UNLEASHING GMO'S INTO THE ENVIRONMENT[1]

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ON THE eve of a major conference on the safety of genetically modified food and crops, two research teams have put forward their vision of how scientists can ensure that transgenic plants and animals don't run riot when released into the environment. "At the moment, the environment is being used as an open air laboratory," says Adrian Bebb of Friends of the Earth in Britain. There is no agreed way to evaluate the dangers of GMOs before field trials are carried out. Once an organism has been released, it could be too late. Now William Muir and his colleague Richard Howard at Purdue University in Indiana have developed a way to spot rogue GM organisms long before they are released into the environment.

The technique could do for GMOs what clinical trials do for drugs. "Pharmaceuticals companies have to ensure that their drugs are safe for human consumption," says Muir. "Agricultural companies should have to ensure that their organisms are safe for the environment." His plea comes as delegates from OECD countries, the UN Food and Agriculture Organization and the World Health Organization prepare to meet in Bangkok on 10 July to thrash out a consensus on the science behind GMOs and the public's concerns. Muir and Howard hope their method will win enough support from scientists and regulators to be adopted worldwide. It is based on taking the results of extensive lab tests and feeding them into a computer model. This, they say, can predict whether a foreign gene would spread if a GM organism escaped or was released into the wild. So far Muir and Howard have only tried their model on fish, but in a paper published this week in The American Naturalist (vol 158, p 1), they say the same principle would work for any animal or plant species.

The model would give scientists common ground-something they can agree on, says Muir. "Once scientists are able to agree, that makes something much more acceptable to the public." Environmentalists have given the idea a cautious welcome. "It would help," says Bebb. "I do think there's a need for research like this before experiments come out of the lab." Sue Mayer of GeneWatch UK agrees. "Models are extremely useful and they can really pick up what things are sensitive to. They are bound to make you feel that there has been rigorous investigation before you go to the next step." But models are only ever as good as the data you put in, she warns. But what will the biotech companies think? "I suspect that industry would baulk at such a thorough approach," says Peter Kareiva, a senior ecologist at the US National Marine Fisheries Service. It could take up to five years to get enough data on GM salmon strains for the model to work, for example. But Mayer says that firms won't have a choice if regulators deem such tests appropriate. To develop their model, Muir and Howard identified six aspects of the life history of fish that affect their "fitness"-the number of offspring they produce. These include how many fish survive to adulthood, the age at which they sexually mature and the number of eggs females produce. Then they developed a computer model based on these six traits that predicts how any modified strain would fare against the wild-type fish.

The researchers applied their model to a strain of Japanese ricefish, or medaka, to which they had added the gene for human growth hormone. They counted and measured separate populations of modified and unmodified fish for around two years to see how they compared.

[1] New Scientist, issue of July 07, 2001: http://www.newscientist.com

The modified fish were less likely to survive to adulthood, but they reached sexual maturity earlier and the females laid more eggs. Attempting to predict how these effects balance out would be extremely difficult, but the computer model can work it out.

Muir and Howard found that even though the modified fish were more likely to die young, they would still take over the natural population if released into the wild-so this should never be done. "There's an assumption that if juvenile viability is lower, then the gene won't spread," says Muir. "That's the common misconception that everybody's been working with. But we've shown that there are several other factors that can offset this." "It is a sensible approach," says James Bullock of the Centre for Ecology and Hydrology in Dorset. "Modeling and lab-based stuff only give a limited picture, but it gives you an idea of what may happen."

If anything, the model should overestimate the risks of GMOs in the wild, says Muir. "We consider the lab to be more benign and hospitable than nature," he says. "So if in the lab, transgenic organisms are not found to be a risk when they are given a beneficial environment, we feel confident that in nature there will be even less of a risk." But John Beringer, former head of Britain's Advisory Committee on Releases to the Environment, disagrees. "I don't believe that we know enough about fitness for that to be valid," he says. "We don't know which characteristics are important because environments change so much."

While Muir is working out the risks of foreign genes spreading in the wild, Bullock is trying to estimate the consequences of such contamination. He's using a technique called matrix modeling to combine data obtained from natural plants in the wild and from related GM crop species in the lab. This model predicts whether wild plants that gain foreign genes from their GM relatives would be likely to invade habitats at the expense of native strains. "We're saying: what if gene flow has already happened, what would be the consequences of that?"

He is measuring life-cycle traits such as seed germination, seed production and the survival rate of native plants in different habitats in the wild. His model uses these to calculate how fast their populations are increasing. He then does the same for GM plants grown in the lab. From this, he hopes to be able to tell whether a foreign gene will make wild plants more invasive or not. Bullock hasn't published his results yet, and acknowledges that modelling can't give definite answers. But his initial results indicate that GM oilseed rape could affect its wild turnip relatives. In one worst-case scenario, a population of turnips could increase hugely at the expense of other species if it took up an oilseed rape gene that boosts seed production, he says. The results could be used to help decide which GM plants are safe enough for field trials, Bullock says. "If you then put a plant into the wild, you could be fairly sure what the problems are likely to be."

The researchers accept that modeling environmental effects doesn't take into account other factors, such as ethical considerations, possible threats to human health and the potential benefits of the modified animals and plants. But Muir says he hopes his work will help make biotechnology more acceptable.