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BIOTECH CROPS CAN IMPROVE THE SOIL

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Background

Though defined by various schools of thought, the US National Science Foundation defines biotechnology as "the controlled use of biological agents such as microorganisms or cellular components for beneficial use". On the other hand, soil refers to the unconsolidated mineral or organic material on the immediate earth surface. This natural medium consists of a vast array of microscopic bacteria and fungi operating within a matrix of nutrients, water and air pockets which provide nourishment for growth of land plants.

The fertility and general health of soils in Uganda continue to deteriorate because of nutrient mining and other human induced land operations. The essential plant growth nutrients such as nitrogen, potassium and phosphorus, are lost at the rate of 85, 75 and 10 kilograms per hectare per year respectively. As a result, these soils have inadequate supply of the major plant nutrients, very low nutrient holding capacity and deficiencies or toxicities of trace elements, which places a significant toll on crop yields. The current soil fertility management practices of recycling crop residues such as biomass transfer, short fallow and other organic practices are inadequate to replenish the nutrient outflow.

Recent advancements in biotechnology including genetic engineering have enabled deliberate plant- genetic-manipulation for enhanced crop improvement. This cutting-edge science is used in the modern crop breeding programs to develop biotech crops with novel traits such as herbicide tolerance, insect resistance, and improved nitrogen fixation and use efficiency, which gives them an advantage over the conventional crops in terms of sustaining the soil ecosystems.

Ways in which biotech crops can improve the soil

Reduced land tillage and global warming effects:

Weeds are a constant constraint that farmers of all production methods must manage to have healthy, high-yielding crops. In a bid to manage this problem, farmers repeatedly till their soil – which is achieved by turning over the top layer of soil to uproot the weeds. While this is one of the solutions for weed control, it leaves the field exposed to erosion and runoff to water ways. If heavy motorized tillage is employed, a lot of smoke and carbon dioxide are produced to the atmosphere leading to global warming effects. Herbicide tolerant biotech crops enable farmers to till less frequently, which preserves the top soil. Preservation of the top soil improves soil health, water retention, and reduces runoff because of the minimal effects on the soil structure and bulky density. The organic matter and moisture that remains in the soil helps crops to survive periods of drought, and less erosion means that the inputs farmers use stay in place thereby giving high yields.

Improved nutrient use efficiency and soil chemical and biological components:

Nitrogen is very abundant in the atmosphere (78.09% of air) but rarely available for plant uptake, thus making it the most limiting nutrient for plant growth. Methods such as fertilization, and intercrops with leguminous plants are being utilized by farmers to combat plant nitrogen deficiency. However, application of inorganic nitrogenous fertilizers, such as urea, alters the biochemical properties of soil; particularly the pH. pH is important in that crops grow properly under specific pH ranges. Thus, alterations in this property constrain the growth of plants through the accruing changes in the Buffer and Cation Exchange Capacities of the soil, which in the end impairs its productivity. Use of nitrogen efficient biotech crops ensures adequate biological nitrogen fixation. Selected nitrogen efficient crops such as maize and rice can fix nitrogen that matches crop needs thereby reducing the effects of inorganic nitrogen fertilizer on the chemical properties of soil. Moreover, the accumulated residual soil nitrogen nurtures high crop yields without compromising the chemical and biological components of soil.

Improved activity of soil microbial communities:

Application of insecticides on crops is meant to protect plants against harmful insects and increase crop yields. In Uganda, a broad spectrum of insecticides such as Cypermethrin, Dursban, Rocket and Dimethoate are being used by farmers to control devastating pests like the Fall Army Worm. However, at soil level, these insecticides influence the physico-chemical and biological properties of soil thus influencing the number and metabolic activity of soil microbial communities.



GMOs Improve SOIL HEALTH

Healthy soil is fundamental for

CROP GROWTH & FOOD PRODUCTION.[1]



Over the last **20 YEARS,** GMOs **HAVE:**

↓8.1% REDUCED PESTICIDE APPLICATIONS[2]

&

↑22% INCREASED CROP YIELDS[3]

Herbicide-tolerant GM crops enable farmers to till – or turn over and break up the soil – less often. This has **increased nutrient-rich organic matter up to 1,800 pounds per acre per year**.[4]



LESS TILLING[5] =

- **↑ Soil Moisture**
- **↓ Greenhouse Gas Emissions**
- **↓ Soil Erosion**

In the last 150 years, half of the planet's topsoil has been lost, largely as the result of erosion. Erosion clogs streams and rivers, hurting fish and other species, and can worsen flooding.[6]

GMOs are part of sustainable farming that preserves topsoil, preventing erosion and desertification.[7]



LESS EROSION AND HEALTHIER SOIL, THANKS TO GMOs.

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gmo answers



In Romania, it was reported that use of broad-spectrum insecticides significantly reduced the number of beneficial bacteria in the soil. Insect resistant biotech crops have inherent capability to repel insect pests and therefore, require minimal insecticide application regimes. This intervention ensures sufficient pest control with minimal impact on the biological components of soil, a technology that enhances nutrient recycling and eventually the general fertility of the soil.

Conclusions and Recommendations

Biotech crops can improve the soil. This is based on their ability to biologically fix more nitrogen, reduce the need for use of pesticides and preserve the top soil through adoption of conservation tillage. In order to achieve the benefits of biotech crops on soil improvement in Uganda, it is recommended that as a country we improve governance and management for biotechnology development at institutional and national levels and establish an enabling policy and legal environment for agricultural biotechnology research and development.

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