AN OVERVIEW OF GMOS By **DG/CEO NABDA PROF. LUCY OGBADU**

OUTLINE

- ✓ What are GMOs
- ✓ Why do we need GMOS
- ✓ Global Adoption rate
- ✓ Safety concerns
- ✓ Europe and GMOs
- ✓ Status of GM crops in Nigeria
- ✓ Conclusion

What are these GM Crops/Foods ?

"Genetically modified crops (GMCs, GM crops, or biotech crops) are plants, the DNA of which has been modified using genetic engineering methods, to resist pests and agents causing harm to plants, or environmental conditions, or resistance to chemical treatments (e.g. resistance to a herbicide), or the production of a certain nutrient or pharmaceutical agent with a view to improve the growth of these plants to assist in farmers efficiency." In most cases the aim is to introduce a new trait to the plant which does not occur naturally in the species., -Wikipedia



Why Use Modern Biotechnology?

- 1) Genetic improvements can be more efficient and precise compared to breeding.
- 2) Beneficial genes and traits found in other organisms can be transferred to crop and livestock species.
- 3) Solution to agricultural problems is in the seed rather than external inputs.



Benefits associated with GM Technology

- Plants maybe genetically engineered to produce:
 - Own toxins e.g. Bt proteins
 - Herbicide tolerance
 - Diseases tolerance
 - Nutrient improvement
 - Efficient nitrogen utilization

Powerful diagnostic tools

- Products on the horizon from gene technology that will revolutionize agriculture in Africa for the poor are drought tolerant and nitrogen efficient crops and Biofortified crops
- An on-going initiative is the Biofortified sorghum project by Africa Harvest funded by Pioneer Du Pont

Impacts of GM/GE Crops

Source: Brookes and Barfoot, 2014; Clive James, 2014

- IMPROVED PRODUCTIVITY AND INCOME Farm income gains of ~ \$117 B from 1996 to 2012, 58% due to lower production costs and 42% due to a productivity gain of 377 M tons
- PROTECT BIODIVERSITY 377 M tons would require additional 123 M Ha with conventional technology biotech is a land saving technology. Strategy: *"sustainable intensification*" – double crop production on same area of 1.5 B Ha of crop land – saves forests/biodiversity – 13 M Ha lost/year
- ENVIRONMENTAL IMPACT Reduce need for external inputs Saving of 497 M kg pesticides from 1996/2012 – 9% saved
 - Saved 27 B kg CO₂ in 2012 contribution to climate change
 - Conservation of SOIL & WATER thru biotech + no/low till
- HUMANITARIAN BENEFITS
 Contribution to poverty alleviation for >16.5 M small resource-poor farmers approx half of them in China at 7.5 M, another 7.3 M in India

For Nutritional Enhancement (eg: Golden Rice)

The vitamin A-producing gene is taken out of a red pepper and put into rice



Advantage: Could save millions of children world-wide from blindness

Insect Resistance eg: B.t. Corn

An insecticidal protein from the bacteria Bacillus thuringiensis is put into corn

Advantage: Corn is protected from pests, so chemical pesticides are not necessary



Global Population, Resource and Weather Trends Create A Humanitarian Necessity to Produce More With Less



Challenges contd......

Low productivity

- Small holdings
- Subsistence
- Limited water and land
- Population is on the increase.
 - Disease, pests, drought, weeds Storage and transportation.
- Conventional plant improvement methods are reaching their limits.
- Agricultural growth is now 1% compared to 3% in 1970s
- Desertification in Nigeria, gully erosion and flood
- Micro-nutrient deficiency

Prevalence of Micronutrient deficiencies in developing countries



Challenges of Agriculture CONt.....

65% of Africa's labour workforce is employed by agriculture





Ageing farmers – Declining number of farmers



The youth shunning agriculture for white-collar jobs in cities

GLOBAL ADOPTION 1996-2015 More than a 100-fold increase from 1.7 to 181.5 M ha

Fastest adopted crop technology 20th year of commercialization



Principal Biotech/GM crops - Globally



Products approved for commercialization in 2013







Drought tolerant sugarcane - *Indonesia* Insect resistant eggplant Bangladesh



Global Potential for Expansion of Biotech Maize

- ~ 177 M Ha of global maize
- ~ 57 M Ha or one-third already biotech
- ~ 120 M Ha potential left

Compiled by Clive

- By continent, Asia has greatest potential = 57 M Ha
- Africa 33 M Ha potential balance of 30 M in Europe (18 M ha) and elsewhere (12 M ha)

Concerns in the Applications of Modern Biotech



- Ethical concerns emerging from the use of the technology to manipulate and transform nature. Perceived human health, environmental and socioeconomic
 - risks that modern biotechnology may cause
- There is uncertainty about the potentials of biotechnology its promises and risks.

MEANWHILE...

 A growing body of evidence and experiences from 20 years of commercial cultivation reveals that modern biotechnology has the potential to significantly increase productivity per unit area of land, reduce the use of pesticides and offer safer and more nutritious food, and consequently contribute to environmental sustainability (FAO, 2004; Juma and Serageldin, 2007; James, 2008; Brookes and Barfoot, 2008).

