

Climate Impact on Species

**Is there a need to change the genetic
of plants for the sake of our cars?**

Climate Impact on Species

Drought resistant Crops

Genetic modified plants to be prepared for severe droughts

Genetically engineered crop plants that survive droughts and can grow with 70 percent less irrigation water have been developed by an international team. The discovery offers hope for global agriculture that is already grappling with limited and variable water supplies.

Genetically introducing drought tolerance in tobacco

Tobacco was chosen as an experimental plant because it is big, fast growing and a good model for many other crop plants. The researchers inserted into the tobacco plants a gene that interrupted the biochemical chain of events that normally leads to the loss of the plant's leaves during drought. With only minimal reduction in yield, these plants survived on just 30 percent of the normal irrigation water -- severe drought conditions that killed all of the plants in the control group.

Researchers hope that similar results will be found in GM crop plants such as tomatoes, rice, wheat, canola and cotton.

Climate Impact on Species

GMOs [1]

QATAR is planning to promulgate a law on food products with genetically modified organisms (GMOs) in order to make the public aware of their existence.

Ghanem Abdulla Mohamed, director of Wildlife Conservation at the Supreme Council for Environment and Natural Reserves (SCENR), told Gulf Times.

The committee will formulate a strategy and action plan to regulate the import and use of GM foods “to protect our country and community from their bad effects”, the official said.

Ghanem pointed out that there was a great debate going on in many countries of the world about the merits and demerits of food products with genetically modified organisms (GMOs).

Ghanem said Qatar was not planning to ban the import of GM foods. But the public had the right to know if the product they were buying contained GMOs. “So, all food products with GMOs should be labelled accordingly.”

In December 2006, Greenpeace commissioned the testing of 35 products containing maize currently sold in supermarkets in Qatar, UAE and Kuwait.

Some 40% (14 of 35) of the tested samples revealed contamination with GMOs. All product testing was carried out by an accredited laboratory in Berne, Switzerland. In Qatar specifically, four out of 10 products tested contained GMOs. As is the case in other GCC countries, none of the products that contained GMOs was labelled, as these countries do not require labelling of such products.

In early 2006, Greenpeace discovered that US imported rice products in Gulf countries and in more than 24 other countries all over the world, were contaminated with an unauthorised GMO rice variety.

[1] Gulf Times Newspaper (2007). Plan to bring genetically modified food under law, 30 July 2007. Doha, Qatar.

Climate Impact on Species

Transgenic wheat

Scientists in Egypt have produced drought-tolerant wheat by transferring a gene from barley into a local wheat variety.

Water stress caused by drought is a major factor limiting plant growth and crop productivity worldwide. The researchers showed that by transferring a gene called 'HVA11' from barley to wheat, the plants could tolerate low water levels for longer before their leaves wilted.

Climate Impact on Species

A plant to survive severe drought and fight global warming effects from U.S. And Finnish laboratories

Researchers discovered the gene that controls the tiny pores known as stomata that are located on the leaves of plants. They play a crucial role in photosynthesis, as the plant absorbs carbon dioxide gas through these pores. Water vapor is also released through the stomata as the plant grows.

The researchers, writing in the journal Nature, say the discovery may allow them to genetically modify a plant that will continue absorbing CO₂, and possibly even absorb more, but release less water vapour. As plants lose 95% of their water through the stomata, this would mean a plant that could survive in extremely dry conditions.

Droughts seem to be occurring more often and for longer periods of time in many sections of the world, a phenomenon some point to as one of global warming's effects. The American west is in the middle of a prolonged period of drought, while Georgia is experiencing a severe if so far shorter lived period of low rainfall.

Climate Impact on Species

Drought resistant rice

Commercial genetic engineering has been based on inserting a single transgene along with control elements into a crop plant. Traits such as herbicide tolerance, insect resistance and virus resistance have been commercialized without much understanding of the metabolic consequences of the alterations.

According to Prof. Joe Cummins transgenic rice modulated in the polyamine biosynthetic pathway has been found to be drought tolerant. Polyamines are carbon chains containing two or more amine (NH₂) groups. Polyamines are essential compounds found in all living cells. They increase as bacteria decompose organic compounds producing a strong rotting odor. Polyamines are given names such as putrescine and cadaverine or spermine and spermidine. Even though the polyamines are essential for cell growth, they may also cause disease in animals.

