

Producing more with less:

How innovation in agriculture is making every drop count

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The world's water supply is fast becoming a scarce and precious resource. A recently released FAO report provided details on the deteriorating state of the Earth's land and water resources, highlighting the challenges that farmers face to sustainably feed a growing world population expected to reach 10 billion by 2050. It is no secret that agriculture accounts for up to 70% of global water use. On average, it takes 3,000 litres of water to produce the food requirements of just one person per day and up to 17,000 litres of water to produce just 1 kilogram of

chocolate. These staggering statistics highlight the huge responsibility of agriculture and most especially, our farmers, to conserve water and protect this life-giving resource. As the impact of climate change is being felt globally with the increased frequency of droughts and extremes in temperatures, there is a growing urgency for agriculture to adapt and equip farmers with the necessary tools to produce more with less.

Agriculture in the 21st Century has made significant strides and is technologically more advanced than ever before. Farmers



have already made considerable progress to reduce their water use through conservation tillage, the use of higher yielding varieties, crop protection technologies and improved irrigation techniques. Farmers' efforts to conserve water are paying off – for example cotton production today requires 50% less irrigated water compared to 20 years ago. But it is going to take an even bigger effort to improve agricultural productivity and efficiency to keep up with global food demands in an environmentally sustainable way that protects our limited water supply. Let us take a closer look at how innovative tools in 21st Century agriculture are helping our farmers to minimise their water usage.

Plant biotech traits ensuring more crop per drop

Over the past 25 years, farmers in both developed and developing countries have widely adopted biotech varieties in key crops such as maize, soybean, cotton, and canola. The global uptake of biotech crops has been dominated by insect resistant and herbicide tolerant traits and have indirectly contributed to farmers' efforts to sustainably produce more food with less water. The planting of herbicide tolerant crops has facilitated the use of less toxic herbicides, better weed control and the adoption of no-till farming (conservation tillage). These practices have assisted water conservation efforts by reducing weeds from competing with crops for water and encouraging zero tillage of soil, leading to significant improvements in soil moisture content.

The adoption of insect resistant crops, offering built-in protection against targeted pests, have helped to reduce crop losses due to insect damage and the need for pesticide applications. In this way water resources are conserved by limiting water wastage through production losses and reducing water requirements associated with pesticide applications. South Africa being a water scarce country, has fortunately been an early adopter of biotech crops with herbicide tolerant and insect resistant traits. With most South African farmers opting to plant biotech cotton, maize, and soybean, they too have been able to play their part by farming with technology that

promotes efficient utilisation of the country's precious water resources.

Other more direct ways that plant biotech traits are helping to meet global food demands with less water is through the deployment of drought tolerant crops. Drought tolerant varieties enable plants to use water more efficiently by stabilising crop yields under moderate drought conditions. Drought tolerant technology is already commercially available in South Africa. In sub-Saharan Africa, which is more prone to drought and dependent on rainfall for crop production, drought tolerant varieties are being rolled out through a public private partnership known as the TELA maize project. This initiative is working towards making transgenic drought-tolerant and insect-protected maize varieties available royalty-free to smallholder farmers in selected countries in Africa to help boost food security during times of drought.

Maximising plant breeding innovation to reduce water use

Groundbreaking innovations in plant science over the past decade have given us novel plant breeding tools. These breeding tools consist of various genome editing techniques, such as CRISPR (clustered regularly interspaced short palindromic repeats), that is widely being used in agricultural research applications to address several key challenges. What sets genome editing techniques apart from older genetic engineering technology, is that these tools enable targeted genetic improvements in crops, in a more precise, cheaper, and faster way without the need for introducing foreign DNA. The accessibility and advantages of genome editing tools offer exciting prospects for present and future agricultural innovation, including providing farmers with sustainable solutions to counter the myriad of challenges they face due to climate change and the declining availability of resources. While there are no gene edited crops with water efficient traits in the market yet, intensive research efforts are underway to design crops that require less water to grow. Here are some examples of how these novel technologies are helping crops to adapt in water scarce environments.

- **Drought tolerance** in crops is an extraordinarily complex trait that involves

a number of genes. Genome editing tools are being used to target various drought related genes to improve the ability of plants to thrive during prolonged drought conditions. Technology applications for drought tolerance and durability to extreme temperatures are progressing in cereal crops such as maize, rice and wheat as well as in more traditional crops such as sorghum, yams, cowpea, and bananas.

- Gene editing applications are being used to alter the genetics of rice plants to enable **earlier flowering** and crop maturation. These trait improvements would make rice crops more amenable to thrive under changing climatic conditions and the shortened life cycle through early flowering means that less water would be needed for growth.

- **Water-use efficiency** in plants is also part of the innovation pipeline. Based on our understanding of how photosynthesis works in plants, with the use of gene editing tools researchers have successfully managed to modify a single gene in tobacco, that tricks the plants into closing tiny pores (stomata) on the surface of its leaves to minimise water loss. The end result is tobacco plants with up to 25% better water-use efficiency i.e. less water absorption from the soil. The demonstrated success with water-use efficiency in tobacco is currently being evaluated in other important food crops such as maize and soybean.

Protecting our water to secure our future and our food

Every single day, farmers around the world are using innovative tools and technologies to produce more with less.

Innovations in plant science are playing a critical role in helping our farmers to conserve water and combat drought through an expanding toolbox of sustainable solutions. We can all agree that water is a precious resource without which we cannot live. Ensuring sustainability in agriculture under worsening conditions due to climate impacts, disease and pest pressure and deteriorating natural resources, places a huge responsibility on our farmers. Fortunately, technologies such as plant biotech and genome editing are lending a helping hand so that farmers strike a perfect balance between protecting agriculture's precious water resources and feeding the world's growing population.



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