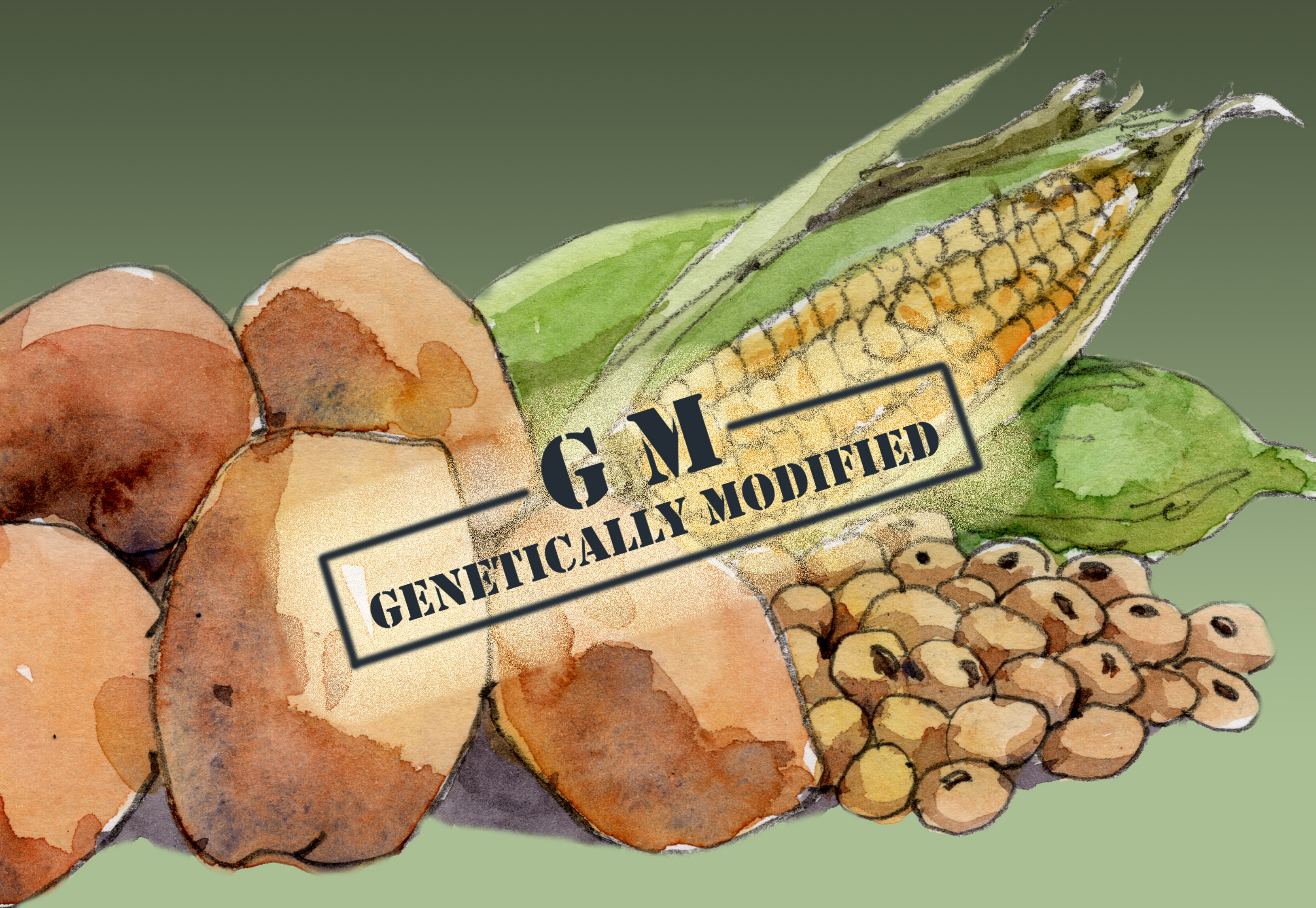
Genetically Modified Crops in the Malaysian Food System



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Consumers Association of Penang, 10 Jalan Masjid Negeri, 11600 Jelutong, Penang, Malaysia
and
Sahabat Alam Malaysia, 10 Jalan Padang Tembak, 11400 Penang, Malaysia
and
Forum Kedaulatan Makanan Malaysia, c/o B-05-03, 3 Two Square, 2 Jalan 19/1,
46300 Petaling Jaya, Selangor, Malaysia

The Third World Network is an independent non-profit international research and advocacy organisation involved in bringing about a greater articulation of the needs, aspirations and rights of the peoples in the South and in promoting just, equitable and ecological development.

The Consumers Association of Penang is a grassroots non-profit civil society organisation established to promote critical awareness and action among people to uphold consumer rights and interests, engaging in education, community mobilisation, research, advocacy, training and publication.

