Post-Green Revolution study: Projected crop yields unable to feed the world by 2050, we need GMOs, gene editing and other ‘genetic strategies’

The current trajectory for crop yields is insufficient to nourish the world’s population by 2050. Greater and more consistent crop production must be achieved against a backdrop of climatic stress that limits yields, owing to shifts in pests and pathogens, precipitation, heat-waves and other weather extremes.

Here we consider the potential of plant sciences to address post-Green Revolution challenges in agriculture and explore emerging strategies for enhancing sustainable crop production and resilience in a changing climate. Accelerated crop improvement must leverage naturally evolved traits and transformative engineering driven by mechanistic understanding, to yield the resilient production systems that are needed to ensure future harvests.

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Research advances have provided innovative opportunities and technologies across the plant sciences, which can furnish solutions for addressing future food security. The strategies described here for enhancing the resilience and sustainability of crops will only be realistic if they are part of an integrated approach to agriculture that is developed collaboratively with agronomists, engineers and farmers.

A critical challenge is the time from research discovery to true and widespread implementation in agriculture. Some high-impact breeding and genetically modified traits (for example, pest resistance mediated by individual Bacillus thuringiensis Cry proteins) have spread relatively rapidly. However, even in cases that involve breeding into diverse varieties, the time from initial discovery and development to broad use has often exceeded ten years.

Regulatory processes and intellectual property hurdles associated with technology can lead to additional delays in implementation. The robust assessment of varieties in variable field environments is essential to timely adoption.

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The current timeline for increasing the resilience and sustainability of crops is too long. Crop varieties with new combinations or variants of disease-resistance genes are in preparation for use against newly emerged virulent pathogens. Advances in sequencing and the early detection of invasive pathogenic strains should enable better monitoring of disease, and therefore knowledge regarding where to deploy particular crop genotypes.

The horizon for tailored panels of appropriately controlled genes that impart functional immunity in a commercial crop is years away. The most rapid translation to the field will be for small suites of genes from existing crop germplasm. For challenges that are difficult to overcome (such as resilience to heat and aridity during plant sexual reproduction), disruptive advances such as the asexual propagation of seeds could lessen yield loss due to male infertility. Success in the engineering of improved photosynthesis,

nutrient use and beneficial plant–microorganism interactions requires intensive investment, but could result in the gains needed.

The plant sciences have a critical role in meeting the food and fibre challenges of the future. Timely investments and research at many levels and collaborative efforts are paramount to deploying resilience mechanisms and improving the sustainability, yields and nutritional value of our crops.

Read full, original article: Genetic strategies for improving crop yields