In animals and fungi, putrescine is the precursor of spermidine and spermine ; it is synthesized from the amino acid ornithine. Plants have an alternative pathway that converts the amino acid arginine to putrescine, using the enzyme arginine decarboxylase (ADC) , the product of the *adc* gene. This is followed by additional reactions to form spermidine and spermine using S-adenosylmethionine and the action of the enzyme S-adenosylmethionine carboxylase (SAMDC), the product of the *Samdc* gene.

[1] Drought Resistant GM Rice Toxic?
<http://www.i-sis.org.uk/DRGMrice.php>

Climate Impact on Species

Rice plants were transformed with the ADC gene from *Datura* (Jimson weed, a traditional and commercial source of drugs), driven by the maize ubiquitin promoter and the first intron; and transcription was terminated with the *Agrobacterium nos* transcription terminator. The transgenic rice plants had elevated basal levels of putrescine, that were further elevated during drought stress, leading to enhanced production of spermidine and spermine by increased SAMDC enzyme.

The exact mechanism by which increased putrescine increases drought resistance is not fully understood but it is clear that elevated putrescine levels activate spermidine and spermine synthesis that, in turn, regulate putrescine production and sets in motion the resistance to stress. The transgenic rice is designed to provide sustainable rice production under stress conditions.

Stress resistant rice has been reported without reference to the potential impact of the metabolic alteration – such as increase in polyamines - on mammals consuming the transgenic rice. Polyamines are known to be elevated in the cells and body fluids of cancer patients. Drugs inhibiting the synthesis of polyamines can prevent cancer and have been used in cancer treatment.

[1] Drought Resistant GM Rice Toxic?
<http://www.i-sis.org.uk/DRGMrice.php>

Climate Impact on Species

Moreover, polyamines can give rise to toxic products. Spermidine and spermine can be metabolized to hydrogen peroxide, ammonium and acrolein, which are toxic to cells. Polyamines can contribute to the suppression of immunologic reactions in the lung. Polyamines are implicated as uremic toxins leading to renal failure. Chicken feed containing elevated amines, such as putrescine, performed poorly and caused a condition called “necrotic cellular debris”. Wines may contain elevated polyamines from grape must and fermentation. It is believed that spermidine and spermine may be beneficial in wine while putrescine and cadaverine are linked to symptoms such as nausea, sweating and difficult breathing.

The good-news message that transgenic rice may be grown under drought conditions should be tempered by the bad-news that eating the transgenic rice may make one quite ill. The promotion of this transgenic crop along with others in the scientific journals seems invariably to neglect the potential adverse effects of the crop on humans and wild life. Open field trials should not be undertaken in the absence of proper risk assessment and toxicity tests.

[1] Drought Resistant GM Rice Toxic?

<http://www.i-sis.org.uk/DRGMrice.php>

Climate Impact on Species

Acidification of water and noise stress

Low-frequency sound in the ocean is produced by natural phenomena such as rain, waves and marine life, as well as by human activities, such as the use of sonar systems, shipping and construction. Sea water absorbs sound mainly owing to the viscosity of the water and the presence of chemical constituents, such as magnesium sulphate, boric acid and carbonate ions. The concentration of dissolved chemicals absorbing sound near 1 kHz depends on the pH of the ocean¹, which has declined as a result of increases in acidity due to anthropogenic emissions of carbon dioxide. [1]

[1] Ilyina, Tatiana; Zeebe, Richard E.; Brewer, Peter G.: Future ocean increasingly transparent to low-frequency sound owing to carbon dioxide emissions. *Nature Geoscience*. Published online: 20 December 2009 | doi:10.1038/ngeo719. <http://www.nature.com/ngeo/journal/vaop/ncurrent/abs/ngeo719.html>

Climate Impact on Species

in the years 1800–2300. According to our projections, ocean pH could fall by up to 0.6 units by 2100. Sound absorption—in the range between ~100 Hz and ~10 kHz—could fall by up to 60% in the high latitudes and in areas of deep-water formation over the same time period. We predict that over the twenty-first century, chemical absorption of sound in this frequency range will nearly halve in some of the regions that experience significant radiated noise from industrial activity, such as the North Atlantic Ocean. We suggest that our forecast of reduced sound absorption in acoustic hotspots will help in identifying target regions for future monitoring. [1]