Sahabat Alam Malaysia (Friends of the Earth Malaysia) is an independent non-profit organisation focusing on environmental issues that impact communities across Malaysia.

Forum Kedaulatan Makanan Malaysia (Malaysian Food Sovereignty Forum) is a platform for discussion and action in matters related to food security and food sovereignty, with approximately 100 members consisting of organisations and individuals.

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Introduction

Since Malaysia's National Biosafety Act was enacted in 2007, 64[1] applications for the import of genetically modified (GM) crops for food, feed and processing purposes have been approved by the National Biosafety Board (NBB). Five non-food or feed products have also been approved, e.g., microorganisms to produce ingredients for fertilisers, biocontrol or food preservation in contained use. A further four field trials have been conducted.

Civil society organisations in Malaysia have long rejected the import and release of genetically modified organisms (GMOs) and their products (Consumers Association of Penang, 2015; Sahabat Alam Malaysia, 2019; Sanmugam et al., 2021; TWN, 2013). Based on statistics as of September 2018,[2] a majority of Malaysians surveyed (60%) stated they would never consume GM foods, while 33% stated they would. In contrast, organic farming, which excludes GMOs, has grown in popularity, with certification of organic foods supporting consumer trust (Alrashidi et al., 2022).

Public opposition has thus far been instrumental in stalling cultivation or environmental release of GMOs in the country. An application for field trials of a GM glyphosate-tolerant rice variety in 2019 was not approved, likely because of concerns raised and the importance of rice as a food staple in the country.[3] Similarly, an initial GM mosquito trial was not advanced to the next phases, reportedly "fearing outcry" from the public (USDA, 2017). Public opposition,[4] including from non-governmental organisations (NGOs) and local communities near the field trial site, and fears of high costs were instrumental in persuading the government to stop the project.

In contrast, approvals for the import of GM crops for food, feed and processing purposes have been consistently granted by the NBB. In addition to concerns over the potential risks of such GMOs to human and animal health, the high numbers of imports could also create challenges for proper implementation of Malaysia's GM labelling regulations. This would undermine consumer choice to avoid consuming GMOs.

The situation has only become more urgent, with approvals markedly increasing in recent years. This risks exposing the public to increasing amounts of GM ingredients, as well as associated pesticide residues. Indeed, recent testing of soybean products sold in Sarawak state found widespread GM contamination of tofu, tempeh, animal feed and raw soybeans (two samples of which were labelled as GMO-free) (Sani et al., 2022). Fifty-seven out of 65 samples tested positive for the glyphosate herbicide-resistance gene, which confers the most common GM trait.

Furthermore, GM crop varieties are increasingly "stacked" with multiple traits, for example, using multiple toxins for insect resistance, and/or expressing tolerance to multiple herbicides. Such trends in imported varieties only amplify food safety risks, as there is little robust assessment of the risks of exposure to cocktails of GM crops and their associated herbicides. Moreover, novel crops such as those utilising RNAi gene silencing processes are also now entering the food market, raising further concerns.

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1 https://www.biosafety.gov.my/main/article/keputusan-permohonan-pelepasan-lmo-and-produk-lmo

2 https://www.statista.com/statistics/983765/malaysia-willingness-to-eat-gm-foods/

3 https://www.malaysiakini.com/letters/485031#google_vignette

4 https://consumer.org.my/an-open-letter-to-the-government-from-malaysian-ngos-on-genetically-engineered-aedes-aegypti-mosquitoes/

GM industrial agricultural failures lock in dependence on toxic traits

The evolving trends in approvals for GM food and feed expose the significant failures in GM industrial agricultural systems, with direct food safety implications for consumers. Despite almost 30 years of commercialisation in industrial agricultural systems, GM crop developers have failed to move away from the two dominant traits of herbicide tolerance and insect resistance. Nor have long-promised traits such as nutritional enhancement, or increased resilience to abiotic stress such as drought, materialised in any meaningful way. As such, the imported foods have zero intended benefits to consumers, but instead are linked to human health risks.

The widespread use of herbicides in conjunction with herbicide-tolerant crops has resulted in a rapid proliferation of herbicide-resistant weed species, with 60 resistant species recorded to date.[5] The environmentally destructive practice of soil tilling, which herbicide-tolerant crops were supposed to help reduce, has since resurged, in order to combat the newly-evolved herbicide-resistant weeds no longer controlled by blanket herbicide spraying.

