

## Letters to the Bill and Melinda Gates foundation and Rockefeller foundation

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Dear Sir/ Madam,

I am a plant physiologist working at the University of Milan. I have been involved with molecular biology since the beginning of my university studies around 25 years ago and with plant biology and biotechnology since I moved to the University of Milan 15 years ago. I spent my life reading, researching and teaching these subjects.

It is with this background that I am writing to you after reading with great dismay the letter and the report (1) Greenpeace and Foodwatch addressed to you questioning the Golden rice project and the support your respective foundations give to it. In the letter they state that

"Even trivial technical data on how much carotenoid content remains in the rice after it has been stored and cooked have not been published. [--] However, such findings are highly relevant for assessing the technical quality of genetically modified rice." And also that "In addition, possible risks have been largely ignored. Issues such as out-crossing and the creation of new health risks are hardly taken on by the project managers and to date no test results have been published. However, there are strong indications that genetically modified rice can spread uncontrolled when it crosses with wild strains of rice."

Let me comment on the first statement. There is plenty of evidence that different tomato varieties contain varying amount of the different carotenoids. Classical mutants also show great changes in carotenoid composition (2). This can be easily appreciated for instance when the fruit colour changes from red to yellow, as it happens for instance with some varieties (3).

In this case it is clear that the red conferring compound (lycopene) has been quantitatively converted to other yellow carotenoids (e.g. beta carotene). Around 2,000 crop varieties produced by mutation breeding are distributed, cultivated and consumed with minimal or no oversight from regulatory authorities. The changes observed in the varieties mentioned above are the result of changes in gene structure or expression, usually far wider than those occurring in transgenes (4-6), that are reflected upon metabolite composition.

In other words they are truly genetically modified, even though this term is solely applied to plants obtained through the more precise and predictable technology of genetic engineering. The implication is that every objection raised against genetically engineered (GE) plants must also be applied to any other plant with new traits, irrespective of the method used to generate them. In many years of study and reflection I could not identify any risk specifically connected to GE plants and I am comforted in this by a statement undersigned by several thousands scientists (7). Rather, what is relevant in terms of risk is the specific trait being selected for and the plant bearing it. In other words is the product not the process that matters. It is obvious, in theory, that any novel variety with an altered composition could create new health risks.

Let me comment now on the second statement quoted above. Cultivated plants did not exist forever, but were created by humans along with agriculture. Wild species were 'domesticated' by continuous selection by primitive farmers. The traits selected were

obviously beneficial to humans, such as loss of shattering (hampering spontaneous seed dispersal), reduction of toxin content, reduced seed dormancy, increased seed or fruit weight, fruit taste and nutrient content, just to name the most obvious ones. These novel traits fixed by human selection in crop plants were the result of spontaneous mutations, but which equally spontaneously would be wiped out by natural selection if not propagated by farmers. Cultivated plants are unfit for survival in natural environments. This has been investigated by scientists, but it is the very basic experience of every farmer at any latitude. Crops are rapidly taken over by weeds or destroyed by pathogens and pests. If crop plants were invasive and resilient as weeds, agriculture would not be a problem or a pain to many farmers.

There are several statements in Greenpeace's report (1) or presentation document (8) that are grossly inaccurate and witness a flawed idea of farming. For instance: i) "--genetically modified rice can spread uncontrolled when it crosses with wild strains of rice" ii) "--there are plants outside of fields that are potential partners for crossing, such as strains of wild rice and weedy rice." iii) "If this weed crosses with normal rice in the fields, it can lead to huge losses in the harvest." iv) "--plants that grow from crossing GM rice and weedy rice varieties exhibit surprising characteristics - their rate of reproduction seems be higher due to changes in flowering and seeding patterns. This gives them an advantage over other plants and they can assert themselves more strongly in the environment than normal members of the same species."

The report and the document play extensively on the meaning of the word environment. They interpret it as the environment at large, but truth is that weedy (also known as feral or red) rice is a problem only in agricultural environment, not in the wild, and yield losses are due to the fact that weedy rice competes with the crop, not to crossing (9).

Moreover, wild rice is a minor problem. Even if crossing occurs with weedy or wild rice, the resulting hybrid will not be more invasive than weedy rice, particularly outside of fields. Suggesting a scenario where "outcrossings with GM rice will significantly aggravate the spread of weedy rice" or that the hybrid will "exhibit surprising characteristics" or show "improved fitness (increased rate of reproduction)" disregards the fact that every GE rice must be examined on its own. In certain cases, e.g. herbicide resistant GE rice, the crossing may allow transfer of the resistance trait to weedy or wild rice, but this is, again, a problem in an agricultural setting, where herbicides are being used, not in the wild.