[1] Ilyina, Tatiana; Zeebe, Richard E.; Brewer, Peter G.: Future ocean increasingly transparent to low-frequency sound owing to carbon dioxide emissions. *Nature Geoscience*. Published online: 20 December 2009 | doi:10.1038/ngeo719. <http://www.nature.com/ngeo/journal/vaop/ncurrent/abs/ngeo719.html>

Climate Impact on Species

The rice gene map is called the “Rosetta Stone for crop genomes” due to its extensive co-linearity with its evolutionary cousins: corn, wheat, sorghum, barley, rye, and sugar cane(TIGR). It provides a reference that will expedite the sequencing of these other vital food crops. The inter-transferring of important genes among these organisms could lead to the development of superior varieties of these staples.

Climate Impact on Species

Scientists of the Purdue University cloned the gene WAX2 of a mutant of Arabidopsis, a commonly used experimental plant. The gene is directly associated with the synthesis of the protective layer of plants, called the cuticle, and its contained waxes.

The mutant Arabidopsis has increased ability to retain water because of the mutation wax2. The structure of the cuticle differs from that of plants which have the normal gene, WAX2. Malfunction of the WAX2 gene causes the protective wax within the cuticle membrane to be displaced, affecting transpiration. The plant becomes very permeable to water and overall is less able to withstand drought conditions.

Altering the wax2 gene may bring disastrous consequences.

[1] Chen X, Goodwin SM, Boroff VL, Liu X, Jenks MA: Cloning and characterization of the WAX2 gene of Arabidopsis involved in cuticle membrane and wax production. Plant Cell. 2003 May;15(5):1170-85.
<http://www.ncbi.nlm.nih.gov/pubmed/12724542>

Climate Impact on Species

Cuticular wax

The vital importance of plant surface wax in protecting tissue from environmental stresses is reflected in the huge commitment of epidermal cells to cuticle formation. During cuticle deposition, a massive flux of lipids occurs from the sites of lipid synthesis in the plastid and the endoplasmic reticulum to the plant surface. Recent genetic studies in *Arabidopsis* have improved our understanding of fatty acid elongation and of the subsequent modification of the elongated products into primary alcohols, wax esters, secondary alcohols, and ketones, shedding light on the enzymes involved in these pathways. In contrast, the biosynthesis of alkanes is still poorly understood, as are the mechanisms of wax transport from the site of biosynthesis to the cuticle. Currently, nothing is known about wax trafficking from the endoplasmic reticulum to the plasma membrane, or about translocation through the cell wall to the cuticle. However, a first breakthrough toward an understanding of wax export recently came with the discovery of ATP binding cassette (ABC) transporters that are involved in releasing wax from the plasma membrane into the apoplast.

The use of forward and reverse genetic approaches in *Arabidopsis* has led to the identification of enzymes involved in fatty acid elongation and biosynthesis of wax components, as well as transporters required for lipid delivery to the cuticle. [2]

[1] Samuels L, Kunst L, Jetter R: Sealing plant surfaces: cuticular wax formation by epidermal cells. *Annu Rev Plant Biol.* 2008;59:683-707.

<http://www.ncbi.nlm.nih.gov/pubmed/18251711>

[2] Kunst L, Samuels L: Plant cuticles shine: advances in wax biosynthesis and export. *Curr Opin Plant Biol.* 2009 Dec;12(6):721-7.

<http://www.ncbi.nlm.nih.gov/pubmed/19864175>

Climate Impact on Species

Do not spend resources remediating damages caused by climate change. Costs are enormous and are not an investment for the future. Not to be accomplished are:

- Interfering in the genetic code of plants to get drought resistance
- Dams to be aware from rising sea level
- Geoengineering such as fertilising the sea for algal bloom as a carbon sink.
- CO2 cap and store with no place to store it.
- Building nuclear power plants without waste repository.
- Do not combat the **consequences** of climate change

Avoid the CAUSSE of climate change. Invest in clean energy of the future:

Solar Energy

Wind turbines

Hydrogen as energy storage and as fuel

The End