

## **GE Food and Agriculture: Safe and Sustainable for Malaysia?**

Public Forum:  
The Genetic Engineering of Rice & Other Crops  
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## **Biotech Malaysia**

- **National Biotechnology Policy 2005**
  - Focus on agriculture sector, health related natural products and bio-generic drugs, bio-processing and bio-manufacturing
  - Establishment of biotech centres of excellence
  - Establishment of Malaysian Biotechnology Corporation
- **Ninth Malaysia Plan (2006-2010)**
  - Biotechnology identified as a major thrust
  - Focus on agriculture biotech, healthcare-related biotech, industrial biotech and bioinformatics

**Table 1: List of plants, traits & processes in transgenic research in Malaysia**

Plant	Trait/Process	
Banana cv Berangan <i>Musa acuminata</i>	Transformation Protocols/ early flowering	Wong W.C <i>et al.</i> (2009), Transgenic Plant Journal (in press)
Banana cv Berangan <i>Musa acuminata</i>	<i>Fusarium</i> resistance	Sreeraman <i>et al.</i> (2006) Scientia Horticulturae , Vol. 108, (4), pp. 378-389
Chilli pepper <i>Capsicum annuum</i> L.	CMV coat protein	Zarina Zainuddin <i>et al.</i> (2002) Malaysian Journal of Science, Vol 21 (1 & 2): 25-30. ISSN 1394-3065
Chilli pepper <i>Capsicum annuum</i>	Development of transformation process	I. Ismail <i>et al.</i> (2005) Malaysian Journal of Biochemistry and Molecular Biology, Vol 12: 1-7 <a href="http://ejum.fsktm.um.edu.my/ArticleInformation.aspx?ArticleID=604">http://ejum.fsktm.um.edu.my/ArticleInformation.aspx?ArticleID=604</a>
Eggplant <i>Solanum melongena</i> L.	Transformation protocol	Z.Ramli (1997) in Abstracts, 5th International Congress of Plant Molecular Biology (no.1414.) ed J.F.D.Dean
Mangosteen <i>Garcinia mangostana</i> L.	Early flowering genes	Summary available at: <a href="http://www.nbbnet.gov.my/research%20project/extra%20summary/Adrain.htm">http://www.nbbnet.gov.my/research%20project/extra%20summary/Adrain.htm</a>
Oil palm <i>Elaeis guineensis</i> Jacq.	Polyhydroxyalkanoates	Abdul Masani Mat Yunus, <i>et al.</i> (2008), Asia Pacific Journal of Molecular Biology & Biotechnology, 16 (1):1-10. <a href="http://www.msmbb.org.my/apjmb/html161/161a.pdf">http://www.msmbb.org.my/apjmb/html161/161a.pdf</a>
Oil palm <i>Elaeis guineensis</i> Jacq.	BT gene	Lee Mei Ping <i>et al.</i> (2006) Electronic Journal of Biotechnology, 9 (2). ISSN 07173458 <a href="http://www.ejbiotechnology.info/content/vol9/issue2/full/3/BIP/index.html">http://www.ejbiotechnology.info/content/vol9/issue2/full/3/BIP/index.html</a>
Oil palm <i>Elaeis guineensis</i> Jacq.	Transformation protocols	Parveez A. (2003) MPOB Information Series MPOB TT No 189 ISSN1511-1871 N.Abdul Majid <i>et al.</i> (2007) Asia Pacific Journal of Molecular Biology & Biotechnology, 15 (1):1-8. <a href="http://www.msmbb.org.my/apjmb/html151/151a.pdf">http://www.msmbb.org.my/apjmb/html151/151a.pdf</a>
Orchid <i>Dendrobium</i> sp.	Transformation Process	Ong, A. <i>et al.</i> (2000) Asia Pacific Journal of Molecular Biology & Biotechnology, 8 (1), pp. 85-94.
Orchid (tulips) <i>Dendrobium, Mokara, Oncidium</i>	Transformation protocols	M.Mahmood <i>et al.</i> Summary available at: <a href="http://www.nbbnet.gov.my/research/list07.htm">http://www.nbbnet.gov.my/research/list07.htm</a>

