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Briefing
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'Golden Rice', Patents and Vitamin A Deficiency

Excerpt from "Hungry Corporations - transnational biotech companies colonise the food chain",
by Helena Paul and Ricarda Steinbrecher with Devlin Kuyek and Lucy Michaels, Zed Books, London, October 2003 (ISBN 184277 3011)

'Golden Rice' first caught the headlines in 2000. Genetically engineered with 3 genes from daffodils and bacteria, this GM rice has been designed to produce pro-vitamin A. Claimed by GM proponents and biotech industry as the answer to vitamin A deficiency (VAD), others see it as a diversion from relatively low-cost, but effective, initiatives, which can help people to achieve a better diet almost immediately. Furthermore, the experience of Southern farmers is that intensive rice production with the use of high chemical inputs ended their integrated farming systems. Such systems included other food sources such as fish, snails, water fowl and green leafy vegetables to provide a wide range of essential nutrients including (pro)vitamin A. 'Golden Rice' has still not been tested for environmental or food safety nor assessed for socio-economic impacts.

Vitamin A deficiency (VAD) affects 100–140 million children worldwide and causes 250,000–500,000 vitamin-A-deficient children to become blind every year, half of them dying within 12 months of losing their sight.[95] With its promise to combat VAD, Golden Rice was quickly identified and adopted as the long-awaited saviour for the beleaguered biotech industry. Overnight it became their symbol of genetic engineering's promise.

However, for others Golden Rice symbolises 'application-driven' science with a narrow focus and a top-down approach, characterised by a failure to consider the broader implications of the proposed development. Like the green revolution, it seeks to substitute technical solutions for necessary political and social change. Golden Rice demonstrates the use of patents and the barriers they create, the cost and complexity of dealing with multiple owners of intellectual property, and the use of public relations to persuade the public to accept genetic engineering 'solutions' in general. It also demonstrates the complexity of the relationship between 'independent' research and corporate interests, and provides an example of how publicly funded research can be co-opted by private interests.

In January 2000, an article in *Science* announced the creation of a genetically engineered rice containing pro-vitamin A (beta-carotene).96 As the beta-carotene colours the grain orange, the rice was named Golden Rice. A pre-print of the article was sent to journalists around the world, ensuring global coverage of the news.

Exclusive rights for industry

In May 2000, AstraZeneca (now Syngenta) and Germany-based Greenovation[97] acquired exclusive rights to commercialise Golden Rice. The inventors say that this deal will give poor farmers in developing countries free access to the genetically engineered rice (see above), while allowing the life sciences company to sell it commercially in the developed world: what is called market segregation. Zeneca itself admits that the two-tier system will be hard to police. The Peasant Farmer Movement of the Philippines (Kilusang Magbubukid ng Pilipinas or KMP) made the following statement:

> Why should Zeneca have the right to patent for its own profit the results of publicly funded research? And why should anyone believe that this is for the poor when Zeneca has made it clear that their motive is to make money from the technology in the North?[98]

On 2 June 2000 BIOTHAI, KMP and MASIPAG (Farmer–Scientist Partnership for Development) issued a statement saying moves like Zeneca's 'are clouding the real issues of poverty and control over resources'.99 And Gordon Conway, president of the Rockefeller Foundation, said in an interview:

> I agree … that the public relations uses of Golden Rice have gone too far. The industry's advertisements and the media in general seem to forget that it is a research product that needs considerable further development before it will be available to farmers and consumers.[100]

What lies behind the patent issue?

The research was presented publicly as the work of the independent Zurich based Swiss Federal Institute of Technology, led by Dr Ingo Potrykus, in collaboration with Peter Beyer (University of Freiburg, Germany). Potrykus had spent the last 10 years working on this technology, transferring three genes from daffodils and bacteria into rice. His research was mostly funded by the Rockefeller Foundation and for shorter periods by (amongst others) the European Union, the Swiss Federal Office for Education and Science and (through the contribution to the carotinoid sub-project in the EU Biotech Programme) the company AstraZeneca.[101]

The *Scientist* reported in 2001:

> Potrykus maintained that 'from the beginning' he wanted to make golden rice available free of charge. Still, he couldn't turn his research into a product as a 'freedom-to-operate' study [carried out by ISAAA] revealed that 70 patents belonging to 32 holders covered technology used in the process. He convinced AstraZeneca to help tackle the problem, and together they agreed on a definition of humanitarian use that could circumvent patent obstacles: 'Everything which leads to a less-than-$10,000 annual income to farmers should be considered a humanitarian use,' Potrykus stated. The public/private compact paved the way for patent waivers.[102]

Co-inventor Peter Beyer stated in an interview with the *Hindu* newspaper on 7 November 2002:

> Farmers can produce and sell Golden Rice to the tune of $10,000 a year. But they can only sell it within the country and not export it.

