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Abstractions

LAST AUTHOR

In the 1990s, Hawaii's papaya industry looked set to collapse owing to widespread destruction by the ringspot virus. But the papaya trade was saved by genetic modification that confered resistance to the virus. Now the succulent fruit is the first transgenic crop to have its entire genome sequenced. Maqsudul Alam, director of the Advanced Studies in Genomics, Proteomics and Bioinformatics programme at the University of Hawaii in Honolulu, and 84 colleagues from 20 institutions mined the data on page 991. Alam tells *Nature* that the Pacific island's scientific capabilities now rival those of the mainland.

Why sequence the genome of a successful transgenic crop?

When they first began to export transgenic papaya, growers faced concerns about whether genetic alterations might have occurred when the gene that confers ringspot-virus resistance was introduced. Some wondered, for example, whether allergy causing proteins could result from such alterations. Knowledge of the full genome sequence should allay these fears. It will also allow us to develop solely hermaphrodite fruits, which are preferred by growers and consumers alike for their greater fruit content and smaller seed cavity.

Will the papaya genome foster new areas of scientific research?

Yes. For example, the papaya may contain genes that confer natural resistance to bacterial and fungal pathogens, and genes responsible for anti-ageing compounds. And on a more basic level, the papaya's primitive sex chromosomes are still evolving, so the genome sequence will shed light on the evolution of sex chromosomes.

Was it difficult to do this work in such a remote location?

The University of Hawaii got its first high-throughput genomics facilities in 2004, which made this study possible. We sequenced more than 2.5 billion base pairs in 18 months to piece together the papaya's 372-million-base-pair genome. We created our own bioinformatics software and assembly infrastructure with collaborators in China to complete the sequence. Even in the middle of an ocean, cutting-edge science can be done when there is a dream and vision.

What is the research climate like in Hawaii?

We now have opportunities to conduct both discovery and applied science. We are working with US collaborators on several important microbial genomes and on acute rheumatic fever, a complication of streptococcal infection, to which Polynesian children are very susceptible. ■

MAKING THE PAPER

Werner Kurz

Mountain pine beetles contribute to carbon release and climate change.

The balmier climate of recent years has helped the mountain pine beetle of western North America reach ever-higher latitudes and elevations, resulting in the largest-ever recorded outbreak of this insect. And a large-scale multidisciplinary effort to catalogue and predict the effects of the outbreak now reveals that the destruction of pine forests by growing beetle populations will further contribute to climate change. Although the news is bleak, says Werner Kurz, a forest ecologist with the Canadian Forest Service in Victoria, British Columbia, and lead author of the report, it might help forest managers make proactive and informed decisions and allow them to reverse the trend.

North America's temperate forests are one of Earth's greatest assets in combating climate change because they function as carbon 'sinks', soaking up carbon dioxide from the atmosphere. But explosions in mountain pine beetle (*Dendroctonus ponderosae*) populations are threatening to turn these forests into carbon sources rather than sinks. "There are literally several hundred million cubic metres of wood out there in the forests decomposing and releasing carbon dioxide back into the atmosphere," says Kurz.

The only way to stop the beetle is to kill it and its host: that is, cut down and burn infected trees. "There is no chemical agent that one could spray to control them," says Kurz. Another factor that makes beetle infestation difficult to contain is that, unlike forest fires — another cause of carbon-dioxide release into the atmosphere — infestation does not start from a single ignition point, but rather as many small clusters that then grow together and "bleed across the landscape", says Kurz.

Kurz and his colleagues performed both aerial and ground surveys to document the extent of destruction in the south-central forests of British Columbia. They also drew on decades of plot measurements and historical data on forest-growth curves gathered by government bodies. The numbers show that by the end of 2006, the beetle outbreak area covered 130,000 square kilometres, resulting in an estimated loss of 435 million cubic metres of timber in commercial forests alone and many millions more in protected areas and parks.

The group then conducted 100 simulations to calculate the long-term range of the outbreak and its effects on trees, also taking into account factors such as forest fires and harvesting (see page 987). These models project that between 2000 and 2020, the beetle outbreak in forests in the south-central region of British Columbia will increase atmospheric carbon by 270 million tonnes. This equates to 990 million tonnes of carbon dioxide — more than the entire annual emissions reported by Canada in 2005.

Alarming though the situation is, Kurz believes that there is a "silver lining". "I think there are things that we can do now that we're confronted with this challenge to try to mitigate the impacts of climate change," he says. "That's really my life's effort these days."

One possibile way to offset the impact of pine beetles on climate change, Kurz believes, would be to turn pellets from the affected timber into a biofuel, thus making use of some of the wood that would otherwise decompose and release carbon. And we can also replace lost trees and, in doing so, help safeguard against similar events in the future. Most of the mature pine forest is expected to fall victim to the pine beetle during the next few years, but quickly planting younger trees of varying species should make forests more resistant to insect attacks, helping to tip the scale back in favour of carbon uptake. ■

FROM THE BLOGOSPHERE

After speaking at a recent conference, *Nature Medicine*'s editor Juan Carlos Lopez writes on Spoonful of medicine (http://tinyurl.com/4cv6lm), "It was fascinating to see how difficult it was for some people to understand that scientific publishing costs money, and that there are different models to recover your costs — the author-pays model, the subscription model and everything in between ... publishing groups ought to choose the model that works best for each of them. In our case, the subscription-based model is the only one that seems viable for the time being. How difficult is it to get this point?"

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