EXPERTS' OPINION ON GMOs

With respect to the safety of GM crops and foods, United Nations Organizations, regional and advanced countries food safety authorities, have these to say:

- According to WHO, GM foods currently on the international market have passed risk assessments and are not likely to present risks for human health. In addition, the general population in the countries where they have been approved has shown no negative effects on human health as a result of the consumption of such foods.
- The certification of safety of GM food types as contained in the report of 28th April 2006 of European Food Safety Agency (EFSA) is as a result of rigorous food and feed certification procedures that such foods have to go through.

EXPERTS OPINION Cont'd

- Food and Agricultural Organization (FAO) has stated categorically that no adverse impact on human health have been shown as a result of the consumption of GM foods by the general population in the countries where they have been approved:
- African Union (AU) and NEPAD: A body known as African Biosafety Network of Expertise (ABNE) has been established under the AU-NEPAD to assist member countries to develop the right biosafety expertise to effectively carry out biosafety regulation. This is to balance the adoption of biotechnology as a tool to advance the Continent. Working under the UN, 54 African nations have signed the Cartagena Protocol on Biosafety, which requires countries to domesticate the Cartagena Protocol having their own respective Biosafety Laws.

- National Academies of Science study concludes: 'Genetic engineering is one of the newer technologies available to produce desirable traits in plants and animals used for food, but it poses no unique health risks that cannot also arise from conventional breeding and other genetic alteration methods."
- Noble laureates position on the technology is clear
- Biotech crops have been cultivated for about 20 years and foods derived from agricultural biotechnology have been eaten by billions of people.

What about Europe?

• Cultivation of GM crops:

✓ around 181M ha globally; in EU around 150,000 ha
 primarily in Spain

Field trials conducted:

✓ 1992 – 2008: 2,404 conducted (of which 2/3 before 2001), around 12 in 2014

✓ field trials in the US 1987-2008: 14,300

 Strong R&D base in life sciences including agricultural biotechnology, but dwindling

Some recent EU developments

- 2 March 2010: Amflora (BASF) starch potato approved for cultivation [commercial development stopped after 2 seasons of planting]
- Review, approval process completed after 13 years ... 1996 ⇒ 2010
- Second approved product after insect-resistant Bt maize (MON810, 1998); first one under current regulatory regime
- Adds to list of products approved for importation, and processing as food and feed:
 - GM maize, canola, soybean, sugarbeet,
 - cotton, carnation, ... <u>49 different products</u>
 - EU Register of Authorised GMOs:

http://ec.europa.eu/food/dyna/gm_register/index_en.cfm



The EU trading bloc imports massive quantities of GM commodities mainly for animal feed use. About 70% of soybean meal consumed in the EU is imported and 80% percent of this meal is produced from GM soybeans. On average, EU imports of soybean meal and soybeans amount to US\$9 billion and US\$6.5 billion per year, respectively.

Source: USDA Foreign Agricultural Service

Summing up: Impacts of Current Genetically Modified Crops

- Product specific -- case by case
- Some of the benefits of some crops:
 - Increased yields (including reducing post harvest losses)
 - Reduced pesticide use (health impacts!)
 - Increased farm income
 - Simplified farming
 - No-till opportunity
 - Reduced farmer poisonings
 - Safer product less mycotoxins
 - Emerging consumer benefits of 2nd generation GM crops

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EUROPE & GM IMPORTS

- Which GM crops and products can be imported into the EU?
- As of April 2012, a total of 47 GM crops were approved in the European Union, most of them for imports and processing and/or for food and feed. More than half of those crops were types of GM maize. Other crops included soybeans, rapeseed, sugarbeet, cotton and potatoes.

Why does the EU import GM crops?

- Europe imports a substantial portion of its animal feed, and a large part of the world's supply is GM.
- Around 30 million tons of grain are imported per year from third countries, including 13 million tons of soybeans, 22 million tons of soymeal, 2,5 million tons of maize, 2 million tons of oilseed rape and 0.1 million tons of cotton.



Research Progress in Africa Pipeline GM Crops



Source: Clive James, 201

RSA – maize, potatoes, sugarcane, **Cameroon:** cotton Kenya – cassava, cotton, maize, sorghum, sweetpotato Ghana- cotton, cowpea, rice **Egypt** – cotton, potato, wheat, cucumber, melon Uganda - banana, cotton, cassava, maize, rice Nigeria - cowpea, cassava, sorghum

Progress in Nigeria



Conclusions

- Steady increase in GM crop adoption to date (1996-2015)
- Two decades of safe use and consumption
- Significant adoption for maize, cotton, and soybeans
- Most prevalent traits are insect resistance (Bt) and herbicide tolerance
- Demonstrated, and potential, benefits are substantial, especially for Africa
- Commercialization of GM crops envisaged to increase in Africa
- CFTs carried out in several African countries on important food security crops / traits

-WAY FOWARD

- Nigeria has the greatest potentials to catch up with Asia and other developed countries. We have the human capital, environment and all that it takes to be like brazil, Asia and others.
- It is important for to note that we must embrace modern science and technology for the wind of change to be realized.
- Africa should learn from Europe's mistakes and not repeat them"

"The new ingredient in Biotech crops is not black magic or radioactivity; it is KNOWLEDGE"

Mark Cantley (2006)