There are at least three issues here. The first is the breeding of Golden Rice transgenes (engineered genes) into local rice varieties – the inventors' preferred option. 'Local varieties' might mean farmers' varieties but, in view of their widespread replacement by high-input varieties, could equally mean varieties like the widely grown IR64 rice developed by the Philippines IRRI. Harmut Meyer of GENET (European NGO Network on genetic Engineering) comments on the potential consequences:

> [E]ach rice variety that carries the Golden Rice transgenes seems to be barred from export by patents and contracts. If that is really true, the Golden Rice story gains a completely new dimension. The celebrated licence agreement in which biotech companies allow the use of patented technology for humanitarian use could have the potential to serve as means to control the rice economy of a whole country. One central demand to the inventors and owners of the Golden Rice is to disclose all licence agreements.

The second issue is potential patent infringement claims arising from unintentional cross-pollination of rice with the Golden Rice transgenes – as has been the case for Canadian farmer Percy Schmeiser, successfully sued by Monsanto for having their patented gene in his oilseed rape crop.

The third is whether the patent dilemma has been exaggerated or used as an excuse to hand all the rights to Syngenta. GRAIN noted that:

> of the 60 countries with Vitamin A deficiency – which Golden Rice is supposed to address – only 25 could possibly honour any of the patents involved. And in these countries, only 11 of the patents could constrain the project locally. Seven of those are held by four transnational corporations (Syngenta, Aventis, Monsanto and DuPont), two of which have expressed their interest to make the technology freely available to the poor. The other patents are held by public institutions. Furthermore, ISAAA's study looked at patent *applications* filed through the World Intellectual Property Office [sic], without confirming whether the patents were actually granted or not in the different countries.103

On the subject of patents Potrykus had strong words: 'So many fields of research are blocked by corporate patents. I had to ignore them or I couldn't move at all.' Scientists should simply break the law, he said. 'What company wants the negative publicity of putting me in jail for fighting poverty?'[104] On a similar note he observed in 2001 that 'industry cannot be expected to be bothered about problems of people and well-being of the poor as its interests are different'.[105]

However, Ingo Potrykus used to work at the Novartis-owned research institute, FMI, and he still has very close connections to this company. According to the Blueridge Institute,

> database research revealed that Ingo Potrykus is named as 'inventor' and thus has interest in 30 plant-related patents, most of them belonging to Novartis [now Syngenta]. The latest Novartis patent with Potrykus as inventor was issued in February 1999 (No. US 5976880). Furthermore Potrykus admits himself that they filed a patent application for the transgenic rice ('before others do it').[106]

Access to vitamin A and other micronutrients

The biotech industry seems to suggest that Golden Rice is the only way to save children from VAD and blindness. So what happened to the natural sources of vitamin A, foods of animal origin such as eggs, dairy products, liver, meat or salt-water fish? The human body also produces vitamin A from pro-vitamin A (beta-carotene), which can be found in many plants, especially in carrots, yellow

cassava, yellow sweet potato, mango and apricots (also in dried form), leafy greens such as spinach, coriander, curry and radish leaves, and, most of all, red palm oil.

The problem is not a lack of foods containing vitamin A and beta-carotene, but a lack of access to these foods. It is 'hidden hunger', including the loss of knowledge about the relation between diet and health, and the consequences of eating only rice. Furthermore, vitamin A and beta-carotene are fat-soluble nutrients and can only be properly absorbed in the presence of oil and other components. Children who suffer from diarrhoea due to dirty water and poor hygiene conditions will not be able to take up or retain nutrients like vitamin A from their food.