Genetically modified corn. Approvals for the import into Malaysia of GM crops for food, feed and processing purposes have been consistently granted. *Photo: Maggilautaro (CC BY-SA 3.0)*

5 https://www.weedscience.org/Pages/SOASummary.aspx

The proliferation of resistant weeds has forced the industry to develop GM varieties that are tolerant to multiple herbicides, including older and more toxic herbicides that glyphosate was promoted to replace, for example, 2,4-D, an active ingredient in the notorious Agent Orange. Indeed, Bayer (formerly Monsanto) announced in March 2025 that their latest soybean variety, Vyonic™, designed to be tolerant to five herbicides – glyphosate, glufosinate, dicamba, mesotrione and 2,4-D – is expected to be introduced into the market in 2027 (Bayer, 2025).

Similarly, for insect-resistant crops such as Bt crops, which are genetically engineered to produce toxins intended to kill pests, there are growing pest resistance problems. Over the last 25 years, 19 cases of practical resistance have been documented across five major pest species with regard to Bt crops (Entomological Society of America, 2020).

In order to combat these fundamental challenges to the long-term viability of the GM industry's flagship products, developers have been combining several traits together, described as "stacked traits". Stacked traits are achieved by inserting several genes conferring different traits into a crop at the development stage (molecular stacks), or by breeding parental GM crops together (breeding stacks).

Due to resistance development, GM crops are increasingly stacked with several insecticidal toxins and/or tolerance to multiple herbicides. Indeed, a list of corn traits available to no-till US farmers in 2024 shows that there are no longer any single toxin traits available, with all single as well as some stacked traits now phased out (Texas A&M University, 2024). Stacking is also widely deployed to combine herbicide tolerance with other traits, such as insecticidal resistance.

The US is the largest adopter of GM crops globally and a major GMO exporter to Malaysia. There, 90% of maize (corn) planted in 2024 was herbicide-tolerant, while 86% was insect-resistant, with approximately 83% "stacked" with both traits (USDA, 2025). For soybean, the US reported that 96% of soybeans planted were herbicide-tolerant. Brazil is the second largest adopter of GM crops and another major exporter to Malaysia. There, just three corn varieties are dominating the market, all of which have stacked traits of both herbicide and insect resistance (see section on breeding stacks).

With a dearth of new traits, the GM industry has resorted to approving more and more stacked products of differing combinations of the same 30-year-old traits, a trend which appears set to continue. Alternative insecticidal traits promised by the industry to address Bt resistance issues have not yet come to fruition, despite claims that such products were on the cusp of commercialisation. A case in point were DuPont's claims of non-Bt insecticidal traits in 2016 (e.g., NPR, 2016).

The outlook for continued approvals of imported GM foods thus appears to be more herbicide residues and more Bt insecticidal toxins entering the food supply. Indeed, the most significant evolution of new varieties has been the increased percentage of stacked varieties. With the rise of genome editing, companies such as Inari are further trialling crops that have added new "edited" traits to already existing herbicide-tolerant and insecticidal crops. But this merely prolongs the use of these older crop varieties, while extending new patents on them (AgriNovus Indiana, 2022).

The integrity and safety of food in Malaysia is therefore increasingly compromised by GM crop imports for food and feed, even as they do little to advance food security or provide clear benefits. Instead, the country may be inadvertently providing fertile ground for technology dumping of products that are characteristic of a failing GM industrial agriculture system.

Increasing importation of GM food increases exposure to chemicals

The growing list of GM food imports into Malaysia is likely making it increasingly difficult to prevent exposure to GMOs. Indeed, a 2011 study detected the presence of GM proteins in circulating blood of consumers in Canada (Aris & Leblanc, 2011). This finding directly contradicts claims by developers that GM proteins do not survive digestion.

GM crops and their associated herbicides are widely linked to potential health and environmental problems. An extensive review by the Brazilian Ministry of Agrarian Development identifies 750 studies linking GMOs to health, environmental and socio-economic risks (Ferment et al., 2016). More recently, the Mexican government filed a formal response in a trade dispute with the US over its desire to restrict GM maize imports, presenting hundreds of academic studies that show cause for concern (MEX-USA-2023-31-01, 2024). For example, certain Bt toxins have been shown to trigger inflammatory and exacerbated immune reactions, and are classified as a systemic immunogen that induces responses in both small and large intestines where the Bt toxins are not fully degraded (Vázquez-Padrón et al., 2000).

The herbicide glyphosate is classified as a probable human carcinogen by the World Health Organisation's cancer agency (IARC, 2017). Studies on people exposed directly to glyphosate in agricultural settings, e.g., via spraying, have revealed the health risks of herbicide-tolerant crop systems. Over 100,000 class action lawsuits have taken place in the US as a result of occupational exposure resulting in serious, and potentially fatal, illnesses including non-Hodgkin lymphoma.

