

Gene Mapping Japan's Number One Crop

Japan wants to map the rice genome, but some Japanese corporations are raising sticky problems

Tokyo—JAPANESE SCIENTISTS HAVE BEEN voicing doubts about joining international efforts to sequence the human genome, but it seems that there is one genome that they are determined to call their own: that of rice, the key agricultural crop for Japan and the rest of Asia. Within weeks, Japan's Ministry of Agriculture, Forestry, and Fisheries (MAFF) is expected to announce the first steps in a 7-year, \$25-million project that will bring together up to 100 researchers to produce a high-resolution map of the rice genome and sequence the most important genes.

The project should create one of the most detailed maps of the genome of any crop plant. (The only plant to be more thoroughly mapped is the weed *Arabidopsis thaliana*; since last year it has been the focus of a \$4.5-million-a-year international project led by the U.S. National Science Foundation.) But a key question for plant researchers is how much of the data from the Japanese rice project will be made public. Industry will provide many of the researchers and, with negotiations still at a delicate stage, there is no final word on whether companies will agree to provide open access to data they gather—a question that has cropped up in U.S. plant mapping efforts as well.

With an estimated 450 million base pairs, the rice genome does not present the same problems as the 3-billion base pair human genome. But it is still quite a challenge compared to the 70-million base pair genome of *Arabidopsis*. The first stage in making a map—the identification of genetic markers—has begun in Japan, with some 350 restriction fragment length polymorphisms (RFLPs) isolated. A group at Cornell University, headed by Steven Tanksley, is also on the way and has already assembled a crude map containing 400 RFLPs. But MAFF's ambitions are much greater. The plan is to map 2000 RFLPs and create a high-resolution physical map of the genome within 7 years. At the same time, researchers will look for key gene sites and functions and create a cDNA clone library; this phase of the project should be complete in 2 to 3 years and the sequencing of the most important genes could begin as early as 1992.

"First, we will seek genes that increase nutritional productivity," says Masahiro

Nakagahra, Joint Research Coordinator of the project at MAFF. He says they would like to find something as important as the glutinous gene, isolated in maize by U.S. researchers. Transferred to rice, the gene would cause the sugar amylose to be replaced by amylopectin, making the rice stickier, more nutritious, and better tasting. Next in priority will come genes that confer resistance to diseases, such as rice blast. Attempts will then be made to transfer genes between different strains of rice (Japan keeps a collection of 13,000 varieties) and, later on, between rice and other plants, says Nakagahra. He envisions, for example, the creation of a "rice tofu," which would put genes for soybean proteins into rice, creating a high-yielding "plant factory."

But to make all these dreams come true, MAFF needs the help of Japanese corporations. "We hope to bring together MAFF and Japanese corporations in a major joint research program for the first time. Corporate researchers could join the larger scientific community," Nakagahra states. But there's doubt about how enthusiastic corporations will be to join that community.

Although the image of Japan Inc. is of government and industry working in perfect harmony, the reality is that cooperation is never assured without a lot of tough behind-the-scenes bargaining—what the Japanese politely call "forming a consensus." Not surprisingly, the chief problems are who does the work, who pays for it, and who benefits at the end.

Minoru Yamada has the job of negotiating with Japanese corporations on behalf of MAFF. After 7 months work, he is confident that several companies—including Kirin Breweries and members of the Mitsui and Mitsubishi groups—will each send up to ten researchers, perhaps later this year. But one biotechnology analyst warns that there is a risk that the corporations may just send along inexperienced researchers for what they regard as little more than government-supported training. And so far, there is little sign of any financial commitment from the corporations. Although they were originally slated to provide up to half the \$25-million budget for the project, they have not yet come up with any cash. So, to start things



The Image Bank

To everything there is a sequence.
Japan's rice harvest.

going, MAFF will provide \$2.7 million this year, about 90% of which will go directly to fund research and buy equipment.

The corporations are also playing hardball about who benefits from the research. While MAFF likes to advertise the project as a contribution to international science, the companies are demanding the right to keep all research results to themselves as the price of their participation. If corporations have their way, MAFF researchers fear, only the RFLP probes on the physical map will be shared openly. The more valuable information on the locations of genes—and their all-important sequences—could be kept confidential. Such secrecy could block scientific publication for years.

"If the Japanese corporations can hoard their information like that," says Tanksley, "China, Korea, India, and others could become reluctant to join large-scale genome efforts. It would have a significant, chilling effect on international interactions."

The partial opening of Japan's rice market to cheap foreign imports may strengthen MAFF's hand in their dealings with industry, and in competition for research funds. As a biotechnology analyst puts it: "The politicians will want to be able to argue that they are doing something for the rice farmers, who are the backbone of powerful rural voting blocks. So maybe they will provide extra funds for rice genome research." But unless MAFF controls all the research funds, one knowledgeable observer says, its authority will be diluted, enabling Japanese corporations to exercise powerful leverage of MAFF's research choices—and perhaps turning a research project into another source of international friction.

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