

# BIO BIZ

Biotechnology Transforms

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Carrots genetically selected for color

## This month, Bio Biz is taking a look at Agricultural Biotechnology

By Mandy Latimer

As long as man has inhabited the earth, he has had an effect on the genetics of species that he came in contact with either directly or indirectly. Although his past methods of breeding and culling were laborious and time consuming, they were generally accepted by others of his species. But, when man acquired the ability to move genes between unrelated species, people began to take notice. Alarms were raised when people realized that their seemingly innocuous food staples were tainted with foreign DNA and were now labeled as GMOs (Genetically Modified Organisms). As Dr Weil states (Test-tube Veggies article pg 4), "We face some possible dangers" and suggests that readers "protect themselves by sticking to organic produce." Ironically, due to the lack of pesticide residue on GMO products, many of these end up labeled as "organic". The reality is that we have been ingesting GMOs since 1995 when the first GMO soybeans and tomatoes were introduced followed by rape seed oil in 1996 (look out smokers, genetically modified tobacco plants were introduced in 1987). As of 2007, 90 % of the soybeans, 70% of the corn and 80% of the cotton crop were GMO. The benefits are staggering. Graham Brookes, an agricultural economist and director of UK-based PG Economics, stated that the "the economic and environmental benefits of biotechnology in agriculture since 1996 resulted in a reduction in pesticide applications of 172,000 metric tons across four main biotech crops, an increase in global farm income of US\$28 billion, and a reduction in greenhouse gases of 10 million metric tons."

On another front the pharmaceutical industry has been facing a facilities crunch. It seems that the demand for pharmaceuticals has outpaced the capacity of most of the production plants. These plants cost a lot to build and maintain and can be a huge drain on a company's finances. So, company's began to look for alternatives and one of these is plant-made pharmaceuticals. You can read all about this industry on pg 2.

And.....

Just when you think that you have heard it all, "bioplastics" could be the green answer to our fears of plastic contaminating our lives. From plastic baby bottles to the wrappers on our fast food, we are exposed to plastics and the chemicals that leach out of them. Now, scientists have been creating plastic replacements with plastic made from corn, grass & sweet potatoes! See pg 3.

### Employment opportunities

Athens Research & Technology Inc are looking for research scientists.

USDA is looking for student workers. Contact Jodie Plumblee for more info:

[Jodie.Plumblee@ARS.USDA.GOV](mailto:Jodie.Plumblee@ARS.USDA.GOV)

Noramco (a Johnson & Johnson's company) is recruiting a Microbiologist Job ID 0802131

Meril currently has 1 R&D and 6 industrial operation positions open. ([us.merial.com/careers](http://us.merial.com/careers))

GBI crime lab associate  
[www.ganet.org/gbi/JOBS/](http://www.ganet.org/gbi/JOBS/)

**AN INDUSTRY UPDATE**  
**ON**  
**PLANT—MADE PHARMACEUTICALS**

*Bio, a biotechnology industry organization, Dec 2006 [www.bio.org](http://www.bio.org)*

Pharmaceuticals produced from biotech plants are a new application of biotechnology that turns plants into “factories” that produce therapeutic proteins used in biopharmaceuticals. Medicines produced from plants represent one of the brightest new hopes in medicine. While great strides have been made through biotechnology in the search for treatments and cures to the most formidable diseases, research and development of biotech drugs may be cut short due to capacity and cost issues. Plants may offer a cost-effective, sustainable, and faster source of medicines for patients, and provide access to new treatments which would otherwise be out of reach. Since 2006, progress in the plant-made pharmaceutical industry has advanced significantly:

- Jan 2006- First Federally- approved plant-made vaccine –will be used in veterinary applications.
- July 2006– SemBioSys announces that it can produce over 1 kilogram of insulin per acre of protein-producing safflower. This is enough to supply 2,500 patients for one year. Producing insulin in GMO safflower, can reduce capital costs compared to existing insulin manufacturing by 70 % and products costs by 40 %.
- Meristem a Cystic fibrosis treatment from biotech corn.  
Chlorogen a breast cancer treatment from biotech tobacco.  
Biolex production of monoclonal antibodies from duckweed.
- May 2007- Rice modified to express proteins often found in breast milk will be planted in Kansas.
- Jan 2008- A recent study shows that flavanoids, biological compounds found in more than 4,000 fruits and vegetables, seem to inhibit the growth of human cancer cells in laboratory tests.
- Feb 2008- A compound that naturally occurs in grapefruit and other citrus fruits may be able to block the secretion of hepatitis C virus (HCV) from infected cells, a process required to maintain chronic infection.



