A Review on Genetically Engineered Trees

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ABSTRACT:Forests are crucial to the world's ecological, social, cultural and economic well-being, but pressures such as rising demand for timber and other forest products, land conversion and destruction, and climate change increasingly threaten the sustainable supply of goods and services from forests. Highly productive forestry, intensively controlled, using the most advanced tree breeding techniques, including the application of genetic engineering (GE), has enormous potential for producing more wood on less land. The deployment of GE trees in plantation forests, however, is a contentious issue and concerns about potential environmental damage have been especially expressed.This paper, prepared by the International Expert Group on Silviculture, Forest Tree Breeding, Forest Biotechnology and Environmental Risk Assessment (ERA) meeting in April 2012, discusses how GE trees can be applied to the ERA paradigm used for GE crop plants for use in forest plantations. It stresses the importance of distinguishing between ERA for GE trees for confined field trials, and ERA for unconfined or commercial-scale releases.In the case of forest trees, special attention is paid to the characteristics of forest trees, which distinguish them from shorter-lived plant species, the temporal and spatial size of forests, and the biodiversity of the receiving ecosystem of the plantation forest.

KEYWORDS:Environment, Forests, Genetic engineering, Risk assessment.

INTRODUCTION

The Food and Agriculture Organization of the United Nations [1] reports that the forest area of the world is slightly over 4 billion ha, which is 31% of the land area. Forests are important for the ecological, social, cultural and financial well-being of the world. In the global carbon cycle, they play a major role, with 289 gigatons deposited biomass-only carbon, maintaining land and water supplies, controlling avalanches, stabilizing sand dunes, controlling desertification, protecting coastal areas and providing many plants and animals with habitats. Wood is a major product.It is the raw material for wood, pulp, paper, packaging and, more and more, bioenergy, biofuels and biomaterial feedstock. The majority of fuel used for cooking and heating is supplied by forests, and is vital for leisure, tourism, and cultural and spiritual well-being.Demand for goods and services from forests is growing as the global population continues to grow.

The worldwide use of wood rose from around 2.9 billion m3 in 1980 to around 2.9 billion m3 in 1980.In 2010, approximately 3.4 billion m3 were used for industrial purposes and half were used as cooking and heating fuel.As populations grow, living standards rise, and new uses for wood in bioenergy and biomaterials are established, wood use will likely continue to increase. Large forest areas are being converted to agriculture or urban development, with approximately 13 million hectares of forest lost between 2000 and 2010. In many forests, timber harvesting is prohibited, and those with high biological diversity where harvesting is forbidden now account for 13 percent of the world's forests. In forests in vulnerable watersheds, coastal areas or at the edge of expanding deserts for soil and water protection, logging is also frequently prohibited.Just about 30 percent of the world's forests have a designated primary wood production feature, and the area of such forests continues to shrink, dropping by more than one percent since 1990, 50 million hectares.

ENVIRONMENT RISK OF THE GENETICALLY ENGINEERED TREES

A series of steps usually accompany the pre-commercial production of GE plants, each followed by regulatory oversight. Confined field trials provide scientists with an essential experimental forum through the evaluation of GE plants outside the laboratory or greenhouse to further basic and applied science research[2]. Confined field trials also allow confined field testing developers of goods to determine the efficiency of transgenic events and to collect data to comply with regulatory requirements.Typically, the first ERA for a specific GE case is for a confined field trial. Limits in time and space are placed by regulatory permits to perform restricted field trials of a GE plant. This can include limitations of size (e.g. area to be planted, number of locations and number of plants), length and types of activities permitted (e.g. area to be planted, number of locations and number of plants) (e.g. transportation, analytical and other experimental studies etc.). Permittees are expected to apply control measures to ensure that the within these limits, GE plants remain.GE crops can involve spatial separation from the same or sexually compatible species, planting of border rows/pollen traps, and/or cleaning specific machinery, transport and disposal procedures for confining GE trees.The primary emphasis of ERAs for confined field trials is on the efficacy of risk management measures. As a result, less information is required to determine the risks posed by field trials than for

Environmental launches, commercial-scale. Typically, confined field trials of GE plants test phenotypic features and agronomic results. In evaluating the suitability and efficacy of control steps, the biology of the parent species, in particular its reproductive capability, and its potential for gene flow and long-distance dispersal, must be considered.It may also be useful to provide descriptions of the added gene(s)/genetic modification, the predicted phenotype and any experience with the same or similar modifications in other plant species.National information on the species and characteristics of GE trees in restricted field tests is publicly available via the internet. In certain examples, a detailed overview of the genetic historyChange and associated risk assessment are available. Risk assessments for field trials of eucalyptus, poplar, white spruce and sweetgum, as well as sweetgum, were published in the United States.Papaya, apple, walnut and plum trees are non-forest trees (APHIS, 2012). Similarly, for field trials of GE trees, New Zealand published comprehensive risk evaluation and risk management decisions.Although no GE forest trees have been approved for field trials in Australia, comprehensive risk assessment and risk management plans are available for several fruit trees and other long-lived perennials that are important to forest trees, including papaya, banana, grapevine and sugarcane. Inside the notification Reports summarizing possible environmental effects and risk management are published by the European Union Measurement Action. Notably, these reports address forest trees explicitly as recipient or parental plants and explain factors influencing potential spread.Countries such as Japan (J-BCH, 2012) and Brazil provide information on risk management practices and procedures, while Canada publishes species-specific requirements that must be met during restricted field trials.

