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By Jack Kaskey

Nov. 13 (Bloomberg) -- Crop breeders increasingly are using radiation and gene-altering chemicals to mutate seeds, creating new plant varieties with better yields -- all without regulation.

The United Nations' Nuclear Techniques in Food and Agriculture program has received 39 requests this year for radiation services from plant breeders in dozens of countries, the most since records began in 1977, according to program head Pierre Lagoda. The group in Vienna promotes developing more "sustainable" crops by irradiating them to resist threats like drought, insects, disease and salinity.

Mutation breeding, after booming in the 1950s with the dawn of the Nuclear Age, is still used by seed developers from BASF SE to Dupont Co. to create crops for markets that reject genetic engineering. Regulators don't demand proof that new varieties are harmless. The U.S. National Academies of Science warned in

1989 and again in 2004 that regulating genetically modified crops while giving a pass to products of mutation breeding isn't scientifically justified.

"The NAS hits the nail on the head and I don't think that any plant- or crop-scientist will disagree," said Kevin M.

Folta, a molecular geneticist and interim chairman of the horticultural sciences department at the University of Florida.

"Mutation breeding is absolutely the least predictable."

Health Risks

The increase in mutation breeding raises questions of fairness and safety compared with genetic engineering, a regulated technique used by companies such as Monsanto Co. that involves transferring specific genes from one species to another. Monsanto's Roundup Ready soybean, a blockbuster product in the U.S. and Brazil, can't be grown in the European Union, where national governments have cited concerns about risks to health and the environment.

In contrast, mutagenesis deletes and rearranges hundreds or thousands of genes randomly. It uses a man-made process that mimics with a greater intensity what the sun's radiation has done to plants and animals for millennia, spawning mutations that sometimes are beneficial or hazardous to the organism.

The randomness makes mutagenesis less precise than St.

Louis-based Monsanto's genetically modified organisms, known as GMOs, the NAS said in a 2004 report. It's the breeding technique most likely to cause unintended genetic changes, some of which could harm human health, the academy said.

Fewer Hurdles

Still, mutagenesis is gaining in popularity because it's a far cheaper way to give crops new traits than the $150 million to $200 million that companies such as Monsanto pay to get a new GMO on the market. Mutant crops also face no labeling requirements or regulatory hurdles in most of the world.

"These difficulties in getting a GMO to the market, we don't have it in mutation breeding," Lagoda said in an Oct. 16 phone interview.

Breeders have registered more than 3,000 mutant varieties with Lagoda's program, a partnership between the UN's Food and Agriculture Organization and the International Atomic Energy Agency. Those varieties are just "the tip of the iceberg"

because many breeders actively avoid revealing how they create new plants, Lagoda said.

This year alone, Lagoda's program has gotten requests to help irradiate 31 plant species, ranging from sugar beets from Poland and wheat from the U.K. to rice from Indonesia and potatoes from Kenya.

Atomic Gardens

Some of the program's greatest successes have been in Asia.

In Vietnam, mutant varieties of soy now account for half of the crop and higher yields from mutant rice has made the country self-sufficient in that grain, Lagoda said. Vietnam now is using the technique to develop salt-tolerant rice, he said.

Mutant breeding was developed during World War II and promoted during the Cold War as a peaceful use of nuclear technology. It created thousands of new plant varieties by knocking out genes with X-rays and gamma rays as well as chemicals.

Atomic gardens, built around gamma-ray emitters, were popular among breeders in the 1960s and Japan still operates one. China began launching seeds into space in 1987 to take advantage of cosmic radiation and low gravity, developing more than 40 mutant crops with higher yields and better disease resistance, including varieties of rice, wheat and pepper.

Most of the world's wheat, rice and barley are descendants of mutant varieties, according to Lagoda. Mutagenesis is used to give fruits and vegetables a new color and to make grains shorter and easier to harvest. In the U.S., mutagenesis was used to develop Star Ruby grapefruit and varieties of lettuce, beans, oats, rice and wheat.

Mutant Sunflowers

BASF, the world's biggest chemical company, is having success with its line of Clearfield crops. The German company made the crops tolerant of its Clearfield herbicide through chemical mutagenesis. It alters the crops' DNA by dousing seeds with chemicals such as ethyl methanesulfonate and sodium azide, according to company filings in Canada, the only nation that regulates such crops.

"This has been a technique used for many decades without issue, without concern," Jonathan Bryant, a BASF vice president said by phone.

BASF enlists the help of 40 seed companies, including DuPont Co. and Dow Chemical Co. in the U.S. and Switzerland's Syngenta AG to sell Clearfield crops in markets that reject GMOs. Clearfield wheat, rice, lentils, sunflowers and canola are planted from Russia to Argentina and the U.S. without regulatory review.

DuPont Products

Operating earnings at BASF's agriculture unit rose 27 percent last year, partly because of higher demand in Eastern Europe for Clearfield herbicide and the mutant crops that tolerate it, the company said in its annual report. Its products are safe for consumers and the environment, said Nevin McDougall, a BASF senior vice president.

DuPont's Pioneer seed unit created an herbicide-tolerant sunflower by exposing the seeds to ethyl methanesulfonate. The sunflowers are marketed as ExpressSun and are grown primarily in

Russia, Ukraine and throughout Eastern Europe, said Paul Schickler, president of Pioneer, where plant breeders use both genetic modification and mutagenesis.

"There is not a black line between biotechnology and non- biotechnology," Schickler said. "It's a continuum."

Monsanto Chief Technology Officer Robb Fraley agreed. Plant breeders for the past five years have had the ability to use molecular markers and sequenced genomes of corn and other crops to improve crosses, making conventional breeding more like genetic engineering, he said.

Withdrawn Varieties

"For all practical purposes, breeding and biotechnology are converging," Fraley said in an interview, adding that Monsanto uses mutagenesis "a little bit."

Still, for some scientists there's a clear distinction between mutagenesis and creating GMOs. The latter are more likely to be safe because regulators require breeders to document why any new proteins won't cause health problems such as allergies, said Alan McHughen, a molecular geneticist at the University of California in Riverside.

Breeders who avoid genetic modification are simply trusted to rid their new plants of any hazards. That doesn't always

happen: Varieties of conventionally bred potatoes, celery and squash have been pulled from the market after breeders accidentally increased levels of naturally occurring toxins.

GMO Safety

The NAS and other science groups have urged the U.S. to adopt a system more like Canada, where novel food traits are examined for safety regardless of the method used to create them. In the U.S., where only GMOs are required to pass through an approval process, the Department of Agriculture issued a memo this year verifying crops created through mutagenesis as acceptable even for organic farming.

"Any GMO on the market today is safer than anything that hasn't gone through that safety regulatory step," McHughen, a member of the National Academies who helped write the 2004 report, said by phone.

Despite that view, Monsanto -- the world's largest maker of genetically altered crops -- faces not just regulation of its GMOs and bans in some countries, but also political hurdles that can delay product introductions for years, sometimes indefinitely.

In July, it withdrew applications for planting its seeds in the EU, which has approved only one application in two decades.

BASF last year decided to move its plant-science division, which works on engineered crops, to the U.S. from Germany. Given the situation in the EU, breeders have little choice except to switch to mutation breeding, Lagoda said.

"The current regulations are a huge incentive to go back and do things the old way," including mutagenesis, Wayne Parrott, professor of crop science at University of Georgia at Athens, said by phone. "Simply because, even though you may bring in a bunch of unknown genes and a lot of unknown changes, it's not regulated."

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