Consequently, the most effective international programmes targeting Vitamin A deficiency take into account cultural and economic considerations, with socially based strategies such as dietary diversification, schooling for girls and improved sanitation. In the assessment of the World Health Organisation,

> These strategies will include promoting breast feeding, dietary diversification to increase intake of vitamin A-rich foods, agricultural reform and food fortification. Public health measures to deliver vitamin A supplements, via immunisation programmes, and infection control will also contribute in appropriate situations; for example, the relative importance of each intervention which will be countryspecific. The delivery of vitamin A supplements is intended as a temporary solution to VAD until other more natural methods of raising vitamin A status have been found.[107]

Through existing programmes of food fortification – and without GM crops – VAD figures are already on the decline.

Food-based projects are in progress across Africa and South-east Asia. In Bangladesh, for example, families were helped by the FAO and others to grow vitamin-rich vegetables and fruits in small home gardens or vines up the sides of their houses, and to plant beans, pumpkins and bottle gourds in the vines – all of these have leaves which are commonly eaten. Health conditions improved and it was shown that small plots of land are enough to provide sufficient vitamin A. Scientific evaluation also showed that the uptake of pro-vitamin A (beta-carotene) increased with the number of varieties of vegetable and fruit eaten by a person, independently of the quantity eaten.[108] The highest levels of pro-vitamin A are found in natural food items such as the livers of animals, carrots, red palm oil, and certain green vegetables and fruits. Most palm oil has the red colour removed from it for marketing purposes, but this also removes the pro-vitamin A. Palm oil is used throughout Asia and Africa. Leaving palm oil with its original red colour and persuading people to cook with it might be a far more useful action than trying to persuade them to accept Golden Rice.

Given all the above, the glow of Golden Rice fades rapidly, not least because Golden Rice is a single-nutrient, single-plant approach. But there are other reasons for the gold to tarnish.

What has Golden Rice to offer?

Golden Rice does not exist yet in any usable form. First, pro-vitamin A is in the 'wrong' type of rice and still needs to be crossbred into varieties grown or consumed in the VAD-affected countries – this is probably the smallest of the hurdles. Second, no safety tests have yet been performed, either for human and animal consumption, or for impacts on the environment and biodiversity. Such crucial tests will take at least four years once the right variety has been developed. Third, no tests have been conducted to find out whether the beta-carotene present in Golden Rice can be absorbed when eaten and converted into Vitamin A. There is still a lack of understanding of the factors influencing this conversion and recent scientific data suggest that the conversion ratio is not 6:1, as previously thought, but rather 12:1 or even 21:1. This means that 6–21 micrograms of beta-carotene are needed to produce 1 microgram of vitamin A.

Another serious problem was first pointed out by Vandana Shiva:[109] could Golden Rice, in its current or its planned form, provide the amount of beta-carotene needed to achieve the recommended daily allowance of 400 (children aged 1–3) to 1,000 (males of 11 years and upwards) micrograms of vitamin A?[110] Whilst the current Golden Rice produces less than 1.6 micrograms of beta-carotene per gram of rice, the inventors of the pro-vitamin A rice stated that their ultimate goal was to achieve a rice that produces 2 micrograms per gram.[111] One hundred grams of rice would thus contain enough beta-carotene to produce 9.5 micrograms of vitamin A or 33.3 micrograms at best, using the old conversion ratio of 6:1 (see above). A small child would thus have to eat 1.2 to 4.2 kg of uncooked rice per day, which swells to 3.6–12.6 kg when cooked, which no child aged between 1 and 3 years could possibly do.

In comparison, one carrot, whether eaten cooked or raw, will cover the whole daily requirement, and 100–200 grams of spinach, dandelion, kale, coriander leaf or amaranth will suffice, especially when a few drops of red palm oil are added.

Golden Rice thus stands accused of being either a fraud or an intentional diversion from relatively low-cost but effective initiatives that can help people to achieve a better diet almost immediately. Furthermore, the experience of Southern farmers is

that intensive rice production with the use of high chemical inputs ended their integrated farming systems that included other food sources such as fish, snails, water fowl and green leafy vegetables to provide a wide range of essential nutrients, including vitamin A.

Meanwhile, new breeds of vitamin A-rich grains have been announced, namely millet (Golden Millet – ICRISAT)[112] and rice (Dream Rice – IRRI),[113] neither of which has been genetically engineered. Even so, as with Golden Rice, those grains cannot answer the problem of hidden hunger and malnutrition, which need a far more integrated solution.

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