Amberwaves Special Report:

The First Independent Study of Genetically Engineered LibertyLink Rice

By Dr. Joe Cummins

LibertyLink Rice, the first GM (genetically modified) rice developed in America, was cultivated in Texas in 2001 by Aventis, a large biotech company. However, because of the controversy surrounding StarLink Corn, another one of Aventis's GM products, and its contamination of conventional and organic crops, the company decided to destroy all 5 million pounds of the rice, and it never came to market. Since LibertyLink Rice may be released in the future, Amberwaves, a grassroots organization devoted to preserving natural and organic rice, wheat, and other essential foods, asked Professor Joe Cummins, a Canadian geneticist, to prepare a scientific report on LibertyLink Rice and its possible effects on human health and the environment.

LibertyLink Rice is rice resistant to the herbicide glufosinate (Liberty or Basta); it was produced by the AgrEvro company (which consolidated and is currently Aventis). The United States Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) approved the AgrEvro petition (98-329-01p 26 Jan 2001 found online at (http://www.aphis.usda.gov/biotech/dec_ docs/9832901p_det_ea.HTM) to determine non regulated status for the glufosinate tolerant rice. The APHIS review included a cursory environment assessment concluding that the rice will not harm the environment. The plants will have no plant pathogenic properties,

are not likely to become weeds, will not increase weediness of cultivated or weedy species with which they interbreed, will not harm beneficial organisms nor will they damage agricultural commodities. The genetically modified (GM) rice were obtained by transforming rice varieties M202 and Bengal, respectively, with the bar gene derived from the soil-borne bacterium Streptomyces hygroscopicus. The bar gene encodes phosphinothricin-N-acetyltransferase (PAT), an enzyme which inactivates the herbicide glufosinate ammonium. The bar gene was introduced via a well characterized method that introduces DNA directly without the use of vector agents according to the APHIS report. It is presumed that the cryptic comment means that the rice was transformed using the biolistic (gene gun) method, and APHIS seemed unaware of the viral promoter (CaMV promoter is usually employed), antibiotic resistance gene, and residual bacterial genes from the plasmid used in propagating the genes used in the engineering of the rice. The 18-page APHIS report seemed to have been generated using the bureaucratic rubber stamp. For example, there is clear agreement that the glufosinate tolerance gene will be spread to the weed red rice, but APHIS agrees with AgrEvro that the resistant red rice does not pose a threat because it can be controlled by other herbicides!

Rice is an allotetraploid whose cultivated varieties are relatively current in evolutionary terms (Ge et al 1999). Allotetraploids are made up of two or more diploid chromosome sets combined from grass species to make hybrids. Rice is the world’s most important food crop. GM rice is effected by somaclonal variation—a form of gene and chromosome instability that results from the tissue culture embryos used to propagate GM crops (Labra et al 2001). Somaclonal variation occurs in tissue culture embryos from both normal and GM crops, but the effect is greatest in GM crops. Somaclonal variation is caused by replication of genetic elements called retrotransposons that replicate in the plant cell nucleus and are inserted into structural genes to cause mutation and

chromosome rearrangement (Agrawal et al 2001). The genetic changes activated in producing GM crops may be numerous and subtle and may produce gradual loss in productivity of GM varieties or unexpected toxic plant products. Govermental regulators seem to have been blissfully unaware of such complications. For example, glyphosate resistant soybean cultivars had significantly lower yield than did sister lines which were not genetically modified (Elmorer et al 2001). Regulators should require full and truthful analysis of GM crops.

In conclusion, government regulators appear to be closely allied to the chemical industry giants. USDA engages in commercial enterprises on a grand scale in joining commercial interests to patent numerous genetic engineering techniques including the terminator procedure which benefits only commercial interests and works against farmers who traditionally save seed. USDA and the food and drug administration (FDA) are too closely associated with commercial interests, and such association seems to blind the government agencies to legitimate concerns and clear dangers. Truly independent regulators that are fully protected from industrial and political influences are needed at this time.

Notes on the Teratogenicity of Glufosinate

Glufosinate is a herbicide that kills almost everything green; it is used extensively with genetically engineered crops including corn, canola, and soybeans. The herbicide resistant crops were approved by the Canadian and United States governments, even though there was clear evidence that the herbicide caused birth defects in experimental animals. The chemical acts by causing premature cell death in the immature brain by a process called apotosis. It also prevents development of glutamate channels in the brain, thus disrupting cellular communication. The birth defects observed in animals included brain defects leading to behavioral changes. Cleft lip and skeletal defects or kidney and urethra injury were observed

in treated newborn. The herbicide also caused miscarriage and reduced conception in treated mothers. Exposure of male farm workers caused birth defects in their children.

Glufosinate use may be increased greatly by introduction of liberty link crops such as corn, canola, and soybeans along with commercial rice. The herbicide may also be used as a desiccant prior to grain harvest on crops that are not resistant to glufosinate (such applications are used to mature grains threatened by frost damage). Such applications are undesirable because the microbial activity is reduced at low temperature and more teratogen will enter the surface and groundwater.

References on LibertyLink Rice

Agrawal, G, Yamazaki, M, Kobayashi, M, Hirochika, R, Miyao, A and Hirochika, H "Screening of rice viviparous mutants generated by endogenous retrotransposon Tos17 insertion tagging of a zeaanthin epoxidase4 gene and a novel OsTATC gene" Zool Plant Physiology 125, 1248-57

Elmore, R, Roeth, F, Nelson, L, Shapiro, C, Klein, R, Knezevic, S and Martin, A "Glyphosare resistant soybean cultivars yields compared with sister lines" 2001 Agron J. 93, 408-12

Ge ,S, Sang, T, Lu, B, and Hong, D "Phylogeny of rice genomes with emphasis on origins of allotertraploid species" 1999 Proc. Natnl Acad Sci USA 96, 14400-5

Labra, M. Savini, C, Bracale, M, Pelucchi, N, Columbo, L, Bardini, M and Sala, F "Genomic changes in transgenic rice plants produed by infecting calli with Agrobacterium tumefacians "2001 Plant Cell Reports On line reports DOI 10.1007/s002990100329

References on Glufosinate and Birth Defects

EPA/OTS:Doc #88-920003678

FuJii, T. and Ohata, T. J.Toxicol.Sci. 1994, 19, 328.

Garcia, A., Benavides, F., Fletcher, T. and Orts, E. "Paternal exposure to pesticides and congenital malformations" Scand J Work Environ Health 24, 473-80, 1998)

Watanabe, T. and Iwase, T. Terat.Carcinog. Mutagen 1996, 287, 1996

Watanabe, T. Neurosci Lett. 1997, 222, 17

Watanabe, T. Teratology 1995, 4, 25B

Professor Joe Cummins, professor emeritus of genetics at the University of Western Ontario, is one of the foremost scientists active in the campaign to protect the safety of crops, foods, human health, and the environment. Prior to joining Western in 1972, he taught genetics at Rutgers University and the University of Washington (Seattle) and since 1968 has been involved in a range of environmental issues related to mercury, asbestos, PCBs, pesticides, toxic waste, and genetic engineering. Prof. Cummins is the author of more than 200 scientific and popular articles and has published recently in Nature Biotechnology, The Ecologist, and Biotechnology and Development Review. *He lives in London, Ontario, Canada. His e-mail:* jcummins@uwo.ca

Amberwaves
P.O. Box 487, 305 Brooker Hill Rd., Becket, MA 01223
Te l (413) 623-0012 • Fax (413) 623-6042