01.2012

GM TREE PLANTATION RESEARCH FACT SHEET

Innovative new technologies and informed debate on science-based policy are vital if we are to find a balance between the growing demands and pressures on forests, forest products and the ecosystem services forests provide. GM plantation forestry is a key advance to address these future challenges. To date, classical breeding has greatly improved tree productivity, however, the methods are slow, and breeding programs for valuable traits such as resistance to biotic and abiotic stresses are difficult to implement. Genetic modification of trees offers a direct and rapid approach to tree improvement and also allows the development of traits that would not be possible by conventional means. Given the scale of the problems facing native and managed forests and silviculture in general, we must look at all solving options, especially GM trees.

KEY FACTS:
- Over 800 GM tree field trials conducted worldwide since 1988 for nearly 40 different tree and woody perennial species and nearly 30 GM traits provide a documented history of safe use;
- The bulk of GM traits evaluated have been for environmental benefits and have been carried out by the public sector;
- There is an established track record of risk assessment and supporting documentation. Existing risk assessment guidelines and biosafety protocols established for GM plants are applicable to GM trees;
- There is an established dialogue on appropriate data and safeguards for GM trees;

GM tree field trials:
GM tree field trials of trees (for industrial purposes; fibre, pulp and chemicals), or horticultural trees and woody perennials (for food and fruit production, or industrial products such as wine and oil) are researched and evaluated under the provisions of the national biosafety laws of the countries in which they are developed. GM trees have been evaluated in this way in over 800 field trials since 1988 and detailed information on these trials is readily available on the websites of the national regulatory agencies that evaluate, authorise and monitor GM tree field trials worldwide. There are clear and compelling reasons why existing environmental risk assessment principles can be successfully applied to GM trees and why future trials of GM trees should receive full support:

1. An established track record of risk assessment and supporting documentation
There are a number of existing environmental risk assessments and supporting documentation for environmental risk assessment that are freely available for consultation: In the USA, environmental risk assessments for transgenic trees have been prepared and published by the United States through the U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA/APHIS). In Europe, risk assessments for other tree species have also been performed and published by the European Union. Each report includes details of an assessment of environmental impact and risk management. The OECD's Working Group for Harmonisation of Regulatory Oversight in Biotechnology publishes Biosafety Consensus Documents as part of its core mission to allow sharing of information on key components that member countries believe are relevant to an environmental safety review. The Consensus Documents are a tool for scientists preparing applications for regulatory authorizations; regulators conducting environmental risk assessments for transgenic organisms; and governments promoting public education, research, and information-sharing. The goal is to ensure that countries use common methods to collect consistent information for risk/safety assessments in their development of biotechnology regulations and guidance and that any information relating to the biology of an organism would be the same regardless of what country's regulatory system was involved.

2. History of safe use of transgenic trees in over 800 trials around the world
Over 800 GM tree field trials (including forest trees, fruit trees and woody perennials) have been assessed worldwide since 1988 under existing criteria for transgenic plants, and none of these tests have reported any harm to biodiversity, human health or the environment. This indicates that the fundamental principles of environmental risk assessment are the same and existing frameworks within these countries are sufficiently flexible to manage plants with a wide range of biological characteristics, including trees.

3. An established dialogue on appropriate data and safeguards for GM trees
There have been multiple workshops held to discuss and evaluate how the basic principles of environmental risk assessment and regulatory oversight are applicable to trees. In 2004, the FAO published a report: "Preliminary Review of Biotechnology in Forestry, Including Genetic Modification" which provides statistical information on the extent and patterns of transgenic research and applications to forest trees globally[1]. From April 25 to June 30, 2000, FAO also organized an electronic discussion forum on "How appropriate are currently available biotechnologies for the forestry sector in developing countries?" A summary of the conference and key points is available[2] . The International Union of Forest Research Organisations (IUFRO) recently created a Task Force on Forests and Genetically Modified Trees[3] and issued a Position Statement on the Benefits and Risks of Transgenic Plantations[4].

Recommendations for fur her policy dialogue on GM trees
Given the diversity of traits, species, locations and environments under study, a case-by-case approach to GM tree regulation would seem to be the sensible way to proceed, and this basic approach is officially recognized in the Cartagena Protocol for Biosafety Annex III/6[5].