Secondly, there has been and there is no criticism whatsoever by the same organizations over the introduction of herbicide resistant varieties, such as Clearfield rice (10), which pose exactly the same risk in agricultural terms that Greenpeace claims as the GE herbicide tolerant counterparts mentioned above and a definitely higher risk than golden rice. The reason for this double standard is that Clearfield rice is not GE. Indeed the herbicide resistance gene from the non-transgenic Clearfield rice rapidly appeared in weedy rice due to outcrossing (9). On the contrary, genetic engineering, using technologies that mitigate gene flow, is believed to allow a more efficient management of weed weedy rice and prevent resistance to herbicides (11). Third, carotenoid accumulation occurring in golden rice does not bring any foreseeable advantage either in the wild or in the field. The only advantage is to humans consuming it.

Indeed, Greenpeace's document is unable to provide details about the 'strong indications' of the claimed uncontrolled spread. The only reference is to a Chinese research presented at the 'International Biosafety Workshop' in Beijing (September 2008) generalized to all GE

varieties, without details about the researchers or about the content. A tenet of scientific enquiry is the humble submission of theories and results to the judgement of the competent scientific circles firstly and mainly through the process of anonymous peer review adopted by scientific journals and granting bodies. Criticising the golden rice project on the basis of unpublished research is the symptom of an ideological attitude.

The fact that Greenpeace singles out Golden rice as a target for their campaign implies not only that they ignore the basics of gene technology and breeding, but they have a complete lack of connection with the real world of agriculture and farming. Being forced to raise their own food might bring them back (always too late, I am afraid) to reality. Their attitude can only be described as a total disregard for human suffering. If they were really interested in the diets of poor people they would fund some research, but they seem to be interested only in preventing this safe technology to be delivered to poor farmers. Truth is that Greenpeace and their allies are in a corner after so many years spreading lies and raising fears about risks never proved. I hope this is their last attempt. Indeed, "the campaign against genetically modified rice is at the crossroads".

For the reasons stated above I urge you not to withdraw any support to the Golden rice project, but rather to provide even more support to this and other research efforts involving plant biotechnology and breeding for developing countries.

I remain completely at your disposal should you require any clarification, any of the cited literature or other information on these matters. I could name several tens of esteemed colleagues from universities and public research centres worldwide in support of my position.

Please, accept my best regards together with gratitude for supporting the golden rice project so far.

Yours sincerely,

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1) [http://www.foodwatch.de/english/golden\\_rice/index\\_ger.html](http://www.foodwatch.de/english/golden_rice/index_ger.html)

2) For examples of classical mutation or transgene affecting carotenoids, see: Long et al., (2007) Metabolite profiling of carotenoid and phenolic pathways in mutant and transgenic lines of tomato: Identification of a high antioxidant fruit line *Phytochemistry* 67:1750-1757. See also: Fraser et al., (2007) Metabolite profiling of plant carotenoids using the matrix-assisted laser desorption ionization time-of-flight mass spectrometry. *Plant J.* 49:552-64.

3) For some yellow tomato varieties developed by S. Arrenger, a British breeder in Italy, see: [http://www.riviste.provincia.tn.it/PPW/TerraTre.nsf/0/8DB89E22F35A0297C125749E004983B2/\\$FILE/10pomodori.pdf?OpenElement](http://www.riviste.provincia.tn.it/PPW/TerraTre.nsf/0/8DB89E22F35A0297C125749E004983B2/$FILE/10pomodori.pdf?OpenElement)

4) Batista et al., (2008) Microarray analyses reveal that plant mutagenesis may induce more transcriptomic changes than transgene insertion. *Proceedings of the National Academy of Sciences of the United States of America*, 105:3640-3645 <http://www.botanischergarten.ch/Genomics/Batista-Microarray-Analysis-2008.pdf>

5) Baudo et al., (2006) Transgenesis has less impact on the transcriptome of wheat grain than conventional breeding. *Plant Biotechnology Journal*, 4:369-380 <http://www.botanischergarten.ch/Organic/Baudo-Impact-2006.pdf>

- 6) Shewry et al., (2007) Are GM and conventionally bred cereals really different? Trends in Food Science & Technology 18:201-209  
<http://www.botanischergarten.ch/Wheat/Shewry-Are-GM-Convent-Cereals-different-007.pdf>
- 7) AgBioWorld statement subscribed by 3400 academic and professionals including 25 Nobel prize winners: <http://www.agbioworld.org/declaration/petition/petition.php>
- 8) Foodwatch webpage: [http://www.foodwatch.de/english/golden\\_rice/index\\_ger.html](http://www.foodwatch.de/english/golden_rice/index_ger.html)
- 9) Valverde BE, The damage by weedy rice - can feral rice remain undetected?, in Crop Fertility and Volunteerism, ed. by Gressel J. CRC Press, Boca Raton, FL, pp. 279-294 (2005).
- 10) <http://agproducts.basf.us/products/Clearfield-Rice/Clearfield-Rice.asp>
- 11) Gressel and Valverde (2009) A strategy to provide long-term control of weedy rice while mitigating herbicide resistance transgene flow, and its potential use for other crops with related weeds. Pest Manag Sci vol. 65 (in press).