Papaya <i>Carica papaya</i>	Delayed ripening	ISAAA: "Biotechnology Transfer Projects: Asia, SEA Researchers Target PSRV Resistant and Delayed Ripening Papaya." <a href="http://www.isaaa.org/projects/SEAsia/Papaya.htm">http://www.isaaa.org/projects/SEAsia/Papaya.htm</a>
Papaya <i>Carica papaya</i>	PRSV resistance	Reviewed in Umi K. Abu Bakar <i>et al.</i> (2005) Food Nutr Bull 2005 Dec;26(4):432-5 <a href="http://www.unu.edu/Unupress/food/fnb26-4.pdf">http://www.unu.edu/Unupress/food/fnb26-4.pdf</a>
Pegaga <i>Centenella asiatica</i>	Metabolic Engineering	Z. Abdul Aziz, (accessed Feb 2009) <a href="http://www.ums.edu.my/sst/new_sstjpenyelidikan.htm">http://www.ums.edu.my/sst/new_sstjpenyelidikan.htm</a>
Pineapple <i>Ananas comosus</i>	Resistance to Blackheart disease	ACIAR Project ID:PHT/1999/040 <a href="http://www.aciar.gov.au/project/PHT/1999/040">http://www.aciar.gov.au/project/PHT/1999/040</a>
Rice <i>Oryza sativa</i> L.	Fungal resistance	Zamri Zainal, Summary available at: <a href="http://www.mosti.gov.my/mosti/tech_fund/list technoFund.pdf">http://www.mosti.gov.my/mosti/tech_fund/list technoFund.pdf</a>
Rubber <i>Hevea</i> sp.	Biopharming	K.Arekiaraj (2006) In: International Symposium on Molecular Farming in Plants: Prospect for the Asia Pacific, Abstract available at: <a href="http://msmbb.org.my/apjhome/htm">http://msmbb.org.my/apjhome/htm</a>
Senduduk <i>Melastomataceae</i> sp.	Optimisation of agrobacterium-mediated transformation parameters	Yong, W. T. L., Abdullah, J. O., & Mahmood, M. (2006). Scientia Horticulturae, Vol 109(1): 78-85.
Sweet potato <i>Ipomoea batatas</i>	Transformation protocols/ Vaccine	Report in IHMC, UNIMAS bulletin <a href="http://www.unimas.my/research/ihcm/ihcm_JE.htm">http://www.unimas.my/research/ihcm/ihcm_JE.htm</a>
Teak <i>Tectonis grandis</i>	Biolistic Process (UidA gene)	N. Adnan <i>et al.</i> (2007) Asia Pacific Journal of Molecular Biology and Biotechnology, Vol. 15 (3) : 115-120 <a href="http://www.msmbb.org.my/apjmb/html153/153c.pdf">http://www.msmbb.org.my/apjmb/html153/153c.pdf</a>

## GE research in Malaysia

- MARDI (*source: MARDI powerpoint*)
  - GE papaya (delayed ripening, virus resistance)
  - GE pineapple (blackheart resistance)
  - GE orchids (improved shelf life of flower, colour, virus resistance)
  - GE rice (resistance to floods, drought, high temperatures; *source: <http://www.isaaa.org/kc/cropbiotechupdate/online/default.asp?Date=1/23/2009#3638>*)
  - GE pomelo (improved colour)
  - GE passionfruit (virus resistance)
  - GE chilli (virus resistance)
  - GE mangosteen

## GE research in Malaysia

- Malaysian Palm Oil Board (MPOB)
  - GE oil palm (e.g. high oleate; *source: <http://www.ejbiotechnology.info/content/vol11/issue3/abstract7/index.html>*)
- Malaysian Rubber Board (MRB)
  - GE rubber trees (molecular pharming - human serum albumin, antibodies against tooth decay - *source: <http://myais.fsktm.um.edu.my/3814/>*)
- Forest Research Institute Malaysia (FRIM)
  - GE trees - teak (*source: FRIM newsletter*)

## What's in our food?

- Approved events in Malaysia
  - Roundup Ready soybean for FFP (since 1998)
  - MON 810 Bt maize for FFP
  - NK 603 Roundup Ready maize for FFP
  - MON 863 Bt maize for FFP
  - Ice structuring protein (copy of protein found in fish) expressed in GE yeast, extracted for use in Unilever's ice cream
- Administratively approved
- What about *unapproved* events?