Environment Risk Assessment of the GE Tree for the Commercial Purpose:

The ERA paradigm of GE plants, as previously described, takes into account the biology of the host plant, the characteristics of the introduced trait(s), the expected receiving environment and the host plant's biology.Interactions to measure the probability that ecological damage will be caused by a field trial or cultivation. When added to theThe evaluation context of the ERA of GE plants for an unconfined release is very different from that of confined field trials as limits on cultivation in time and space are generally not necessary (otherThose procedures that are usually introduced when the traditional equivalent is grown).An Age for an unconfined, therefore,In order to determine possible threats that can no longer be handled, the release of a GE forest tree will typically require substantially more details than for the ERA of a confined field trial.Via containment steps, including: the possible impact on sexually compatible populations of introgression of the transgenic trait; and the effects of longer-term exposure on species in the receiving area. Laboratory experiments and restricted field trial data are supplemented with literature data and past risk assessments (whereRelevant) to discuss the risk that harm would be caused by the new phenotype.Commercial applications for fruit trees or other perennial woody species can also provide valuable information related to the risk assessment of forest tree planting species. There are published risk assessments for papaya events and one plum event, as well as risk assessments for rose, another perennial woody species approved for commercial development in the United States and Australia. Although the biology of these species varies from that of forest tree species in many ways, these studies serve as examples of how risk assessments for plants other than annual row crops have been successfully performed.

Important Points for the ERA of GE trees:

ERAs of GE plants are conducted using a comparative method for the purposes of unconfined or commercial releases. In the receiving area, the possible adverse environmental impacts of the GE plant are contrasted with those of the unmodified host plant [3](OECD, 1993; OGTR, 2009; SCBD, 2009;In 2000)[4]. This approach is critical because it allows the risk assessor to concentrate on the possible adverse effects of any definedInstead of trying to explain some possible environmental interaction between the GE plant and the climate, discrepancies between the GE plant and its unmodified (or conventional) comparator[5].If there are no variations between the GE plant and the unmodified host plant in environmental interactions other than the change conferred by the new characteristic, the ERA should focus solely on the possible environmental effects of that change. If the adjustment conferred by the new feature falls within the usual range and variation in the host species for that feature, then it is not appropriate to proceed further with the risk assessment.Comparator selection may have a considerable effect on the data requirements, interpretation and conclusions drawn from the risk assessment [6]. The selected comparators should be those that have the most important data. In order to distinguish intrinsic characteristics from those resulting from the introduction of a new trait, appropriate comparators should also cover the usual range and variety of the species. The counterpart used is typically the near-isogenic parent in practice. In certain cases, a transgenic plant, such as a subsequent transformation of an already commercialized transgenic plant, may itself be the most closely related comparator.Generally, the genetic diversity of the species will also be regarded as part of the ERA for comparative evaluations, usually by considering a variety of varieties, cultivars or lines for crop species[7]. There may already be valid data on genetic diversity in the literature and, thus, it is important to note that comparative evaluation does not necessarily mean comparative research. For forestry species where natural variability is typically higher, consideration of genetic variability will be especially important as comprehensive breeding for variety production has not taken place.A sound understanding of the comparator's biology is central to the risk evaluation since it is necessary to differentiate between the potential for harm resulting from the characteristics that are intrinsic to the species as a result of the added characteristics.

Uncertainty in ERA:

Although risk assessment is a scientific undertaking, it is necessary to bear in mind that it is not fundamental science. Risk evaluation is a risk assessment that is a systematic, logical approach to resolving ambiguity based on scientific/technical evidence's plausibility and power. That is thecritical for an evaluation to identify the sources of uncertainty that are likely to have a major effect on the probability and magnitude of risks found. However, it is equally critical that these uncertainties are addressed in the assessment in the light of the knowledge and expertise available for the evaluation.Scientific uncertainty must also be differentiated from political uncertainty in Age, as the latter can be confused with the former when decision-making parameters are not established or clear [8]. The aim of the assessment, which is to provide as accurate an image as possible of the potential for adverse impacts in order to encourage informed decision-making, is not to highlight uncertainty without placing it into context and to clarify its importance to the overall conclusions of the risk assessment.

CONCLUSION

Plantation forests are habitats that are highly maintained. While they provide important services for the ecosystem, the primary objective of forests of this type are intended to grow wood and other forest products. Much is known about the biology of tree species used in plantations, and the site-specific impact on productivity, reproduction and development of forestry practices. The fact that plantation forests are intensively managed indicates that both the host plant and the receiving ecosystem are significantly familiar with and competent, and this knowledge is vital to a robust Period.Equally, the ERA model that has been successfully applied to the pre-commercial assessment of GE crops applies to the risk assessment of GE trees that will be used in forestry plantations. While forest tree biology differs from annual row crops, tree characteristics such as durability, size and scale are manageable and do not preclude GE tree assessment for deployment in confined field trials or forest plantations.Regulatory authorities have approved the unrestricted release of other long-lived perennial species such as transgenic alfalfa, rose, plum and papaya in countries such as Australia, Canada, Japan and the United States, and most governments have related experience in the field of transgenic alfalfa, rose, plum and papayaNon-transgenic, introduced perennial species risk assessment, which is highly applicable to the ERA of forest tree species.

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