



ECO SYSTEM, AGRICULTURE AND FORESTRY – A SUSTAINABLE DEVELOPMENT

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Abstract

Ecosystem and Forestry was an important to human beings. Plants have always provided food, fuel, food additives, drugs, pesticides, pigments, resins, perfumes and other important industrial, medicinal and agricultural raw materials. The techniques of plant, organ, tissue and cell culture have evolved since the beginning of this century and combined with recent advances in genetics and using conventional plant breeding, the plant biotechnology is having a significant impact on agriculture, horticulture and forestry. Some examples of the current applications in agriculture are micropropagation, somatic embryogenesis, virus and pathogen elimination, embryo rescue, germplasm storage and plant modification by somaclonal variation and genetic engineering. Another significant potential of plant biotechnology is in vitro production of fine chemicals using plant cell / organ cultures. This research article to be discussed about the Ecosystem, Agriculture and Forestry – A Sustainable Development.

Keywords: Ecosystem, Bio productivity, Genetic Conventional Plant Breeding, Social Forestry, Agricultural Technology, Potential Plants, Tissue Culture.

Introduction

What really interested me was why something as promising as this future needy of Ecosystem and Plant Biotechnology. I spent a great deal of time trying to understand both what genetic engineering had to offer small farmers and poor consumers and what was driving the opposition. The evidence that most of the advocacy groups that opposed genetically modified organisms (GMO) forwarded were reasons other than their concerns for health and the environment. I am a believer in the use of modern science to solve problems confronting people and the environment in which we live because I believe it is essential to achieve and maintain the world we would like for current and future generations.

Prof. Per Pinstруп-Andersen
Familiar Eco Scientist

With the increasing recognition of world population feeding and health, global climate change and biodiversity loss, and limited energy resources with fossil fuels calling for alternatives such as biomass crops, the relevance of agriculture and forestry for human well-being in the future is more than evident. In this context, ecosystem and plant biotechnology in agriculture and Forestry applications of methods including genetic engineering, marker-assisted breeding, clonal propagation of elite trees, etc., are becoming very important, but are frequently debated in the public. Genetically modified organisms were first introduced into commercial agriculture more than two decades ago, and have often led to higher yields but also more flexible and efficient management strategies. Trait manipulation of target organisms and production system components also creates opportunities for improved products obtained with more effective resource utilization and reduced negative environmental impact. Nevertheless, manipulated traits may introduce unforeseen effects on ecological processes. Due to the complexity of agricultural and tree production systems and the different scales involved in the biological studies with genetically modified organisms on one hand and ecological studies targeting ecosystem processes on the other hand, trans- or inter-disciplinary approaches are often needed. The intention of this Research Topic was to highlight the need for integrated approaches in research activities and to bridge research progress within the areas of plant biology, ecology, and ecosystem science. Contributions deal with various aspects of crop/tree biotechnology and diversity for biomass, food and feed production and their ecological consequences.

Important issues in using biotechnology in agriculture and forestry are for example to enhance productivity and stress resistance of crops and trees, mainly due to restricted land area and increasing environmental pressures, and to develop carbon dioxide-neutral production systems for sustainable production of fiber/biomass and biofuel with biotechnological methods. Along with the production issues, we need to conserve and protect natural diversity and species richness as a foundation of life on earth. With the recognition that increased plant diversity may also increase productivity, especially at low resource input novel production systems combining aspects of diversity and biotechnology are emerging.



