con Golden Rice Handout

- The gut does not absorb β-carotene efficiently. According to dietary reference guides, only one molecule of β-carotene is absorbed for every 12 consumed. If this is true in Golden Rice, it means that a woman would need to consume 5.25 kg of uncooked Golden Rice (GR1) every day to meet daily vitamin A requirements (U.S. NASIM, 2006).
- Golden Rice 2 (GR2) produces 23× more β-carotene than GR1 and contains sufficient quantities of β-carotene to meet the nutritional requirements for a person. However, no study has yet investigated how this chemical will fare through the steps of rice preparation (milling, storing, cooking, etc.) (Krawinkel, 2007; Glenn, 2008; Enserink, 2008). β-carotene may be degraded by these steps.
- "Although a GMO approach is straightforward in theory, past experience has shown that there is often a trade-off in cereals, where enhanced protein levels can lead to diminished yields or to alterations in other nutritional or grain quality components" (Sun et al., 2003).
- Dietary fats and zinc are needed for the absorption of β-carotene and synthesis of vitamin A. Since these nutrients are limited in rice-eating countries, the absorption of β-carotene from Golden Rice will probably be less than optimal (Jayarajan et al., 1980; WHO, 1998; Dawe et al., 2002; Grain, 2008).
- "Cultivated rice could outcross with its wild and weedy relatives and thus the Golden Rice could possibly lead to genetic contamination of wild rice; this is not reversible […] and brings with it economic and environmental problems" (Liu, 2006).
- It may be difficult to cross Golden Rice with local varieties of rice and preserve the β-carotene trait since many genes are necessary for its production and could be lost during the crossing.
- Cultivation of Golden Rice in many fields across the world will reduce the genetic diversity of rice. Genetic diversity is our insurance against environmental stressors such as parasites and temperature variations. If these stressors occur and wipe out a specific strain of rice, other strains might prove resistant. However, if all the rice in the world is the same, all rice could be wiped out by the stressor.
- Transferring genes between species is undesirable and can lead to allergic reactions. There is a report of people being allergic to GM soybean into which Brazilian nut DNA had been incorporated (Nordlee et al., 1996). Similarly, the gene for a protein capable of killing a common pest of the bean was inserted into pea DNA. The chemical structure of this protein was subtly altered in the new organism and found to cause allergic reactions in mice (Prescott et al., 2005). Since genes from several organisms were inserted into Golden Rice, people with pre-existing allergies to these organisms may also be allergic to Golden Rice (and would eat Golden Rice without knowing the dangers).
- The vitamin A gene in Golden Rice comes from daffodil (Ye et al., 2000). However, rice already makes vitamin A in its husk (the husk is not digestible and is removed before consumption). It should be possible to force the rice vitamin A gene to be expressed in the grain. This would prevent the incorporation of a transgene from another organism.
- Adding the β-carotene genes to local rice varieties will change the color of the rice. "This can give rise to objections in some regions […] It is possible to change people's preferences for color, but it is an arduous process requiring close contact with customers and education measures" (Mayer, 2007).
- As a consequence of choosing a GMO approach to address vitamin A deficiency, "regulatory approval must be sought on a country-by-country basis and will involve the completion of regulatory dossiers

as required by national legislation" (Mayer, 2007). "Present regulatory regimes have made the approval process for transgenic crops prohibitively expensive. Compliance costs in a country like India may amount to $5 million" (Mayer, 2007; see also Pohl Nielsen & Anderson, 2003).

- GMO opponents see Golden Rice as a public relations or marketing ploy to ease public concerns about GMOs, secure positive media coverage, and render this technology more acceptable. It is seen as "a 'Trojan horse' that may open the route for other GMO applications" (Potrykus, 2001).
- Golden Rice might interfere with existing vitamin A supplementation and fortification programs and campaigns (Krawinkel, 2007).
- "The Green Revolution of the 1960s and 70s replaced diverse cropping systems with monocultures of new wheat and rice varieties […] Monoculture in the fields predictably led to less diverse diets. In India, household consumption of vegetables has decreased 12% over the past two decades. In Thailand, 80% of caloric intake now comes from rice, up from less than 50% before the Green Revolution. An impoverished diet that consists of little else but rice (golden or not) will never provide a solution to world hunger or malnutrition" (Legislative Assembly for the Australian Capital Territory, 2004; see also Baggott, 2006).
- The biotechnology firm Syngenta owns the rights to Golden Rice for commercialization.
- "[While the GR1 rice strain is a product of publicly-funded research], the [GR2] rice strain is entirely a product of Syngenta's corporate R&D funding" ("Reburnishing Golden Rice," 2005).
- Many countries are opposed to the use of GM crops on their land. "EU market access is very important to developing countries. Some like Zimbabwe have banned GM foods (including GM food aid and Golden Rice) due to the fear of being shut out of European markets (Baggott, 2006).
- The humanitarian license governing the use of Golden Rice allows farmers with income less than USD$10,000 to have free access to the grain. However, it only permits these farmers to engage in national (and not international) trade of this rice (Al-Babili & Beyer, 2005). This, and international trade agreements on GMOs, will limit the income potential of the farmers by barring access to certain markets.
- "A 2005 Eurobarometer poll showed that 54% of European consumers find GM food dangerous" (Baggott, 2006; see also Pohl Nielsen & Anderson, 2003).