Application of glyphosate herbicide. GM crops and their associated herbicides like glyphosate are widely linked to potential health and environmental problems.

Monsanto/Bayer have thus far been forced to pay $11 billion in damages.[6] Recently, a study has linked glyphosate spray exposure in the US to reduced perinatal health, including smaller birth weights and gestational length for pregnant mothers (Reynier & Rubin, 2025).

In the US, where GM crops are most widely cultivated, glyphosate was also recently detected in over 80% of urine samples. This comes alongside a more-than-100-fold increase in glyphosate use in recent years, in part attributed to glyphosate-tolerant GM crops (Ospina et al., 2022). GM soybeans from Argentina, one of the two main countries exporting to Malaysia, have been found to carry glyphosate residues that were higher than internationally permitted levels (Testbiotech, 2013).

It can thus be expected that Malaysian consumers are regularly exposed to herbicide residues from GM crop consumption. As noted above, high levels of GM contamination from glyphosate-tolerant crops have been found in the soybean supply in Sarawak, though data on pesticide levels are not easily available to provide a wider analysis. A recent study from Mexico detected glyphosate in children, including those living in urban areas (and thus potentially exposed via food consumption), that was linked to increased incidence of kidney disease (Romo-García et al., 2025).

The increase in imports of herbicide-tolerant crops, including stacked varieties tolerant to multiple herbicides, increases potential human exposure to herbicide residues. However, herbicide exposure is not considered in GMO risk assessments, despite well-established human and environmental toxicity. The levels of glyphosate in GM foods recently prompted the American Academy of Pediatrics (Abrams et al., 2024) to urge parents to avoid GM foods for their children, advocating for more research into potential health impacts of GMOs.

Exposure to other herbicides via food consumption is less studied. However, they are widely linked to human toxicity via occupational exposure. Glufosinate, for example, is a known neurotoxin with reproductive, neurological and cardiovascular toxic effects (Calas et al., 2008; García et al., 1998; Herzine et al., 2016; Lantz et al., 2014; Laugeray et al., 2014; Meme et al., 2009). Similarly, 2,4-D has been linked to a variety of human health risks. Notorious for its use in herbicide formulation Agent Orange in the Vietnam War, it has been linked to increased cancer rates and birth abnormalities in farm workers and their children, as well as to disruption of male reproduction in laboratory studies (Garry et al., 1996; Lerda & Rizzi, 1991; Swan et al., 2003). Regulatory data suggest that dicamba can exert reproductive/developmental toxicity in mammals (US EPA, 2005).

GM crops with stacked traits risk combinatorial and synergistic effects

The trend towards stacked events being approved in Malaysia (see Table 1) presents additional biosafety concerns. The introduction of multiple genes and traits raises the possibility of combinatorial and/or synergistic effects that could result in unintended and undesirable changes to an organism. Such considerations are recognised by the Cartagena Protocol on Biosafety, to which Malaysia is a Party. Specific risk assessment guidance has been developed under the Protocol for stacked traits.

[6] https://www.lawsuit-information-center.com/roundup-lawsuit.html#:~:text=As%20of%20May%202025%2C%20Monsanto,trial%20resolutions%20in%20individual%20cases.

Unintended results have indeed manifested with stacked GM crops. Increased application of herbicides in crops designed to be tolerant to more than one herbicide is an issue (Nordgård et al., 2015). Synergistic and combinatorial effects have been documented in insecticidal Bt crops that express multiple toxins in a single plant (Hilbeck & Otto, 2015).

Several studies have shown that Bt toxins are able to trigger synergistic impacts and interactions with other plant stressors (Testbiotech, 2020b). Combinations of Bt toxins have also been shown to be toxic to certain non-target organisms that are not impacted by the single toxins (Kramarz et al., 2007; 2009). The toxicity of some Bt toxins to blood cells and organs/tissues related to production of blood has been observed to occur with increasing concentrations, with effects potentially increasing over time (De Souza Freire et al., 2014).

At the molecular level, transgene expression levels in stacked varieties can differ in comparison to their expression levels in the respective parental lines. These changes are reflected in altered and distinct compositional profiles of plant constituents such as proteins, reflecting altered metabolic profiles in stacked varieties versus their parental single lines (Agapito-Tenfen et al., 2014).

GMO risk assessments already do not cover the considerations of herbicide use in conjunction with herbicide-tolerant crops, a significant gap in biosafety oversight in Malaysia. This is now an increasingly urgent aspect when considering the risks of a combination or cocktail of herbicides used on GM crops.

