Activists bury India's GM mustard hopes

A genetically modified (GM) mustard *Brassica juncea* developed locally that would have become India's first GM food is unlikely to reach the kitchen despite having "conditional" clearance for its cultivation. The go-ahead from the government regulator, the Genetic Engineering Appraisal Committee (GEAC), was issued in May 2017, but the Ministry of Environment and Forests, that was expected to give the final approval, has kept mum in the face of powerful opposition from the anti-GM lobby. "I do not believe the administration has enough courage to stand up to activists," says Chavali Kameswara Rao, secretary of the Bengaluru-based Foundation for Biotechnology Awareness and Education.

The government's indecision is a setback for Deepak Pental whose team at Delhi University took 14 years and reportedly spent Rs.700 ($10) million of public funds to create the hybrid that Pental claims would increase mustard production and help India reduce its import bill for edible oil. But the GM mustard's final commercialization approval was halted by farmers' unions, civil society groups and a lawsuit in the Supreme Court brought by activist Aruna Rodrigues. "With no enthusiasm, the technology will die its own sweet death," Pental says.

It is not the first time that GM food crops face such hurdles in India. In 2009, Bt brinjal (eggplant) was put under an "indefinite moratorium," despite approval by GEAC (*Nat. Biotechnol.* **28**, 296, 2010). In 2002, the GEAC, swayed by critics, denied Bayer's Indian subsidiary ProAgro permission for a field trial of its GM mustard created using a similar technology as that used by Pental.

Being a self-pollinating plant—containing both male and female parts—no natural hybridization can take place in mustard. So Pental's team genetically engineered its "Dhara Mustard Hybrid-11" or DMH-11 by inducing sterility in an Indian variety as the female parental line, using the gene *barnase* that was derived from a soil bacterium, and crossed it with the male East European variety. The bacterial gene (*barstar*) was also introduced in the male line to restore fertility in the offspring (DMH-11) so that the farmer gets fully fertile seeds. Additionally, a herbicide-tolerant third gene (*Bar*), derived from another soil bacterium, was incorporated to identify plants that have been genetically modified. "The *Bar* gene has been introduced only to facilitate hybrid seed production and the DMH 11 will not be required to be sprayed with herbicide by farmers as alleged by critics," says Pental. "All the three genes have more than 20 years history of safe use in GM rapeseed, a sister crop of mustard."

But Kavita Kuruganti, founder of Alliance for Sustainable & Holistic Agriculture says that DMH-11 is a Trojan horse that will open the doors for more herbicide-tolerant crops and pesticide companies. Arguing that there are many non-GM mustard hybrids that are better yielders than DMH-11, P.C. Kesavan, a geneticist and Fellow of National Academy of Agricultural Sciences, says "the government would be extremely foolish to push [the GM mustard's] clearance."

Kunal Sehrawat / Alamy Stock Photo

A mustard plant bloom. India's home-grown GM mustard may never become a commercial product.

As a consequence, confusion reigns in the seed industry. Arvind Kapur, CEO of Rasi Seeds near Delhi, says delaying another GM seed's release will only harm the industry. Indeed, Indian agbiotech firms are commercializing their products elsewhere. Mahyco in Mumbai, whose joint venture with agbiotech giant Monsanto introduced Bt cotton into India, plans to take its GM technology for insect and drought resistance to other South Asian and African countries, and its Bt brinjal, despite the moratorium in India, is already approved in neighboring Bangladesh.

As for GM mustard, it seems destined to remain in limbo as 11 Indian states, including three major mustard growers, Madhya Pradesh, Rajasthan and Haryana, have decided against its introduction.

Killugudi Jayaraman *Bangalore, India*

Corrections

In the September 2017 issue, in the article "CRISPR patent estate splinters" initially published, the first two sentences of paragraph 2, on p.809, column 2, incorrectly stated that MilliporeSigma had received patent grants for the proxy-CRISPR technology, whereas it has filed patent applications for this technology. The sentences, which follow, have been replaced: "It was a `dead' version of Cas9 that secured patent rights for the life sciences arm of Merck KGA. The Darmstadt, Germany -based pharma's wholly owned subsidiary MilliporeSigma, received both European and Australian patents for its `proxy-CRISPR' version of the genome editing system." The business has received an Australian patent grant and a notice of intention from the European Patent Office for a patent that covers the integration of an external DNA sequence into the chromosome of eukaryotic cells using CRISPR. In two instances in the same paragraph a "Merck" spokesperson should have been identified as being from "MilliporeSigma" and, similarly, "Merck claims" should have been "MilliporeSigma" claims. In addition, KGaA was misspelled as KGA; the third mention of "Neuman" was misspelled as "Newman." The errors were corrected in the HTML and PDF versions of the article.

In the September 2017 issue, In the article "What's app? Helix wants you to quiz you genome--some of it for fun" initially published, a disease-carrier screening app was described as "Sema4, provided by Eric Schadt's group at Mt. Sinai Hospital…" The app is called "CarrierCheck" and was developed by Sema4, a company spun out of Mt. Sinai and led by Eric Schadt. The errors were corrected in the HTML and PDF versions of the article.