Additional information about the Biotechnology & Pharmaceutical Manufacturing  
Technology programs is available at:

[www.athenstech.edu/public/biotech](http://www.athenstech.edu/public/biotech)

## 'Bioplastics' seek market niche

For complete article see: [cnn.com/2007/TECH/science/10/22/green.plastics.ap/index.html](http://cnn.com/2007/TECH/science/10/22/green.plastics.ap/index.html)

Plastics made from corn and other plants are carving a tiny niche from the market for conventional petroleum-based plastics and being touted as green alternatives for everything from bulk food containers to lipstick tubes and clothing fiber—as well as gift cards. So-called “bioplastics” offer the world a way to wean itself off oil, and most biodegrade to a varying degree. But their makers green argument is complex, and environmentalists are cautious in their support. Manufacturing bioplastics produces carbon dioxide, which contributes to global warming. The materials are made from crops—corn, switch grass, sugar cane, even sweet potatoes—that require land and water to grow. Some sound alarms because genetically modified organisms are used to spur the fermentation that creates them. And recycling them presents still other pitfalls.

Bioplastics' main benefit would be to reduce from 10 % the share of U.S. petroleum consumption that goes into plastic. The types that are biodegradable also could help compensate for the country's slow progress in recycling—only about 6% of plastic made in the U.S. was recycled in 2005, according to the U.S. Environmental Protection Agency. Bioplastics also lack toxins like polyvinyl chloride that have raised health concerns and led California Gov. Arnold Schwarzenegger this month to sign legislation banning chemicals called phthalates from toys and baby products.



The makers newest entrant is Mirel, from Cambridge—based Metabolix Inc. It more easily biodegrades than rival materials and, unlike others, can break down in a backyard compost bin. Its first consumer application came in July when Target Corp. began using it in gift cards at 129 stores. Metabolix is talking with potential clients about dozens more applications for Mirel, from razorblade handles to a coating for disposable coffee cups. Agricultural processor Archer Daniels Midland Co. provides corn feedstock for making Mirel, which requires genetically engineered bacteria to aid in fermentation.

The most widely used bioplastic, NatureWorks—a product of a subsidiary of Minnesota-based Cargill Inc.—also is corn-based and biodegradable. It is made without genetically modified bacteria. Some of the corn that goes into it is modified, raising environmental concerns on the sourcing end, but the company notes that protein from the corn is destroyed in processing.

Though most consumers lack the patience to sort out all the arguments, environmental friendliness can sell. Ralph DiMatteo, 48, of Painesville Township, Ohio, said after learning Sam's Club gift cards are made of NatureWorks plastic that he would buy them as holiday gifts. “I don't spend a lot of time researching these kinds of things, but if something is presented to me properly to show me how my effort can make a difference for the environment, I'm willing to pay a couple extra cents,” DiMatteo said.



For now, Metabolix is banking on that kind of attitude, said co-founder and chief scientific officer Oliver Peoples.

“We believe that there is a segment of the population that is willing to pay to basically feel better about using plastics,” Peoples said. “And if a company decided it wanted to go in that direction of charging \$2.03 for a cup of coffee rather than \$2.00, our view is that we're adding something to their brand.”

**Test –Tube Veggies Dr. Debunker  
By Andrew Weil, M.D.**

*A pioneer in the field of integrative medicine, Andrew Weil, M.D., is a bestselling author and the editorial director of [www.drweil.com](http://www.drweil.com).*

**Q:** In the mid-1990s scientists began tinkering with the genes of crop plants—for instance, to extend the shelf life of tomatoes or to create blight-resistant soybeans. Are such genetically modified (GM) foods safe?

**A:** Actually, human beings have been genetically modifying foods for thousands of years by selectively breeding and hybridizing plants and animals. Whether the results are good or bad depends a lot on the motivation behind the effort. Developing tastier, more nutritious tomatoes is good. Developing hard tomatoes to resist damage from shipping is not so good—at least not for most of us.

Apply this same kind of analysis to GM foods, the difference being that now we are able to take genes from one organism and put them in another, often of a different type. That adds a new layer of complexity to the question of safety. Like most major advances in technology, the new methods of genetic modification can help us or harm us. I do not have a simple answer to the question “Are GM foods safe?” One possible danger is that GM foods might trigger allergic reactions or other health problems in some people. Another is that foreign genes in widely planted crops such as corn and soy might spread by seed to nearby fields of these crops. Yet another is that products of those genes, manufactured on a larger scale than ever before by acres and acres of cultivated GM plants, might have unpredictable deleterious effects on the environment. The bottom line is: we don’t know. Given that uncertainty, we had better hope the scientists modifying the genetics of our food sources and the businesspeople marketing their inventions are doing their best to think through all the possible consequences of making these unprecedented changes. Chances are, they are not.



Until I know more, I prefer to err on the side of caution. At the very least I want to know whether the foods I eat have been genetically modified. I want them to be so labeled. At the moment most foods in grocery stores in the United States and Canada contain genetically modified ingredients—largely derivatives of corn and soy—with no notice of that fact on their labels. (There is a grass-roots effort to ensure that GM foods are labeled as such; see [www.thecampaign.org](http://www.thecampaign.org).) If you want to avoid GM foods, eat products labeled “organic”—these cannot be genetically modified—and cut down on processed foods, which often contain GM ingredients.