Impacts could include interactions between herbicides and other traits such as with Bt toxins, between herbicide mixtures, as well as additional interactions with the plant itself. A known example is that glyphosate has been shown to modify the effects of purified Bt toxins on non-target insects. Pesticide mixtures are also known to potentially interact, resulting in increased toxicity. 2,4-D and glyphosate mixtures at legally permitted levels, for example, have been recently shown to enhance adverse reproductive outcomes, including sperm and testicular cell abnormalities and reduced serum testosterone levels in rats consuming a Western diet (Valente et al., 2024).

However, current risk assessments do not assess potential combinatorial, synergistic or cumulative impacts of herbicides as well as other traits used in combination, such as Bt toxins (Testbiotech, 2020a). This remains a significant gap that must be addressed.

What about breeding stacks?

Under Malaysia's biosafety regulatory system, stacked varieties are considered a new product and must be assessed separately, even if developed by cross-breeding two parental GM lines (so-called breeding stacks) that have each been previously approved individually. As submitted to the Food and Agriculture Organization of the United Nations (FAO) by the Malaysian Biosafety Department:[7] "GM food/feed that contains stacked event(s) is considered as a new product even if all single events that are stacked have already [been] approved." This is evidenced by the terms and conditions of approval of numerous GM events, which state that "any import or release of products derived from any new genetically modified lines bred using [an approved event] will require a separate approval from the National Biosafety Board".

[7] https://www.fao.org/food/food-safety-quality/gm-foods-platform/browse-information-by/country/country-page/en/?cty=MYS

An anti-GMO protest in the US. In Malaysia, civil society organisations have long rejected the import and release of GMOs and their products. *Photo: Chris Goodwin (CC BY-NC-SA 2.0)*

As detailed above, the vast majority of crops currently being grown in countries exporting to Malaysia are of the stacked variety, both breeding stacks and molecular stacks. According to the US Department of Agriculture (USDA, 2017), the US and Brazil are the largest exporters of soybean to Malaysia, while the vast majority of Malaysia's corn varieties are imported from Brazil and Argentina.

Brazil has three main corn varieties currently dominating the fields. VT PRO3®, PowerCore®Ultra and Agrisure®Viptera 3 are all breeding stack varieties, and together represent 46% of available technologies in 2020, 64% in 2021 and 56% in 2022 (Pereira Filho & Borghi, 2021; 2022b; 2022a). These crops were developed by the breeding of parental GM varieties, some of which are molecular stacks themselves, already carrying multiple toxins. They have the following cocktail of traits:

- VT PRO3 was developed by breeding MON89034[8] with MON88017.[9] This product has a total of five insecticidal toxins and is also glyphosate herbicide-tolerant.
- PowerCore Ultra was developed by breeding MON89034, TC1507,[10] NK603[11] and MIR162.[12] This product carries multiple Bt toxins.
- Agrisure Viptera 3 was developed by breeding Bt11,[13] MIR162 and GA21.[14]

[8] MON89034: a molecular stack developed to produce multiple insecticidal Bt toxins (Cry2Ab2 and Cry1A.105 (which itself comprises multiple toxins: Cry1Ab, Cry1F and Cry1Ac)).

[9] MON88017: a molecular stack carrying an insecticidal Bt toxin (Cry3Bb1) and glyphosate herbicide tolerance.

[10] TC1507: a molecular stack of an insecticidal Bt toxin (Cry1Fa2) and glufosinate herbicide tolerance.

[11] NK603: a single trait with glyphosate tolerance.

[12] MIR162: a single trait event with one Bt toxin (Vip3Aa).

[13] Bt11: a molecular stack of an insecticidal Bt toxin (Cry1Ab) and glufosinate tolerance.

[14] GA21: a single trait event of glyphosate tolerance.

Similarly, according to the Biosafety Clearing House of the Convention on Biological Diversity that provides a database of GMO approvals, Argentina, the other main supplier of corn to Malaysia, has approved 23 breeding stacks versus 16 that are not breeding stacks. However, information on what is currently being grown there appears publicly unavailable.

Breeding stacks therefore comprise a large proportion of GM crops grown in the countries that export to Malaysia. It is thus surprising that, to our knowledge, there has been only one application[15] for approval of such GM crops. This begs the question: could breeding stacks be entering Malaysia without the requisite separate approvals? This should be investigated as a matter of urgency.

The rising approvals of novel, risky traits

Since 2017, GM crops that utilise a distinct molecular mechanism – "RNA interference" (RNAi) – have been approved for entering the Malaysian food supply. Developers have used RNAi to target and silence genes of interest.

Such RNAi crops include three varieties of "Innate" potatoes (E12, Y9 and X17) developed by the agribusiness giant JR Simplot, which specialises in frozen French fries. All three potato varieties are modified to reduce acrylamide production in fried potatoes, as well as for reduced black spot and blight. Also approved for import are soybean, alfalfa and maize varieties using the RNAi mechanism to confer traits. All but the alfalfa variety are also "molecular stacked" varieties with more than one transgene included in the product, e.g., Bt insecticides, herbicide tolerance or multiple RNAi constructs (see Table 1).

