EDITORIAL

On the Commercial Release of Transgenic Mustard in India

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The strong statement issued by Dr Himanshu Pathak, Director General of the Indian Council of Agricultural Research (ICAR) on the merits of genetically modified (GM) mustard (Herbicide Tolerant Dhara Mustard Hybrid-11 or HT DMH-11), which was approved for commercial cultivation by the Genetic Engineering Appraisal Committee (GEAC) in October last year, is timely and welcome.

The development of Mustard DMH-11, a project fully funded and executed by the public sector, took place at the Centre for Genetic Manipulation of Crop Plants (CGMCP), Delhi University (DU) South Campus, under the leadership of Professor Deepak Pental. The Department of Biotechnology (DBT) and the National Dairy Development Board (NDDB) funded the DU team's project.

This is the first time the head of India's premier centre for agricultural research and science has made such a detailed, scientifically-informed defence of genetic engineering and its strict protocol-based use for the enhancement of agricultural production. The statement offers a systematic and evidence-based rebuttal of the criticisms and challenges, notably by the Coalition for a GM-Free India, to the commercial release of GM mustard.

The statement is particularly welcome as it is perhaps the first time that the ICAR has sought to intervene and communicate in a transparent way in the raging debate over the contentious issue of transgenics in agriculture. Dr Pathak has offered a clear-eyed exposition of why India needs transgenic crops, the science that informs this technology, and how the all-important safety and environmental concerns in the development of transgenic crops have been addressed. This policy statement is precisely what is to be expected of a government agency engaged in cutting-edge science that can impact the lives and livelihoods of a large segment of people. Scientific research cannot be conducted in laboratories that are cut off from life

outside; indeed, the illumination that informed debate and discussion necessarily brings when research institutions keep their windows open, will not only enrich the scientific process itself but also create public confidence in the kind of work that such institutes engage in.

Mustard DMH-11 is the first transgenic food commodity to be released in India, a country where the enhancement of food production remains a critical issue. It would be instructive therefore to look at Dr Pathak's responses to the major objections raised by the critics of GM mustard.

Dr Pathak makes the case for the science of genetic modification, a "disruptive technology" that can bring "targeted change within the crop variety to overcome a problem that is difficult or impossible to achieve [and which is] *also safe to humans, animals, and environment* [emphasis added]."

Although in its petition to the Supreme Court, the Coalition for a GM-Free India directs its criticism at the alleged violations of the regulatory mechanism by the GEAC, it is clear from their writings and campaigns, that their primary opposition is to the science of transgenics itself, a point that we shall return to later in this editorial.

The Centre for Genetic Manipulation used the barnase/barstar system, which according to Dr Pathak, "provides an efficient and robust alternative method for hybrid seed production in mustard, [which] has been successfully deployed in countries like Canada, Australia, and America for many decades." In developing Mustard DMH-11, the Indian team led by Professor Pental made some alterations in the barnase/barstar system, which "has undergone the required regulatory testing processes during 2008-2016," according to Dr Pathak's statement.

Dr Pathak provides the context for the development of transgenic mustard, namely, India's current status in respect of its domestic production and edible oil requirements and its heavy dependence on imports to meet domestic requirements. In 2021-22, he says, the country imported 14.1 million metric tonnes of edible oil, which constituted *two-thirds of India's total edible oil consumption of 21 million metric tonnes*. The total cost of imports of edible oils, mainly palm, soybean, sunflower, and canola, was Rs 1.568 trillion (Rs 1,56,800 crore) in the same year. Closely linked to India's requirements is its current productivity in edible oils, which ranks well below the global average. In respect of rapeseed-mustard, India's production in 2021-22 was 11.75 million metric tonnes from an area of 9.17 million ha: a productivity level of 1281 kg/ha compared with a global average of 2000 kg/ha.

The imperative of securing higher production calls for rapid productivity increases, a goal that is best achieved through the development of hybrids, which have shown to increase yields by 20 to 25 per cent. "Crossing of genetically diverse parents results in hybrids with increased yield and adaptation," he states, "a phenomenon known

as hybrid vigour or heterosis which has been widely exploited in crops like rice, maize, pearl millet, sunflower, and many vegetables." The barnase/barstar system developed in India has, according to Dr Pathak, reduced the usual purity standard of hybrid seeds of rapeseed and mustard from 95 per cent to 85 per cent.

Responding to the issue of the safety of transgenic mustard on other plants, animals, and biodiversity in general, Dr Pathak emphasises the fact that national agencies and public research systems with expertise in the areas of agriculture and health, environment, and ecology have been "officially and formally involved in the risk assessment of the product for its being safe to humans, animals, and environment."

The particular mustard transgenic DMH-11 was tested for three years in confined field trials at multiple locations in India to assess its impact on human health and the environment according to stipulated guidelines and applicable rules. The variant showed approximately 28 per cent more yield than the national average. It is important to note that the safety tests did not stop here. Dr Pathak further states that as a decade has passed since the first round of tests was conducted, "it is relevant to test its performance against the currently grown hybrids and varieties as check in the national trials under the All India Coordinated Research Project on Rapeseed and Mustard as per ICAR guidelines. Only if Mustard DMH-11 is found significantly superior, will it be released for commercial cultivation. This is what is precisely recommended by the GEAC." This suggests that the actual release of the variant will occur only after the second round of tests is conducted.