In their fourth meeting, the Parties to the Cartagena Protocol on Biosafety agreed to establish an Ad Hoc Technical Expert Group (AHTEG) on Risk Assessment and Risk Management to develop modalities for the development of guidance documents on specific aspects of risk assessment of living modified organisms (LMO's), including GM trees[6]. Our recommendations for this debate and elsewhere on the issue of GM tree field trials are:

1. Existing biosafety and regulatory frameworks are adequate and further guidelines are redundant or inappropriate:
The calls for the development of additional risk assessment criteria specifically for GM trees are redundant since the Cartagena Protocol already mandates the general principles to consider for risk assessment and brings together the expertise necessary to determine whether any additional guidance may be necessary. Given the vast experience with understanding the safety of GM trees, environmental risk assessment principles already established for other GM plants are clearly broad and flexible enough to deal with the range of characteristics applied to GM trees. Trees are already being addressed under the Protocol in the work on risk assessment as recognised in article 1(x), and article 1(w) recognises the importance of the Canada-Norway Workshop on Risk Assessment for Emerging Applications of

[1] ftp://ftp.fao.org/docrep/fao/008/ae574e/ae574e00.pdf

[2] http://www.fao.org/Biotech/Conf2.htm

[3] http://www.iufro.org/science/task-forces/genetics/?L=3print%2Fprint%2F

[4] Strauss et al. 1999 Nature Biotechnology 17, 1145

[5] Jaffe, G. Implementing the Cartagena Biosafety Protocol through national biosafety regulatory systems: an analysis of key unresolved issues. Journal of Public Affairs 5, 299 - 311 (2005). Annex III/6 states that under general principles governing risk assessment, "Risk assessment should be carried out on a case-by-case basis. The required information may vary in nature and level of detail from case to case, depending on the living modified organism concerned, its intended use and the likely potential receiving environment."

[6] UNEP/CBD/BS/COP-MOP/4/L.12 Annex 1.(d)(ii)

LMOs. The Canada-Norway workshop report confirms that risk assessment for GM trees should be conducted on a case-by-case basis and that the general methodology for sciencebased risk assessment set forth in the Protocol also applies to GM trees.

2. High-productivity GM tree plantations are needed:

Forests are of vital importance to the world economy, for maintaining and preserving our climate, for biodiversity and for the livelihoods of societies and cultures that depend upon them. Although forests only cover 8% of the planet, they exert a very strong impact on the global carbon cycle, providing 30-60% of the total mitigation capacity needed to reduce the rise in atmospheric carbon over the next 50 years[7]. Deforestation at a rate of 12 million ha per year[8] is a global problem that requires urgent attention, currently accounting for about 30% of greenhouse gas emissions[9]. Presently 242 million hectares of forest are under immediate threat, 96% of which are in Africa, Latin America and South/ South East Asia, with an estimated 127 million people directly affected.

Clearly, steps must be taken to curb the environmental and social impact of the increasing demand for forest trees since global wood consumption is estimated to be at least 3.4 billion m3 per annum[10 11], and this is predicted to increase by 25% between 2007 and 2020.

Plantations are widely regarded as being necessary for sustainable forestry and for alleviating the pressures on native forests. In the last 50 years, carefully managed plantations of elite varieties have become an important global industry, although plantations still only provide about 12% of wood consumed[12]. GM trees will be an important part of modern plantations and efforts to reduce pressures on native forests as industry looks to renewable feedstocks and legislations curbing logging from native forests come into play. China, with an aggressive afforestation and reforestation program provides a valuable reference point for policy dialogue on the economic, social and environmental impact of plantation forestry[13 14], and in particular GM forests. Two key legislations, the 2002 “Law of Desertification Prevention and Control[15]” and the 2003 “Forestry Sector Decision” were implemented to reverse desertification, (a problem that affects 400 million people and 18% of China’s land surface has become sandy[16]) to minimise soil erosion, to accelerate the development of the forestry sector and to protect forest ecosystems. In 2002, Government spending on forestry reached $4.2 billion[17]. In 2002, the Government of China authorised the release of GM poplars and to date, 1.4 million trees have been planted[18], mixed withconventionally bred varieties to provide for integrated pest management. More recently, in 2008, GM poplars engineered to tolerate saline soils were planted for the rehabilitation of saline land. This is an important program in land restoration since in China there are 66.7 million hectares of land affected by high saline and alkaline conditions.