The rationale underlying these traits is highly questionable, introducing potential food safety risks without the presumed benefits. Low-sugar potato varieties already exist that produce less acrylamide. Additional measures such as lowering frying temperature, removal of immature tubers or blanching potatoes before frying can also address the issue (CIAA/FDE, 2011). Furthermore, it has been shown that environmental conditions can affect acrylamide levels such that the same variety grown in different locations can produce significantly different levels (Muttucumaru et al., 2017). The RNAi potatoes are thus based on highly dubious evidence to support their use from a consumer perspective. Moreover, one of the potato varieties does not produce the intended protein designed to resist blight infection (FSANZ, 2017).

RNAi crops further raise specific biosafety concerns due to the nature of the RNAi mechanism incorporated into the engineered organisms. RNAi technologies function by manipulating the RNAi pathway, which acts as a fine-tuner in the process of gene expression, controlling if a gene is turned on or off, i.e., "silenced" or not. This is a naturally occurring genetic regulatory system that exists in animals and plants, working via certain types of RNA molecules (called double-stranded RNAs, or dsRNAs) that target specific genes. It works by sequence complementarity, with the RNA molecule sequence being a complement to the gene it targets. As such, GM crop developers will design an interfering RNA molecule to target the sequence of a gene they wish to silence, e.g., a gene in a pest that, if switched off, will cause the pest to die.

[15] MS11xRF3 canola; not listed as approved for import for food, feed and processing.

However, the RNAi pathway is incompletely understood. Evidence suggests that it functions in a much more complex process than developers claim. As such, there is potential for unintended effects to go unacknowledged and undetected. These include "off-target" effects, where additional genes are silenced unintentionally, or silencing of genes in exposed non-target organisms, with possible lethal effects. Off-target effects have been previously detected in the MON87411 GM maize variety grown in the US (Baum et al., 2007). Synthetic interfering RNAs have been shown to have an estimated 10% off-target effects, despite being designed to target specific genes (Qiu, 2005). As such, unintended gene expression changes could lead to new traits that were not intended in the target organism, with potential to impact food safety, e.g., altering the expression levels of allergens or toxins.

Complexities of the RNAi system also raise many uncertainties and risks, for example, the potential to regulate hundreds of genes, potential amplification and inheritance of RNAi effects, and induction of secondary interfering RNA production that may target different genes. There appears to be no simple one-to-one relationship between interfering RNAs and their targets, with some targeting many genes, while one gene can be targeted by many interfering RNAs. RNAi activity is one mediator of epigenetic inheritance and has been shown to induce heritable effects that last up to 80 generations (Heinemann, 2019). RNAi off-target activity also remains unpredictable (Hanning et al., 2013). Such complexities raise the potential for the dysregulation of genes in exposed organisms that may have important agronomic, health or environmental implications.

Key to food safety are growing observations that natural interfering RNAs in plants have been shown to survive digestion in mammals including humans, and may go on to regulate genes in those that have been exposed via consumption (Zhang et al., 2012; Zhou et al., 2015). As such, interfering RNAs have been suggested to act as a type of dietary nutrient (Li et al., 2019; Zhang et al., 2012). The presence of naturally-existing dsRNAs has been detected in human blood and in human breast milk (Li et al., 2019; Zhang et al., 2012).

While certain RNA molecules (such as dsRNAs) have long been understood to function as genetic regulators, their potential to control gene expression in different species, such as animals or humans that have consumed them, called "cross-kingdom regulation", is only beginning to be recognised. These findings challenge a central safety argument presented by the industry that dsRNA molecules are highly unstable and thus not able to survive digestion. How such novel RNAi molecules exert effects on those who consume RNAi crops remains entirely untested.

Research on the mechanisms of herbal plant medicines used in traditional Chinese medicine and other indigenous medical systems suggests that dsRNAs may indeed be able to regulate human genes, potentially underlying some of the health benefits of plant medicines such as ginger and honeysuckle (Zhang et al., 2012; Zhou et al., 2015).

Current risk assessments do not incorporate the specific risk considerations associated with RNAi crops outlined above, risking the safety of the food supply, and are thus outdated. A confident conclusion with regard to the safety of RNAi crops cannot currently be made based on the information being provided to biosafety authorities.