The statement by Dr Pathak goes on to address another issue that opponents of GM technology have raised. This relates to the safety of three genes, namely, Barnase, Barstar, and Bar, which have been used in developing the technology. He asserts that "extensive studies carried out on toxicity, allergenicity, compositional analysis, field trials, and environmental safety studies of GM mustard lines vs. their non-transgenic comparators have provided evidence that they are safe for cultivation and for food and feed use." The visitation of bees to the transgenic lines–yet another area of concern–is similar to their non-transgenic counterparts as per the data recorded during the trials, the statement adds. This was established as per the data recorded during the Biosafety Research Level-I (BRL-I) and BRL-II trials conducted over three growing seasons at multiple locations as per the protocols approved by the Review Committee on Genetic Manipulation (RCGM) and the GEAC protocols. "The current approval has been given based on the international status on growth in honey production and number of bee colonies, particularly in Canada, which has 95 per cent of rapeseed area under Barnase/Barstar based hybrids," according to the statement. However, even here, as a precautionary principle, the GEAC has directed the developers to generate data on the effects of GM mustard on honeybees and pollinators during the first two years of release.

On the allegation that Mustard DMH-11 will promote herbicide use to favour multinational corporations in agriculture, the statement is clear. First, it clarifies that the Bar gene that confers resistance to herbicide glufosinate has been used in GM mustard on two counts. First, it is a "selectable marker in tissue culture during development process." Secondly, the herbicide tolerance trait of the Barnase female and Barstar male lines will be exploited only in the hybrid seed production programme, and *not in the commercial cultivation of hybrids*, as this trait has not been claimed by the applicant in the dossier. In other words, the GEAC has given approval for herbicide use for hybrid seed production *only*, and that, after getting the expansion of label claims as per existing rules, a point that has been specially mentioned in the approval.

Indeed, the statement makes the point that approximately 15000 metric tonnes of technical grade herbicides worth Rs 70 billion (Rs 7000 crores) are currently being used in Indian agriculture in crops like rice, wheat, and soybean in which the molecules are owned by foreign companies. Does this mean that multinational corporations (MNCs) are being favoured in respect of all these crops too, the statement asks.

Dr Pathak's statement contrasts India's place in transgenic agriculture with that of other economies. Globally, GM crops are grown on 195 million hectares in more than 30 countries. In several countries, the adoption rates of GM traits have been very high, more than 95 per cent in some cases. "There is no evidence of adverse effects reported from the use of GM crops globally. The bulk of produce from GM crops like maize, soybean, etc. is exported from the USA, Argentina, and Brazil, the major GM crop growing countries to many countries, including the EU as animal feed."

Calling the development of GM mustard a "landmark decision," Dr Pathak provides pointers for the future of transgenic crops in India, the research on which is being carried out in several ICAR institutions and universities in the country. Since 2006, 11 public sector institutions through the ICAR's "Network Project on Functional Genomics and Genome Modification" are studying different traits such as "biotic and abiotic stress tolerance, yield, and quality improvement," which in turn are being tested in respect of 13 crops, namely, cotton, papaya, brinjal, banana, chickpea, pigeonpea, potato, sorghum, brassica, rice, flax, wheat, and sugarcane. We are informed that at present, late blight resistant potato developed by ICAR-Central Potato Research Institute, Shimla; pod borer resistance in pigeonpea developed by ICAR-National Institute for Plant Biotechnology, New Delhi; insect resistant chickpea developed by ICAR-Indian Institute of Pulses Research, Kanpur; and iron and pro-vitamin rich banana developed by ICAR-National Research Centre on Banana, Tirchurapalli, are at different stages of development, from event selection to biosafety research level trials following all biosafety guidelines. The ICAR has initiated an All India Coordinated Research Project on Biotech Crops, which has both research and third-party evaluation components for targeted traits. It also will

conduct biosafety studies of six crops during the 2021-26 plan period with a total budget outlay of Rs 247.5 million (Rs 24.75 crores). Dr Pathak concludes that the time has come to put the welfare of farmers and consumers, and the creative energies of both experienced and budding science researchers in the forefront in India's quest for increased agricultural production based on the science of genetics.

The opposition to the introduction of Mustard DMH-11 comes principally from the Coalition for a GM-Free India, an umbrella organisation that brings together all shades of opposition to transgenics, including, at one end of the spectrum, those who believe in cowdung-based solutions to agricultural productivity. In their petition before the Supreme Court, the Coalition has confined its objections to alleged violations of the regulatory process that governs such clearances.

There can be no disagreement on the necessity of enforcing the mandated regulatory processes in respect of the introduction of transgenics in agriculture, regulations that India already has in place. If these regulations have not been enforced, that is no doubt a serious matter and must be addressed. The regulatory process must be robust and dynamic in keeping up with fast-paced developments taking place in the transgenic sector. Dr Pathak, in his statement, has made the assurance that the regulatory framework has been adhered to, and we would look forward to any further clarifications he may want to give on the matter.

As our editors have argued elsewhere, the critics of any form of genetic modification in crops tend to confuse issues in this regard. There are three factors, we argue, in the debate. The first relates to the *science and technology* behind the innovation. The second is the *political economy* aspect, which is related to the *ownership of the technology*. The third is the *impact* that the technology will have on farming and its economics (profitability, labour use, and gendered impacts) and *sustainability* (biosafety, intensity of chemical use, and resistance to toxins, if any).

We can no longer afford to ignore the enormous benefits that the application of bio-technology can bring to the people of India. To respond to an honourable judge of the Supreme Court who asked the government why it was in such a hurry to introduce transgenics in agriculture, we can only point to the fact that India ranks 107 out of 121 countries on the global hunger index, below Sri Lanka, Nepal, Pakistan, and Bangladesh. In such a scenario, hurry we must. Surely this is reason enough to support those individuals and institutions who are seized by a sense of urgency in implementing policies that will help lift the country out of mass hunger.