Bioresearch pins hopes on 'green gold'

Local researchers see potential in plants as raw material to build almost anything

Thursday October 6, 2005
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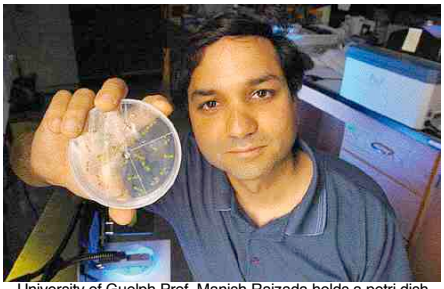
RECORD STAFF



University of Guelph Prof. Manish Raizada holds a petri dish with separated pieces of a plant named Arabidopsis, a type of mustard plant. Raizada is hoping to find a way to use plants as mini factories to make petroleum-like products to be used in the manufacture of various materials, such as plastics.

GUELPH -- As Manish Raizada looks around his office -- at the furniture, the walls, insulation and even the paint -- he sees the potential of plants.

"Everything in this room, other than the glass and the metal, can be produced from plants," says Raizada, a researcher at the University of Guelph.

"A big dream is to get all the raw materials used in manufacturing, for car parts for example, from plants."

The interest in bioproducts has recently surged with the rise of petroleum oil prices.

The higher price for crude oil is not just a headache for consumers filling up their gas tanks. It is squeezing all industries that are manufacturing or using petroleum-based plastics.

Yet living plants and bacteria, which take carbon out of the atmosphere, are good at making oil and other manufacturing materials.

After all, crude oil or "fossil fuel" is basically composed of chains of carbon and hydrogen atoms, and many geologists believe that came from the compressed remains of fossilized plants in the first place.

But until recently, "the petroleum-based plastics were so much cheaper," explains University of Waterloo Prof. Trevor Charles.

With petroleum prices nearing $70 US a barrel, living organisms could be the "green gold" that will replace "black gold."

Researchers at area universities are working on making it more practical to put those living organisms to use in manufacturing.

Charles' lab develops "gene libraries" of DNA coming from thousands of colonies of bacteria.

These bacteria found in nature have useful properties, such as converting carbon into the polymers that plastics are made from.

Meanwhile, the aspect of plants that fascinates Raizada is their incredible ability to regenerate.

If you take a leaf cutting from a plant and put it in water, it can grow roots and then produce an entire new plant.

"That is an amazing thing," Raizada says.

"A root is a major organ."

All along the wound site of a leaf cutting, there are stem cells, or mother cells, that have all the genetic information needed to do that.

By understanding these genes and how to "turn on" regeneration, Raizada is making huge contributions to sustainable agriculture.

The understanding of these stem cells is also important in figuring out how to get plant cells to spew out large quantities of the particular chemicals sought for certain manufacturing.

Raizada's team is trying to figure out exactly which genes cause the regeneration function in a plant called Arabidopsis, which is a member of the wild mustard family.

He describes it as "the fruit-fly of the plant world" because it is easy to work with and to cultivate in lab dishes.

His lab is one of only three in North America that is working directly on the plant-regeneration genes.

Progress is being made.

The particular region in the nucleus of the cell, or the chromosome, where the genes are located, is known. Researchers are now zeroing in on the

specific regeneration genes.

"We hope to isolate the first gene by the end of 2006," Raizada says.

Raizada and his group have also pioneered a new, faster approach to figuring out where the genes are, using florescent "markers" that give off a greenish glow and act as landmarks.

"They tell us where on the chromosome we are, and that position information is very important," Raizada says.

After the genes for regeneration in his mustard plant have been isolated, Raizada and his group would like to transfer that ability to plants that don't regenerate so easily.

In the plant world, the ability to regenerate is quite varied.

Some plants -- grass, tulips and other perennials -- will grow again from the root every year.

A few crops, like sugar cane, will also do that.

But most other crop plants, such as corn (which is related to sugar cane and grasses), will not do that.

After the corn is harvested, the roots die and the soil has to be tilled and re-seeded the following spring.

It takes a lot of water and nutrients just to get the roots to grow from the seeds ever year, Raizada says.

So if he can turn on the regeneration ability of crop plants and get them to regenerate from their roots, it could mean tremendous savings in agriculture resources, not to mention a longer growing season.

It also means the amount of land devoted to growing crops can be minimized, which is important for the environment, especially as people increasingly look to plants for alternative fuels and for making industrial products.

"We need to get more out of renewable systems," Raizada says.

Bioproducts has become an extremely hot area of research, says Prof. David Hume, who co-ordinates the bioproducts initiative at the University of Guelph.

For farmers, the development of biodiesel and ethanol alternative fuel factories are having the most immediate economic impact, but many other bioproducts are in the pipeline, Hume says.

"There are low hanging fruit in this area," he says.

One example Hume recently saw was a foam, made of soybean oil, that could be used by the car industry.

"To my eye, it looked like a product that was the equivalent to the foam that is being used now," he says.

"The interesting thing is that soybean oil is about half the price of crude oil right now," Hume adds.

Besides oils, there are also plant fibres that can be used as fillers in extruded plastics for decking, boards and sound barriers, he says.

Furthermore, starch, from corn for example, can be used to make paints that don't give off as many dangerous fumes as petroleum-based paints.

All of these industries are worth billions of dollars, which is why governments are pouring so much money into this research area.

Economically, the potential is "absolutely staggering," Hume says.

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