Conclusion

The list of GM crops approved for import for food, feed and processing in Malaysia has ballooned since the first approvals. With the GM industry failing to innovate beyond the dominant traits of herbicide tolerance and insecticidal resistance, such imports are increasingly exposing Malaysian consumers to pesticide residues. This is exacerbated by the domination of traits being "stacked" together such that GM crops now commonly carry a combination of multiple herbicide resistance and insecticidal resistance traits in one product. The approvals of GM crops that include RNAi gene silencing techniques are adding further risks and uncertainties that remain insufficiently assessed.

The current situation in Malaysia exposes key gaps in regulatory oversight that need to be addressed. Holistic assessments are needed for the full spectrum of risks and uncertainties of GM crops, including their associated pesticides, entering the food supply. Moreover, loopholes need to be closed to ensure no GM crops escape regulatory oversight. Until such precautionary measures are put in place to ensure safety and the right to choose not to consume GMOs, no more GM crops for food, feed and processing should be approved.

Table 1. List of GM crops approved for import for food, feed and processing in Malaysia

	Event	Crop	Trait/s*	Developer	Date of decision
1.	**MON4032**	soybean	HT: glyphosate	Monsanto	Decision acknowledged by NBB: 2010
2.	**MON603 (NK603)**	maize	HT: glyphosate	Monsanto	Decision acknowledged by NBB: 2010
3.	**MON810**	maize	IR: Bt (Cry1Ab) & HT: glyphosate	Monsanto	Decision acknowledged by NBB: 2010
4.	**MON863**	maize	IR: Bt (Cry3Bb1)	Monsanto	Decision acknowledged by NBB: 2010
5.	**SYN-BT011-1 (Bt11)**	maize	IR: Bt (Cry1Ab) for lepidoptera	Syngenta	2012
6.	**A2704-12**	soybean	HT: glufosinate	Bayer	2012
7.	**MON89788**	soybean	HT: glyphosate	Monsanto	2012
8	**T25**	maize	HT: glufosinate	Bayer	2013
9.	**TC1507**	maize	HT: glufosinate & IR: Bt (Cry1F) for lepidoptera	DuPont	2013
10.	**BPS-CV127-9**	soybean	HT: imidazolinone	BASF	2013
11.	**A55547-127**	soybean	HT: glufosinate	Bayer	2014
12.	**FG72**	soybean	HT: glyphosate & isoxaflaxole	Bayer	2014
13.	**MON89034**	maize	IR: Bt (Cry1A.105 & Cry2Ab2) for lepidoptera	Monsanto	2015
14.	**MON88017**	maize	HT: glyphosate & IR: Bt (Cry3Bb1) for corn rootworm	Monsanto	2015
15.	**5307**	maize	IR: Bt (eCry3.1Ab) for coleoptera	Syngenta	2016
16.	**MIR604**	maize	IR: Bt (mCry3A) for coleoptera	Syngenta	2016
17.	**MIR162**	maize	IR: Bt (Vip3Aa20) for lepidoptera	Syngenta	2016
18.	**GA21**	maize	HT: glyphosate	Syngenta	2016
19.	**3272**	maize	PQ: altered starch for biofuel processing	Syngenta	2016
20.	**SYHT0H2**	soybean	HT: mesotrione & glufosinate	Syngenta	2016
21.	**DAS-59122-7**	maize	HT: glufosinate & IR: Bt (Cry34Ab1 & Cry35Ab1) for coleoptera	DuPont/Pioneer	2016

22.	**MS8RF3**	canola	HT: glufosinate & AP: male sterility	Bayer	2016
23.	**GHB614**	cotton	HT: glyphosate	Bayer	2017
24.	**T304-40**	cotton	IR: Bt (Cry1Ab) for lepidoptera and budworm	Bayer	2017
25.	**LLCotton25**	cotton	HT: glufosinate	Bayer	2017
26.	**GHB119**	cotton	IR: Bt (Cry2Ae)	Bayer	2017
27.	**305423**	soybean	HT: sulfonylurea	DuPont/Pioneer	2017
28.	**DAS40278**	maize	HT: 2,4-D and certain AOPPs	Dow	2017
29.	**MZHG0JG**	maize	HT: glyphosate & glufosinate	Syngenta	2017
30.	**DAS-8149-2**	soybean	HT: glufosinate & IR: Cry1Ac, Cry1Fv3, Cry1F for lepidoptera	Dow	2017
31.	**DAS-4406-6**	soybean	HT: glyphosate, 2,4-D & glufosinate	Dow	2017
32.	**DAS-68416-4**	soybean	HT: 2,4-D & glufosinate	Dow	2017
33.	**E12**	potato	PQ: dsRNA for reduced acrylamide and FR: dsRNA for blackspot	SPS International	2018
34.	**DP73496**	canola	HT: glyphosate	DuPont/Pioneer	2018
35.	**MZIR098**	maize	HT: glufosinate & IR: Bt (Cry1B.34 & mCry3A) for lepidoptera	Syngenta	2018
36.	**MON87427**	maize	HT: glyphosate	Monsanto	2018
37.	**DP4114**	maize	HT: glufosinate & IR: Bt (Cry1F, Cry34Ab1 & Cry35Ab1) for lepidoptera and coleoptera	DuPont/Pioneer	2018
38.	**Y9**	potato	FR: dsRNA for reduced late blight *P. infestan* & reduced black spot & PQ: dsRNA for reduced acrylamide	Syngenta	2018
39.	**MON87701**	soybean	HT: dicamba	Monsanto	2019
40.	**MON87708**	soybean	HT: dicamba	Monsanto	2019
41.	**GHB811**	cotton	HT: glyphosate & isoxaflaxole	BASF	2020
42.	**MON87411**	maize	IR: Bt (Cry3Bb1) & HT: glyphosate	Monsanto	2020
43.	**MON87460**	maize	AP: DT cold shock protein	Monsanto	2020
44.	**RT73**	canola	HT: glyphosate (N.B. carries both EPSPS and additional GOXv247 gly tolerance transgenes)	Monsanto	2020