3. Increased support of the public sector research to disperse the benefits of tree biotechnology.

Public sector research institutions have been responsible for the vast bulk of activities to date in the field of tree biotechnology. Advances in in vitro propagation, genomics and genetic transformation have accelerated the development of GM trees in the last 15 years, and at least 33 species of transformed trees have been successfully regenerated to date[19]. Through global collaborative efforts between many public sector institutes, genomic information on major forestry species has increased dramatically in recent years. In Europe for example, the potential for deriving value from this work is large, given the well connected research networks, the commitment of the European Commission to fund tree biotechnology research in its FP7 program towards its 2020 vision[20], the increasing impact of genomics research

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[7] International Panel on Climate Change. Climate Change 2007. The IPCC 4th Assessment Report of the Intergovernmental Panel on Climate Change. (Cambridge University Press, Cambridge, UK, 2007). http://www.ipcc.ch/

[8] Walter, C. & Fenning, T. (2004). Deployment of genetically-engineered trees in plantation forestry – An issue of concern? The science and politics of genetically modified tree plantations. In: Plantation Forest Biotechnology for the 21st Century (Eds. Walter, C., Carson, M., Research Signpost, Kerala, India, 2004), 423-424

[9] International Panel on Climate Change. Climate Change 2007. The IPCC 4th Assessment Report of the Intergovernmental Panel on Climate Change. (Cambridge University Press, Cambridge, UK, 2007). http://www.ipcc.ch/

[10] enning, T.M. & Gershenzon, J (2002). Trends Biotechnol. 20, 291-296

[11] Food and Agriculture Organisation of the United Nations. Global Forest Resources Assessment. (FAO, Rome, 2005). http://www.fao.org/forestry/site/24690/en

[12] http://faostat.fao.org/

[13] Hyde, W.F., Wei, J. and Xu, J. (2008). Environment for Development Discussion Paper EfD DP 08-11

[14] Ewald, D., Hu., J and Yang M (2006). Transgenic forest trees in China. In: Tree transgenesis: Recent Developments, (Eds. Fladung, M., Ewald, D., Springer-Verlag Berlin Heidelberg 2006), 25-45

[15] http://www.adb.org/Projects/PRC_GEF_Partnership/Desertification.pdf

[16] China Statistics Bureau 2004

[17] http://www.forestry.gov.cn

[18] Wang, L., Han, Y. and Hu. J. (2004) Transgenic forest trees for insect resistance. In: Molecular Genetics and Breeding of forest trees. (Eds. Kumar, S., Fladung M. New York: Food Products Press), 243-261

[19] Frankenhuyzen, K.v., Beardmore, T. (2004). Canadian Journal of Forest Research, 34: 1163-1180

[20] http://ec.europa.eu/research/fp7

in trees, and the societal and environmental relevance of the traits under consideration. This work is carried out with a high degree of transparency and of direct relevance to the present debate. As an example, a project supported by the German Federal Ministry of Education and Research through the European research platform “Biosafenet” and sponsored by the European Commission FP6 programme, is producing valuable data on gene flow, the potential for soil detoxification, genetic stability, and possible impacts on harmful fungi.

This database is freely available and serves as a significant resource for debate on these sensitive and hotly debated issues[21]. Global research networks will remain an important vehicle for communicating scientific advances[22] and with a public goods perspective, the public sector is already focussing a large percentage of the trials analyses on such issues as containment of gene flow, stability of transgenes over generations, environmental impact, environmental remediation and conservation.

The focus on public sector research may underlie the reason why so many different tree species of low- or no commercial value are now actively in field trials and why so many traits are under evaluation. There are a number of key beneficiaries of this, including research into crops of relatively low economic importance globally (such as papaya, plum and raspberry), research into trees of no economic value but of conservational importance (such as elm and American chestnut[23]), and programs for phytoremediation of soils polluted by heavy metals or organic contaminants[24]. With significant funds now available for tree research, some should be applied to projects of global significance, such as understanding tropical forest diversity and conservation, and that the focus of future research is not purely focussed on industrial applications of tree biotechnology.

What is needed is strong support for an international network of field research trials to allow standardisation of procedures, to encourage science-based communication on the benefits and risks of GM trees and comprehensive training on biosafety and risk assessment and monitoring.

[21] http://www.gmo-safety.eu/en/wood/poplar/54.docu.html

[22] http://www.fs.fed.us/psw/publications/documents/psw_gtr170/psw_gtr170.pdf

[23] http://www.acf.org

[24] Merkle, S.A. (2006). Engineering forest trees with heavy metal resistance genes. Silvae Genetica 55: 263-268