drought years or when measures are not taken to manage the pests appropriately. Kenyan scientists have developed a maize variety with inbuilt protection against the stem borer.

For more information about this project, visit http://wema.aatf-africa.org/wema-bt-maize

THE EVOLUTION OF MAIZE (CORN)



A record 18 million farmers, in 28 countries, planted 179.7 million hectares of biotech crops in 2015. Out of the 28 countries, 17 grew biotech maize and five grew more than 1.0 million hectares.

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