Golden Rice: The Corporate Push and Civil Society Opposition in the Philippines

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History of Golden Rice and its Low and Unreliable Level of β-Carotene

- Developments started from 1991 to 2000

  Golden Rice = 1.6μg/g of β-carotene

- Golden Rice 1 (GR1, 2004) = 8 μg/g
- Golden Rice 2 (GR2, 2005) = 36.7μg/g, corn as source of genes
- Golden Rice 2E1 (GR2, 2016) = **3.57μg/g** (1.96 – 7.31 μg/g); varies with location and growing season (PSB Rc82)

Golden Rice in the Philippines

- 2011: confined trial (PhilRice)
- 2012: 4 trials in Luzon; (*declared finished)*
- June 2013: Secret field trials; Aug 8, 2013: Uprooted in Camarines Sur (Philippines)
- Feb 2014: IRRI declared that yield of GR2 is low; needed to improve agronomic trait
- Crossed GR2E with PSB Rc82
- 2015-2016: Confined field trials
- Dec 10, 2019: approved for direct use FFP
- Currently under multi-location testing

Bicolano farmers, led by Peasant Movement in Bikol (KMB) and an alliance SIKWAL-GMO, uproot the Golden Rice plants, today, August 8, 2013. In a dialogue with farmers last February 5, 2013, the local Department of Agriculture (DA) office promised the farmers that they will not conduct anymore field trials and to furnish them results of the completed field trials which ended last January 2013. – *Photo by Sikwal-Gmo*

Bill & Melinda Gates Foundation Grants to IRRI to develop Golden Rice

YEAR	Amount of Grant (US $)	Purpose of Project
2010 to 2017	**10,287,784**	to address the problem of Vitamin A deficiency among millions of people in the Philippines and Bangladesh (83 mo.)
2017 to 2022	**18,000,000**	to develop Golden rice until commercialization stage in Bangladesh and the Philippines (63 mo.)

Golden Rice next steps

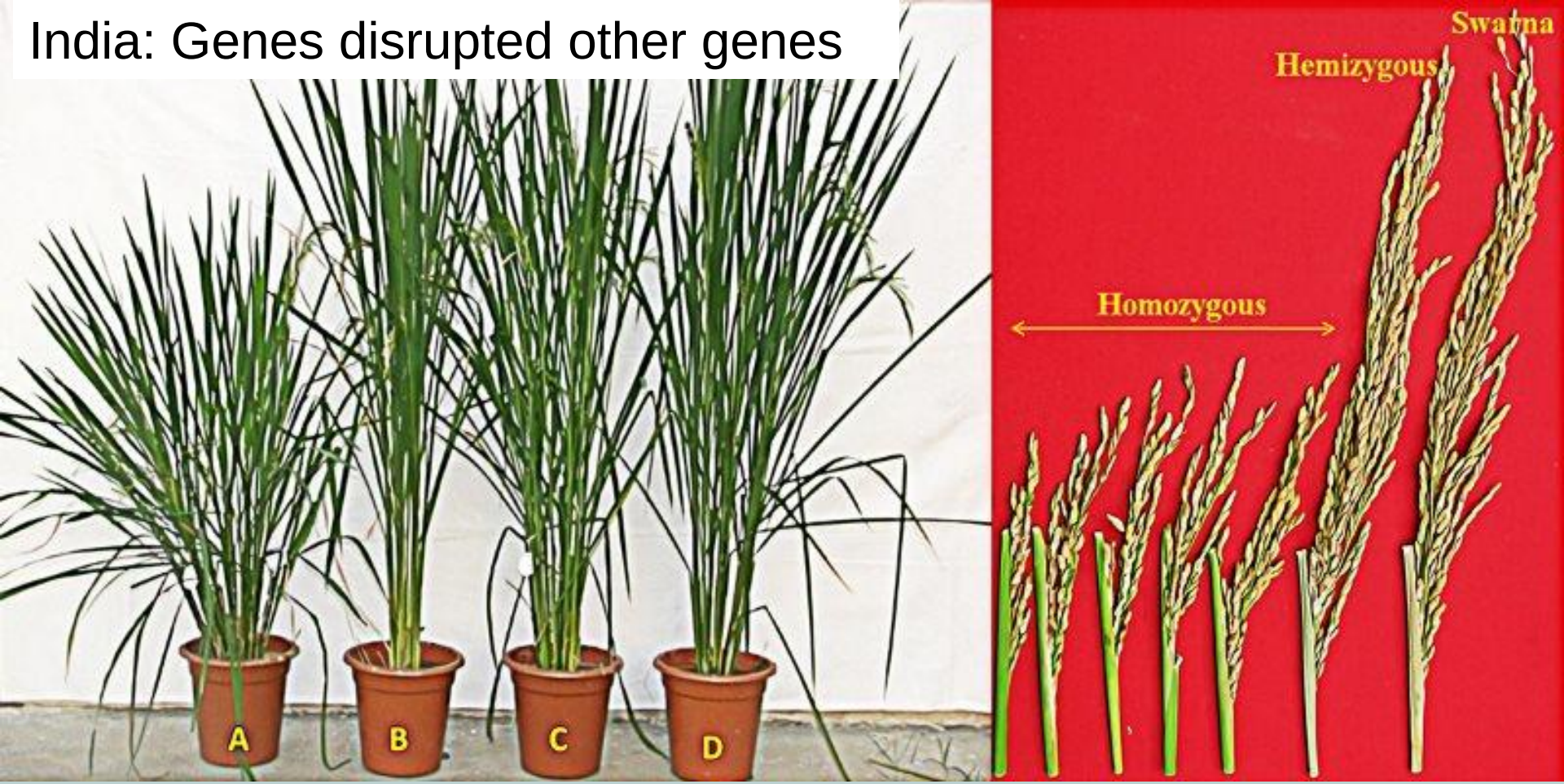
- Approved for Direct use for food, feed and processing, Dec 10, 2019 (*most data submitted are unpublished and confidential; health impact assessment 44 out of 48 questions answered* ***not applicable or NA***)

