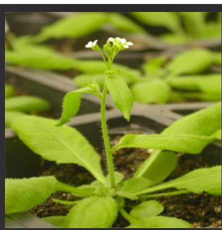

Plants with Altered Pectin and Lignin Biosynthesis and with Improved Growth and Recalcitrance

TECHNOLOGY CA-SEA
1542

INVENTORS

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PATENT INFORMATION

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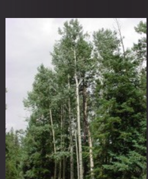

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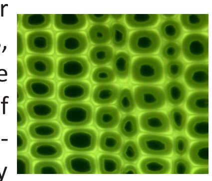
USPTO Link

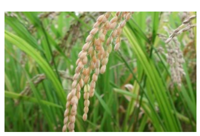
Introduction

There is increasing interest in the use of biomass for biofuel production as an environmental friendly and socio-economically responsible fuel alternative. Bioenergy originates biomass generated by CO_2 fixation by land plants. Approximately 70% of plant biomass is estimated to be present in plant cell wall .As we are currently using only 2% of plant cell wall-based biomass, there is a great opportunity to use this valuable resource as a raw material for the production biofuels and commodity chemicals . The plant cell wall provides mechanical support to the plant and contributes to plant growth and development. Carbohydrates, proteins and phenolic (e.g., lignin) compounds are the major components in the plant cell wall with cellulose, hemicellulose and pectin comprising the major polysaccharides in the wall. Pectins, are enriched in the primary wall of dicot plants, are essential for plant growth, development, signaling, and cell adhesion and have diverse structural characteristics that greatly contribute to wall function. The goal of using bioenergy crops for bio-ethanol production in the United States is well established. However, cost effectiveness is one of the major limitations for this industry and intimately associated with biomass recalcitrance caused in part by lignin, pectin and xylan. The major barrier is the cost of the bacterial and fungal enzymes needed to degrade the plant cell wall. Therefore, an approach to find good candidate recalcitrance genes which can be modified to produce genetically modified plant cell walls from which sugars can more easily be released, and thus, which would serve as raw materials for bio-ethanol industry, is key for greatly reducing the amount of enzymes, chemicals and/or energy demand used to circumvent biomass recalcitrance.



Summary

Dr. Mohnen's group at The University of Georgia has identified a clade of genes that are associated with the control of the biosynthesis of both pectin and lignin (and possibly xylan). Mutations of these genes in certain plants (including switch grass and *Populus*) lead to considerable reduction of recalcitrance (*v*. wild type) , as shown by means of bacterial degradation of modified biomass. Furthermore, *Populus* plants bearing some of these mutations have exhibited a considerable increase in height and stem diameter (*v*. wild type). Plants bearing these mutations may prove suitable for economically viable extraction and use of carbohydrates from plant cell wall, as recalcitrance is greatly reduced and rate of overall growth of modified plants increases.



Advantages and Some Potential Applications

- Sustainable and viable use of biomass as source of biofuels and commodity chemicals from fermentative processes
- Production of biomass with reduced recalcitrance
- Increased yield of carbohydrates from biomass
- Increased growth rates (thus of amount of biomass/mass/year) reflected in both height and diameter of plants
- Modifications have been tested in different species of plants, with similar results (accelerated and higher growth rates)

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Higher Yielding Biomass Plants Developed Utilizing Newly Discovered Cell Wall Structures and Proteins

TECHNOLOGY CASEA
1664

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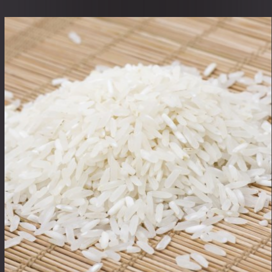

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USPTO Link

Introduction

Biomass is a renewable resource that has shown promise to reduce dependence on petroleum based fuels. However, the cost of biomass-based fuels historically has not been competitive relative to oil or other energy resources. Most biomass initiatives for increasing the conversion rate of biomass to biofuel focus on modifying cell wall components, which have traditionally been viewed as a complex interaction of cellulose, hemicellulosic and pectic polysaccharides. A major barrier in converting biomass into fuels is that a plant's cell walls have built up a natural protection to microbes and enzymes that are used to break apart these cell wall structures to free up sugar resources.

In contrast, the researchers have created a transgenic plant that has much decreased recalcitrance and increased plant stem and root growth, which will directly translate into higher volumes of convertible sugar.

Foremost, the researchers identified novel plant cell wall structures in which cell wall pectin and hemicellulose glycans are linked to structural proteins , enabling great reduction in recalcitrance, while enhancing growth.

This new research suggests a complex proteoglycan network in plant cell walls. This different view of cell wall attributes has enabled a new pathway for the development of techniques and transgenic plants with higher biomass potential. The manipulations according to the invention will produce more degradable plant biomass for biofuel production.

Summary

The researchers have created transgenic plants, which have a higher biomass potential given increased plant size. The new plants also have a decreased resistance to enzymes, which in turn will decrease the cost of converting the plant into biofuel. The new framework allows for understanding cell wall synthesis better, and subsequently enables the creation of novel, economically viable transgenic plants.

Advantages and Some Potential Applications

- The invention of higher yielding transgenic plants will directly increase the efficiency of converting biomass into biofuel.
- The discovery can enable the creation of additional transgenic plants for more effectively converting biomass into biofuel.
- The technique allows for the prediction of novel genes, gene combinations, mutants, and variants for more economical biofuel production.

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