Current Biotechnological methods

Biotechnological methods are currently being developed to explore and make better use of the genetic diversity in important crops, as was reported by for cassava cultivars often grown by farmers in east Africa. Pathogens are one of the biggest threats to crop production in many production systems, and modern biotechnology offers excellent possibilities for high-throughput methodologies for the rapid and efficient screening of economically important crop pathogens. The work by provides a nice example for the development of a biotechnology-based methodology for the early detection and quantification of a potentially important plant pathogen, although verification of the methodology in crop plants and under field conditions still remains to be done. Crop products such as grains are often used as feed in animal production, but need to be stored for extended periods for this purpose which implies the increased use of fossil resources for instance for drying the grain. Alternatively, the moist storage of the grain has environmental and also nutritional advantages, and can be facilitated by using appropriate microorganisms with the moist stored grain. An example for this technology is reported by who exploited the microbial diversity of yeast with biotechnological methods to ultimately improve an animal production system in terms of less use of fossil fuels and enhanced nutritional quality of the feed grain.

More direct uses of biotechnology are applied to improve crop and tree management and yield by modification of plant architecture to enhance the stress resistance of economically important plants or to enhance the productivity and stress resistance of trees in the development of CO₂-neutral biomass production systems. The ecological consequences of biomass production systems need to be evaluated at landscape scale, and biotechnological methods can be used with advantage to investigate the relationships between genetic diversity in tree plantations and an indicator for biodiversity (here arthropod abundance) as an ecosystem service. The latter paper is one of few examples in which serious efforts were made to link genetic diversity of a dominating tree with biodiversity at landscape scale.

The contributions to this Research Topic Ecosystem and Plant Biotechnology in Agriculture and Forestry represent an impressive breath of biotechnology applications in agriculture and forestry. However, keeping in mind that genetically modified organisms have now been used for more than two decades, surprisingly few reports were submitted with a clear focus on the ecological consequences of biotechnology in agriculture and forestry. The poor representation of investigations on ecological consequence assessments is probably indicative of the general paucity of studies linking genetically modified plant traits to ecosystem processes at longer time scales recently pointed out by and illustrates a difficulty when bridging ecological impact assessment and plant breeding: Major targets for ecological impact assessment are quantities at the ecosystem level, while the targets for plant breeding are individual plant traits. Irrespective of the technology of crop/tree improvement used, our knowledge on the mechanistic links between individual plant traits and ecosystem processes is poor and needs to be investigated more in the future. In this context, noted that biotechnology may provide a unique tool for gaining insights into the links between plant traits and ecosystem processes when integrated into basic ecological research. The contributions to this Research Topic indicate an enormous potential for biotechnology applications to improve agricultural and forestry production systems, but also call for better integration of future research activities bridging the relevant subject areas. A major focus of this research should be on the specific traits of modified organisms and their possible ecological consequences, rather than the technologies used to modify those traits.

Conflict in Biotechnology

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest. This branch of biotechnology is connected to agrarian procedures. A case would be the determination and training of plants by means of smaller scale proliferation. Another illustration is the outlining of transgenic plants to develop under particular conditions in the nearness (or nonappearance) of chemicals. One expectation is that green biotechnology may create more naturally inviting arrangements than customary modern horticulture. A case of this is the building of a plant to express a pesticide, along these lines finishing the need of outer use of pesticides.

A case of this would be Bt corn. Regardless of whether green biotechnology items, for example, this are at last more earth well-disposed is a point of significant civil argument. Hereditarily adjusted harvests ("GM yields", or "biotech crops") are plants utilized as a part of horticulture, the DNA of which has been changed with hereditary building procedures. As a rule, the point is to acquaint another attribute with the plant which does not happen normally in the species. Cases in sustenance crops incorporate imperviousness to specific irritations, infections, unpleasant ecological conditions, imperviousness to substance medications (e.g., imperviousness to an herbicide), decrease of deterioration, or enhancing the supplement profile of the product. Cases in non-nourishment crops incorporate creation of pharmaceutical operators, biofuels, and other modernly helpful products, and additionally for bioremediation.