NOTE: ***regulatory process as a GMO is over.***

- Multi-location testing in 7 locations

  (for varietal registration)
- Feeding test (sensory testing only)
- Commercial release

India: Genes disrupted other genes



Golden Rice Hybrid in India had reduced chlorophyll in leaves and consequently fewer grains and lower yield (2017).

Bollinedi H, S. GK, Prabhu KV, Singh NK, Mishra S, et al. (2017) Molecular and Functional Characterization of GR2-R1 Event Based Backcross Derived Lines of Golden Rice in the Genetic Background of a Mega Rice Variety Swarna. PLOS ONE 12(1): e0169600. doi:10.1371/journal.pone.0169600
http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0169600

Bangladeshi version of Golden Rice line (GR2E BRRI dhan29)

First field trial in 2016; Rice grains ave. of 10 µg/g beta carotene

-Bangladesh Rice Research Institute (BRRI)

Possible Health Effects of Golden Rice

- Incomplete information on basic molecular genetics, biological or biochemical properties, stability (pleiotropy concerns)
- Not tested pre-clinically to animals
- Not subjected to any other safety assessment (toxicity, allergenicity, etc.)

Beta Carotene Degradation

- Degradation after 6 months storage
  - = **80-84%** @ 25^{o}C (in plastic, w/ air)
  - = **68-79%** @ 4 ^{o}C
  - >>> 46% degraded @Vacuum pack (Palay)

- After cooking
  - = **24%** degraded

Bollinedi et al. 2019. Food Chemistry. 278:773-779.
Schaub et al., 2017. J. of Ag. and Food Chem. 65

Computing available Beta Carotene

*Fresh and raw Golden Rice = **3.57** ug/g*

⬇ 1. β-carotene after storage (3 months)

=> 3.57ug/g x .6 = **2.14** ug/g

⬇ 2. β-carotene after cooking

=> 2.14 ug/g x .76 = **1.63** ug/g

⬇ ⬇ When eaten w/out fats

=> 1.63 ug/g x ? = ? Absorbed β-carotene

How Much Vitamin A is needed?

- Children = 250 Retinol Activity Equivalent (RAE)
- Adults = 500-700 RAE

Conversion from *β*-Carotene to Retinol:

➤➤ 12 *β*-Carotene = 1 Retinol

Per Capita rice consumption = .33kg/day

Weight increase in cooking = 2.4 units

>>> 0.8 kg cooked rice/day

Rice needed to get Vitamin A

(assuming all is absorbed; 3 mo storage and cooked)

Child:

- 250 *u*g x 12 CF / 1.63*u*g/g = 1,840.5 g rice/day uncooked or (**4,417 g cooked rice/d**)

With Normal rice eating:

- 0.33kg/1.84 x 100 = **18%** vitamin A derived from normal volume of rice consumption/day

Approved in non-Rice eating countries to pressure Philippines

- Feb. 2018 – *approved* by Food Standards Australia New Zealand (FSANZ)
- March 2018 – *approved* by Health Canada
- May 25, 2018 –IRRI no intention of growing GR2E rice in US; IRRI responsible to ensure that their products are safe; US FDA had no further questions to IRRI *(=approved)*

Golden Rice lacks nutritional Benefit

>>Golden rice does not meet the nutritional requirements to make a health claim, as the concentration of beta-carotene is too low

US Food and Drug Administration (2018) letter to the International Rice Research Institute (IRRI)

What is the real objective of pushing Golden rice?