**•By 2025, there will be another 2 billion mouths to feed**  
*United Nations Population Fund*

Farmers will need to at least double production over the next 25 years to meet increased demand. ■  
*Consultative Group on International Agricultural Research*

**Benefits of biotechnology=more food & more \$ for farmers!**

Bt corn – 3.5 billion pound yield increase and \$125 million in additional income  
Bt cotton – 185 million pound yield increase and \$102 million in additional income  
Biotech soybeans – \$1 billion in additional income through production cost savings

## Biotech lab corner

This months lab is a “biodegradation of oil by bacteria” procedure  
Good luck!

### THE BIODEGRADATION OF OIL BY AEROBIC BACTERIA

By John Williams

*As a seventh- grader, John presented an award -winning project demonstrating biodegradation of oil at the North Carolina Student Academy of Science competition.*

*From: [www.accessexcellence.org](http://www.accessexcellence.org) (spring 1994)*

#### Introduction

Oil released into the environment is a well-recognized problem in today’s world. Oil spills affect many species of plants and animals in the environment, as well as humans. The search for effective and efficient methods of oil removal from contaminated sites has intensified in recent years, in part due to the enormous publicity of the Exxon Valdez spill. One promising method that has been researched is the biological degradation of oil by bacteria. The bacteria metabolize the oil in much the same way humans convert food into energy. Like food, oil is a compound rich in carbon. The following experiment can be used to demonstrate that some types of bacteria can degrade oil. Also, other variables can be selected and incorporated into the lesson plan to allow additional experimentation.

#### Materials

- \*8 –1 pint mason jars
- \*Aquarium pumps and tubing
- \*Distilled water
- \*Inorganic nutrients: ammonium phosphate, magnesium sulfate, potassium phosphate, & non-iodinated sodium chloride.
- \*Lightweight machine oil (not motor oil)
- \*Pipettes that can deliver drops or reproducible small volumes.
- \*Soil sample collected from an oil contaminated site (car repair facility, soil where oil has been leaking from parked cars, etc.)
- \*Brown paper bags
- \*Laboratory balance

#### Procedure

- 1) Label jars. This experiment includes 4 treatments, each done in duplicate. (thus, 1A,1B, 2A,2B etc.)
- 2) Put 150 ml of distilled water and 2 g of machine oil into each of the 8 jars.
- 3) Jars 1A &1B are your controls so after adding the water and oil, set them aside.
- 4) In jars 2A, 2B, 4A & 4B add the following mixture of inorganic nutrients:  
0.25g ammonium phosphate, 0.05 g magnesium sulfate,  
0.25 g potassium phosphate, 1.25g non-iodinated sodium chloride.
- 5) Add into jars 3A, 3B, 4A & 4B 5 g of the soil sample.
- 6) Cover the jars loosely with foil and run your aquarium pump tubing through a hole in the foil of each jar.  
(If you use a 4 way splitter, you can use 2 pumps for 8 jars.)
- 7) Results may be recorded from each jar every 3 days or weekly for up to 30 days.

(Continued on page 6)

(Continued from page 5)

## **Results**

Perform a “greasy spot” test, cut a brown paper bag into a 16 x 16 inch square. Then, with a ruler & pencil, divide the large square into eight 2 x 2 inch squares. In the corner of each small square, put the number of each different treatment jar (1A, 1B, etc.), one per square. This way, there should be one 2 X 2- inch square for each jar.

Using a pipette or dropper, draw a small quantity of liquid from just under the top of the water level of one jar. Deposit three drops of this liquid onto the center of the correct square of paper (if the sample was from jar 1A, place the tree drops on the square for 1A, etc.). Take the samples from the same place in each jar each time just under the surface of the water. After a few hours, the water will evaporate, leaving a greasy spot in each square.

Circle the circumference of each greasy spot with a pencil and measure and record the diameter of each spot. Average the results from jars containing identical treatments. During the course of the experiment, the spots from the treatments containing the bacteria & inorganic nutrients should become smaller as the oil is being degraded.

Place your cumulative data into graphs and compare.

What trends do you find, if any?

Where did activity plateau?

Why were the soil sample, inorganic nutrients, oxygen, etc. necessary for the oil concentration to be decreased?

## **Discussion**

As previously stated, the soil sample provides bacteria to digest the oil. However, oil is composed of hydrogen, & carbon, and the bacteria need additional nutrients to grow. The inorganic nutrient mixture provides nitrogen and several essential minerals. The bacteria also require oxygen, provided by the air from the aquarium pumps.



Brussels Sprouts and Broccoli are descendants of the common cabbage plant. Their development took many years of careful selection & breeding of plants with the desirable traits.



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