45.	**MON87705**	soybean	PQ: dsRNA for altered omega-3 fatty acid content & HT: glyphosate	Monsanto	2020
46.	**X17**	potato	FR: dsRNA for reduced late blight *P. infestan* & reduced black spot & PQ: dsRNA for reduced acrylamide	SPS International	2020
47.	**MON87751**	soybean	IR: Bt (Cry2Ab2 & Cry1A.105) for lepidoptera	Monsanto	2021
48.	**MON87769**	soybean	PQ: altered omega-3 fatty acid content (PjD6D & Nc.Fad3)	Monsanto	2021
49.	**MON87419**	maize	HT: dicamba/glufosinate	Monsanto	2021
50.	**MON 88701**	cotton	HT: dicamba/glufosinate	Monsanto	2021
51.	**H7-1**	sugar beet	HT: glyphosate	Monsanto	2021
52.	**MON88913**	cotton	HT: glyphosate	Monsanto	2021
53.	**MON15985**	cotton	IR: Bt (Cry1Ac & Cry2Ab2)	Monsanto	2022
54.	**J101**	alfalfa	HT: glyphosate	Monsanto	2022
55.	**J163**	alfalfa	HT: glyphosate	Monsanto	2022
56.	**KK179**	alfalfa	PQ: dsRNA (CCOMT) for reduced lignin (to improve feed digestibility)	Monsanto	2022
57.	**DP202216**	maize	AP: increased yield (increased expression of ZMM28 transcription factor) & HT: glufosinate	DuPont	2022
58.	**HB4**	soybean	AP: DT & HT: glufosinate	INDEAR	2023
59.	**MON88302**	canola	HT: glyphosate	Bayer	2023
60.	**MON87429**	maize	HT: dicamba/glufosinate/2,4-D & FOPs, e.g., quizalofop	Bayer	2023
61.	**MON95379**	maize	IR: Bt (cry1Da_7 a & cry1B.868) for lepidoptera	Bayer	2023
62.	**MON88702**	cotton	IR: Bt (Cry51Aa2) for hemipteran and thysanopteran pests	Bayer	2024
63.	**MON94100**	canola	HT: dicamba	Bayer	2024
64.	**GMB151**	soybean	HT: HPPD-inhibiting herbicides/isoxaflutole/ mesotrione & NR: Bt (Cry14Ab-1.b) for nematode parasites	BASF	2024

* HT = herbicide tolerance; IR = insecticidal resistance; FR = fungal resistance; DT = drought tolerance; NR = nematode resistance; PQ = product quality; AP = agronomic properties

Note: The NBB decisions and risk assessments for each approval are available at https://www.biosafety.gov.my/main/article/keputusan-permohonan-pelepasan-lmo-and-produk-lmo

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Genetically Modified Crops in the Malaysian Food System

Approvals for the import into Malaysia of genetically modified (GM) crops for food and feed have increased markedly in recent years. Most of these crops are of the herbicide-tolerant and/or insect-resistant varieties, giving rise to health concerns of exposure to herbicide residues and insecticidal toxins via food consumption. The food safety risks are compounded by the proliferation of varieties "stacked" with multiple tolerance and resistance traits, and by crops developed using RNA interference (RNAi) technology that may pose uncertain, unintended consequences. In light of these serious biosafety issues, this report calls for more comprehensive risk assessments and greater regulatory oversight of GM crops to protect Malaysian consumers. Until such precautionary measures are put in place, GM crops for food, feed and processing should not be approved in Malaysia.

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