- To soften resistance against GMOs and pave the ways for the acceptability of GMOs in the long term
- Will lead to control of seed, agriculture and food by Biotech companies through GMOs and patenting of seeds

Strategies of GMO Corporate Lobby

- *Golden Rice recast image of biotech corporations as philanthropic and humanitarian* (Golden Rice Humanitarian Board)
- *"The debate is over, GMOs are safe"; after a billion of meals served, no adverse health effects*
- *"Stopping golden rice is a crime against humanity"*

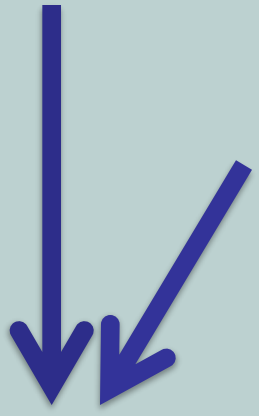
The Biotech companies should be charged of CRIME AGAINST HUMANITY

- For contamination and erosion of biodiversity
- For making rice (staple food of 60 % global population) into a risky, potentially toxic food
- For selling seeds and food without adequate safety testing

>> they sabotaged food, agriculture and nature

Unmasking the players in Golden Rice:

Syngenta owner of Golden Rice



Bill and Melinda Gates Foundation

donated $10.3M+$18M to IRRI for field testing and commercialization (Bill Gates used to own $24M stocks in Monsanto)

IRRI – to project an image of neutral research

PhilRice – to appear as national research

Current Status of Golden Rice in Philippines

1) Biosafety Permit for Field Trial (PhilRice) (agronomic data) – *approved*

2) Biosafety Permit for Direct Use as Food and Feed, or for Processing (PhilRice and IRRI)

-approved on Dec 10, 2019

>> Almost all data submitted are dossier (unpublished) and confidential

>>>> expected to be released by 2022

Where is Golden Rice now?

Field Trials for Varietal Registration

Practical Strategies to Combat VAD

- **Dietary diversification**
- **Food fortification**
- **Supplementation**

  -a teaspoonful of red palm oil per day can meet the Vitamin A requirements of a child

  -two tablespoonfuls of carrot can supply the daily needs of β-carotene for an adult

Natural Food as Alternative are so many:

Some food with high levels of β-carotene

Food Source	**β-carotene Content (μg/g)**
Golden rice GR2E	3.57 (1.96-7.31)
Moringa oleifera	67.8 (19 x)
Corchorus olitorius	118 (33 x)
Basella alba	38.34 (10.7 x)
Ipomea aquatica (water cabbage)	24 – 60 (6.7 – 16.8 x)
Colocasia esculenta	29 (8 x)
Squash	46.8 (13 x)
Tomato	10.2 (2.8 x)
Sweet potato (orange tuber variety)	200 (56 x)
Momordica cochinchinensis (Gac fruit)	497 (139 x)

Other food with high levels of β-carotene

Food Source	**β-carotene Content *(μg/g)***
Golden Rice GR2E	3.57 (1.96-7.31)
Carrots	46 – 125 (24x)
Leafy vegetables	10 – 444 (2.8 – 124x)
Sweet potato leaves	11.4 (3.2x)
Coriander leaves	11.6 (3.2x)
Curry leaves	13.3 (3.7x)
Amaranth leaves	2.66 – 11.6
Cantaloupe	20.2 (5.6x)
Mango	4.4
Palm oil	92.8 (26x)
Liver (goat, sheep)	66 – 100 (18 - 28x)
Cod liver oil	100 – 1,000
*Dunaleilla salina (*algae)	10,000 times of carrots

Do we need hi-tech solution to solve Vitamin A Deficiency?

- β-Carotene-rich orange-fleshed sweet potato improves the vitamin A status of primary school children assessed with the modified-relative-dose-response-test. *Van Jaarsveld, PJ, M Faber, SA Tanumihardjo, P Nestel, CJ Lombard, and AJ Spinnler-Bernade. 2005. Am J Clin Nutr: 81:1080-1087*

- Tried and tested remedies for Vitamin A Deficiency have already "averted an estimated 1.25M deaths since 1998 in 40 countries" - World Health Organization

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What Shall We Do Now?

- We are now at the stage where consumers should be the active opponents of GR
- We need to develop strategies to counter mass production of GR
- We need to organize/develop/support local groups in opposing GR
- Lobby LGUs to make ordinance banning GR
- We need to stop GR now (most effective is **WRIT OF KALIKASAN**)

>>> Stop Golden Rice Network Asia to make multi-pronged campaign

Maraming Salamat.

(Thank you for your attention)