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Who owns plant genetics?

These are exciting, not to say turbulent, times in plant genetics. After a shaky start, large-scale efforts are underway to study the genetics of *Arabidopsis thaliana*, the favoured model organism of plant biology. See, for example, page 403 for a study that implicates a promoter element in systemic acquired resistance. The genomes of commercially important plants, starting with rice and leading on to wheat, corn and others, are soon to be deciphered, in some cases by international consortia.

The resultant knowledge base is likely to enable a tranformation of global agriculture. Putting to one side, for the moment, the heated international debate over the public acceptance of agricultural biotechnology, the full significance of this potential transformation is sometimes missed. For in the parts of the world where most of humanity still lives, agriculture is not only the source of food, but also the dominant economic activity. For the people in so-called 'developing' countries, the improvement of agriculture is a critical priority.

Agricultural research—in developed and developing countries alike—has traditionally been a 'hands-on' activity in which research stations harness a variety of skills (from botany and engineering to public education) in order to integrate plant science into working farms. This approach has been extremely successful in many parts of the world, from the work of the United States Department of Agriculture (USDA) in transforming US agriculture after the Dust Bowl to the so-called Green Revolution, which doubled agricultural yields in India and elsewhere in the 1960s and 1970s.

Unlike, say, astonomers, geneticists seldom think of themselves as pursuing knowledge purely for its own sake. Those working on *Drosophila*, mouse or human genetics are encouraged in their work by the expectation that it will contribute to the fight against disease. Plant geneticists are entitled to expect that they will contribute to the fight against hunger. For this to happen, however, plant genetics—and especially transgenics—must be effectively harnessed by the agricultural research systems of the developing world, as previous agricultural technologies have been. But at the very time when plant genetics is emerging as an effective applied science, formidable obstacles obstruct its widespread adaptation to the needs of poor countries.

One such obstacle is the web of licensing rights that constrain the development and use of agricultural biotechnology. This problem afflicts those seeking to commercialize research in any branch of genetics—but most of the scientists involved have access to the relevant expertise in intellectual property rights (IPR), either at their universities or in the corporations with which they are partnering. The issue represents a significant challenge, nonetheless, for plant geneticists even in rich countries. In poorer countries, where expertise on IPR is thin on the ground and

the need to apply research in the field most pressing—if it isn't of practical value, the researcher is unlikely to be doing it—the problem becomes acute.

Researchers are likely to find, on investigation, that not only genes of interest to them but also materials and methods for gene expression, methodologies such as agrobacterial transformation of monocots, and even entire strategies for plant improvement are protected by a multiplicity of licensing patent arrangements. All of these arrangements will vary between countries, and few are advertised until the time comes to try to distribute the outcome of the research to farmers.

Even the better-resourced agricultural research centres, such as those affiliated to the Consultative Group on International Agricultural Research (CGIAR) and the national agricultural centres of prominent developing world countries, lack the resources and expertise needed to work their way through all of this red tape.

As a result, some research leaders have called on CGIAR and other centres to take a more radical approach to intellectual property. Richard Jefferson, director of the Center for the Application of Molecular Biology in International Agriculture (CAMBIA) at Canberra, Australia and head of molecular technology at the CGIAR's International Institute of Tropical Agriculture (IITA) at Ibadan, Nigeria, and Carol Nottenburg, CAMBIA's Director of Intellectual Property, have been working with the support of the Rockefeller Foundation to develop new tools that will give researchers free and easy access to reasonably comprehensive data on the IPR status of the materials and methods they want to use. In addition to providing databases, Jefferson hopes to persuade scientists in the public sector to develop alternative materials and methods that will not be exclusively licensed, but will be available to all.

Most license rights are held by corporations, which tend to attract most of the available public approbrium for their perceived self-interest. But in his keynote address to the International *Arabidopsis* Congress at Madison,Wisconsin, in June, Jefferson went into the lion's den, as it were, and told plant geneticists working in universities that they were responsible for a large part of the problem. In an address wittily entitled "the weed-choked path to public good," he argued that public institutions, including universities, were "among the worst offenders" because they exclusively license their inventions to major corporations.

This advice is worth thinking about at present because the public institutions, at least in the US, are just starting to make the running in plant genomics. Following the start of the Plant Genome Project in 1996, the National Science Foundation has sharply increased its support of plant genetics at universities and will spend $100 million on it next year. The Plant Genome Project was started single-handedly by Senator Christopher Bond (Republican, Missouri), at the behest of US farmers. The USDA has also become active in supporting plant genetics research for the first time. Industrial players such as Monsanto, which had taken an early lead in the study of the genes of commercially important plants, have welcomed the public activity, and stand to benefit from it.

The conventional wisdom in the US holds that exclusive licensing of techniques developed at public expense in the research universities to industrial corporations is "a good thing". Despite frequent rumblings from politicians that drug companies, in particular, should repay more of the profits they make from such licenses, it is widely believed that exclusive licensing encourages innovation, and that the public ultimately gets its investment back through tax revenues on the resultant economic growth.

That may be true, but some remain indignant about a situation in which the fruits of publicly funded research are likely to be denied to those who need them most—in this case, poor farmers. Although occasional concessions, such as Monsanto's offer to waive license payments on vitamin-A enhanced rice, are welcome, they don't constitute a satisfactory structural arrangement that will integrate new knowledge and technology into agriculture in the poorest countries.