## Potential environmental impacts: Examples

- Transgenic contamination of Mexican maize landraces (Quist & Chapela 2001, Dyer et al. 2009)
  - Mexico centre of origin and diversity of maize -> biodiversity and socio-economic implications
- Gene flow from GM canola in Canada - triple herbicide resistance (Hall et al. 2000)
  - Agronomic/weed problems
- Gene flow to wild relatives from GM rice in China (Lu & Yang 2009)

## Potential environmental impacts: Examples

- Increased use of herbicides in US with herbicide resistant crops due to evolution of weed resistance (Benbrook 2003, 2004)
- Potential harm of Bt corn to aquatic ecosystems, increased mortality and reduced growth in caddisflies, which are food for higher organisms (Royer et al. 2007)
- Reduced fitness and survival of Daphnia when fed Bt corn (Bohn et al. 2008)
- Effect of Bt toxins on non-target organisms e.g. worms (Zwalhen 2005)

## Lack of relevant scientific research on health impacts

- The few studies that have been designed to reveal physiological or pathological differences are extremely few, and they demonstrate quite a worrisome trend (Pryme and Lembecke, 2003):
  - studies performed by the industry find no differences
  - studies from independent research groups reveal differences that should have merited immediate follow-up, confirmation and extension, which has not been the case

## Early warnings

- Rats fed GM potatoes showed changes in stomach and gastrointestinal tract (Ewen and Pusztai 1998)
- GM pea fed to mice elicited immune response, characterised by inflammation of the lungs (Prescott et al. 2005)
- Reanalysis of Monsanto data showed indications of liver/kidney toxicity in rats fed Bt corn MON863 (Seralini et al. 2007)

## Early warnings

- Effects on liver of mice fed RR soya (Malatesta et al. 2008)
- Mice fed GM maize MON 810 x NK603 showed significant negative reproductive effects (Velimirov et al. 2008)
- MON 810 maize induced alterations in intestinal and peripheral immune response of weaning and old mice (Finamore et al. 2008)

## Potential socio-economic impacts

- E.g. Argentina - GM soya has displaced local food crops and caused food insecurity, led to health problems due to herbicide use, displaced local communities from their lands
- E.g. India - Bt cotton failures, more pests, high costs of seeds, farmers increasingly in debt and desperate, protests in AP
- E.g. Indonesia - Bt cotton failed, farmers went into debt as Monsanto charged more for the seed in subsequent year, burnt crops

## Potential socio-economic impacts

- GMO contamination of conventional and organic crops
  - Loss of markets, loss of organic certification
  - Contamination with unapproved varieties - Starlink, Bt 10, LL601 rice
- IPR issues
- Impacts on farmers' rights to save seeds - GURTs/Terminator technology
- Ethical and moral issues
  - E.g. use of human genes in rice

## Precaution as the basis for regulation

- Lack of scientific certainty does not prevent one from taking action to prevent or mitigate potential adverse impacts, e.g. to ban, restrict, place conditions, etc. on GMOs
- Scientific uncertainty due to insufficient relevant scientific information and knowledge regarding the extent of the potential adverse effects

## Biosafety regulation in Malaysia

- Malaysia became a Party to the Cartagena Protocol on Biosafety on 3rd December 2003
- Biosafety Act 2007
- Implementing regulations include for:
  - Approval for import and release activities
  - Notification for contained use, import for contained use, export
  - GM food labelling (MOH)

## Some challenges ahead

- Implementation of the Act
  - Regulations currently being drafted
  - Will the Act be truly protective?
- Capacity building needed
  - How to do risk assessments?
- What avenue for public participation?
- Implementing mandatory labelling
- Gaps e.g. liability and redress

[www.biosafety-info.net](http://www.biosafety-info.net)

Thank you!