Although in vitro culture techniques were developed quite early for all the millet species transformation of millets has so far lagged behind in comparison to major cereals (wheat, rice, maize and barley). One of the main reasons is that many of the millets are not of economic importance to developed countries and therefore scarcity of research funding has always been a problem. Also, major



labs have concentrated their research efforts on improvement of major cereals and many of these cereals have a quite developed transformation system. Genetically modified maize, wheat and rice are either under field evaluation or are being grown by farmers in large areas. The impact of genetically modified crops on society has been discussed in several publications. Millets are still not very responsive to transformation protocols. There are no model cultivars which can be transformed at an efficient rate for any of the millet species. The Agrobacterium transformation system is becoming the main mode of transformation for major cereals. Though initially they were thought to be out of the host range, this system is important because of its usually giving high transformation efficiency, simple integration pattern and simple handling. At present protocols are not available to infect millet explants with the Agrobacterium. Also, the Agrobacterium transformation system is highly cultivar dependent and it is important to look for millet cultivars that can be transformed with the Agrobacterium.

Major growing regions of millets are in the under developed and developing world, where the main goal is still to increase production rather than to improve nutritional value. Increase in production is mainly possible by conventional breeding methods of selection and controlled hybrids. Many of the cultivars with natural resistance against biotic and abiotic resistance are already available. This is also one of the reasons why millets have been overlooked so far for improvement for novel traits.

All the major cereals crops including rice, wheat, maize, barley, Avena and Triticum have been genetically transformed using the particle gun, protoplasts or Agrobacterium mediated gene transfers. But, production of transgenic plants in millets remain restricted only to pearl millet and bahia grass. Other small millets have been overlooked due to economic or regional considerations. The genetic transformation protocols for millets are important to bring the tertiary gene pool into the improved cultivated varieties.

Ecological Consequences

With the increasing recognition of world population feeding and health, global climate change and biodiversity loss, and limited energy resources with fossil fuels calling for alternatives such as biomass crops, the relevance of agriculture, and forestry for human well-being in the future is more than evident. In this context, applications of biotechnological methods including genetic engineering, marker-assisted breeding, clonal propagation of elite trees, etc., are becoming very important, but are frequently debated in the public. Genetically modified organisms were first introduced into commercial agriculture more than two decades ago, and have often led to higher yields but also more flexible and efficient management strategies. Trait manipulation of target organisms and production system components also creates opportunities for improved products obtained with more effective resource utilization and reduced negative environmental impact. Nevertheless, manipulated traits may introduce unforeseen effects on ecological processes. Due to the complexity of agricultural and tree production systems and the different scales involved in the biological studies with genetically modified organisms on one hand and ecological studies targeting ecosystem processes on the other hand, trans- or interdisciplinary approaches are often needed. The intention of this Research Topic was to highlight the need for integrated approaches in research activities and to bridge research progress within the areas of plant biology, ecology, and ecosystem science. Contributions deal with various aspects of crop/tree biotechnology and diversity for biomass, food and feed production and their ecological consequences.

Important issues in using biotechnology in agriculture and forestry are for example to enhance productivity and stress resistance of crops and trees, mainly due to restricted land area and increasing environmental pressures, and to develop carbon dioxide-neutral production systems for sustainable production of fiber/biomass and biofuel with biotechnological methods. Along with the production issues, we need to conserve and protect natural diversity and species richness as a foundation of life on earth. With the recognition that increased plant diversity may also increase productivity, especially at low resource input (e.g., Weigelt et al., 2009), novel production systems combining aspects of diversity and biotechnology are emerging.

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Summing up

More direct uses of biotechnology are applied to improve crop and tree management and yield by modification of plant architecture, to enhance the stress resistance of economically important plants, or to enhance the productivity and stress (drought, pests) resistance of trees in the development of CO₂-neutral biomass production systems. The ecological consequences of biomass production systems need to be evaluated at landscape scale and biotechnological methods can be used with advantage to investigate the relationships between genetic diversity in tree plantations and an indicator for biodiversity (here arthropod abundance) as an ecosystem service. The latter paper is one of few examples in which serious efforts were made to link genetic diversity of a dominating tree with biodiversity at landscape scale.

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