GM—'the most critical technology' for feeding the world, expert says

August 20 2015

A former adviser to the US Secretary of State says that genetic modification (GM) is the most critical technology in agriculture for meeting the challenges of feeding a growing global population, writing in the open access journal *Agriculture & Food Security*.

Nina Fedoroff, molecular biologist and former Science and Technology Adviser to Hillary Clinton and Condoleezza Rice, warns of the detrimental influence of politics and misinformation on the safety of GM crops. Instead, Fedoroff says that: "GM crops are arguably the safest new crops ever introduced into the human and animal food chains."

Addressing safety concerns, Fedoroff highlights recent studies that have revealed that plant modification by molecular techniques has less impact on gene expression, protein and metabolite levels than conventional genetic crosses. New methods are also rapidly being developed that promise to further increase the specificity and precision of genetic modification.

"The overwhelming evidence is that the GM foods now on the market are as safe, or safer, than non-GM foods," argues Fedoroff. She also cites a recent overview by the European Union of more than 130 research projects over 25 years concluding that GM methods are not inherently more risky than conventional plant breeding technologies. Fedoroff adds: "Every credible scientific body that has examined the evidence has come to the same conclusion."

In her commentary, Fedoroff explains that the human population has grown seven-fold over the past two centuries, with the addition of a further 2-3 billion anticipated during the 21st century. The UN's Food and Agriculture Organization has estimated that food production will need to increase by 70% by 2050 to meet this demand.

She writes: "Current yield growth trends are simply insufficient to keep up with growing demand...To live sustainably within planetary constraints, we must grow more on the same amount of land using less water, energy and chemicals. The molecular genetic revolution of the late 20th century that powered the development of precise GM methods is the most critical technology for meeting these challenges."

The negative impact of climate change on agriculture is also predicted to worsen, warns Fedoroff, and arable land continues to be lost to urbanization, salinization, and desertification.

"Supplies of fresh water for agriculture are under pressure, as well," writes Fedoroff. "Today, about a third of the global population lives in arid and semi-arid areas, which cover roughly 40% of the land area... Yet the major crops that now feed the world - corn, wheat, rice, soy - require a substantial amount of water."

The advances in knowledge of plant stress responses and tools for plant breeding have already resulted in the introduction of new drought-tolerant crop varieties, both GM and non-GM, says Fedoroff.

But opposition to GM crops within the political systems of Japan and most European and African countries impeded progress, suggests Fedoroff: "European influence has been especially detrimental in Africa, causing African leaders to be excessively precautionary in approving GM crops and even to ban the import of GM grain to alleviate famine."

Fedoroff discusses missed opportunities in using GM technology for addressing global malnutrition. Severe vitamin A deficiency causes up to 2.8 million preventable deaths and blindness in half a million children annually. The GM crop 'Golden Rice' produces enough β-carotene so that a few ounces of cooked rice could eliminate the morbidity and mortality of vitamin A deficiency. "Golden Rice remains mired in controversy and has been tied up in the regulatory process for more than a decade," argues Fedoroff. "Millions suffer and die while Golden Rice remains in test plots."

More positive stories on the adoption of GM crops are highlighted by Fedoroff, citing studies showing that more than 90% of farmers growing biotech crops today are smallholder, resource-poor farmers, and others concluding that, over 20 years, GM crops have reduced pesticide use by 37%, increased crop yields by 22% and increase farmers' profits by 68%: "The simple reasons that farmers migrate to GM crops are that their yields increase and their costs decrease."

Taking a historical perspective, Fedoroff suggests that much of the opposition to GM crops could lie in our understanding of what constitutes 'genetic modification'.

"Humans practiced genetic modification long before chemistry entered agriculture," explains Fedoroff, "transforming inedible wild plants into crop plants, wild animals into domestic animals and harnessing microbes to produce everything from cheese to wine and beer. Oddly, it is only our contemporary methods of bending organisms' genetic constitution to suit our needs that are today recognized as genetic modification."

In conclusion, Fedoroff asks: "Will we have the wisdom to overcome our fear of new technologies and re-invest in the kind of agricultural research and development that can simultaneously increase agricultural productivity and decrease its environmental impact, so that we might

preserve what remains of our extraordinary biological heritage?...The answers to these questions will, for better or worse, shape our future civilizations."

More information: Nina V Fedoroff, Food in a future of 10 billion , *Agriculture & Food Security* 2015 , DOI: 10.1186/s40066-015-0031-7

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