Introduction and Overview

Diagnosing Maize Diseases with Proprietary Biotechnology Applications Transferred from Pioneer Hi-Bred International to Brazil and Latin America

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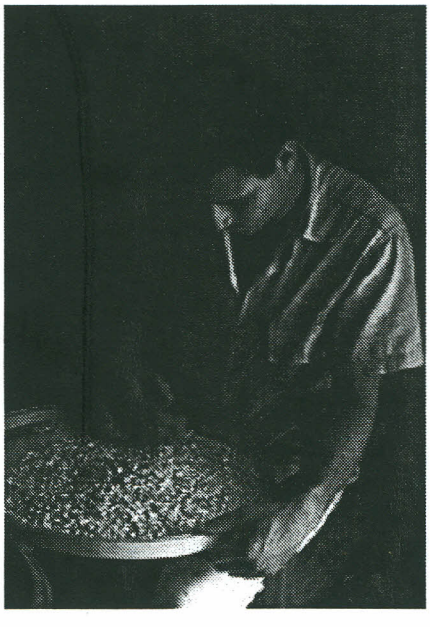
In the early 1990's, scientists in Brazil became concerned about the growing spread of unidentified maize diseases in the crop's major production areas. Researchers at the Brazilian National Maize and Sorghum Research Center (CNPMS) at Sete Lagoas had previously seen virus-like symptoms in several maize varieties, but were unable to identify them. They had little information on the development of the diseases and were in need of reliable methods of detection. At risk was the country's nearly 15 million hectare crop. Its annual production of 30 million tons



is valued at about US$700 million. Although total production meets today's Brazilian demand, the average maize yield at 1.8 tons per hectare is very low. This reflects the lack of high-yielding varieties, use of better soils for other crops and lack of technology.

At the same time, there were reports of new viruses spreading into Brazil from neighboring countries and from other areas of Latin America. Scientists from the International Maize and Wheat Improvement Center (CIMMYT) in Mexico had concluded that Brazil's

[1] Krattiger, A.F. Kulisek, E.S. and Casela, C. 1998. Introduction and Overview: Diagnosing Maize Diseases with Proprietary Biotechnology Applications Transferred from Pioneer Hi-Bred International to Brazil and Latin America. *In* Diagnosing Maize Diseases in Latin America (Eds. C. Casela, R. Renfro and A.F. Krattiger). *ISAAA Briefs No. 9*. ISAAA: NY. Pp. 1-4.

problem was a higher prevalence of the corn stunt virus complex, probably the result of an increase in year round cropping of maize. Because of the growing importance of the crop in Brazil and rapid spread of the diseases, a national virus detection program was given a high priority designation by the country's Agricultural Ministry. CNPMS officials had earmarked funding for staff training and project expenses.

The immediate need was a simple test to quickly identify the diseases under field conditions. Once that was done, scientists could better understand the spread of the diseases, undertake control programs and breed maize varieties with resistance to the diseases. Although some diseases can be visually diagnosed, many require laboratory testing that can take days and weeks to complete. As a result of advances in biotechnology, new products and techniques are now available that can replace time-consuming and sometimes inaccurate laboratory procedures.

Above:Alejandro Ferreira inspecting maize diseases.
Below: Alejandro Ferreira and Dr. Carlos Casela (right).

Early in 1993, Brazilian officials contacted the International Service for the Acquisition of Agri-biotech Applications (ISAAA) for assistance. Following an intensive survey by ISAAA and discussions with several potential donors of the technology, Pioneer Hi-Bred International of Johnston, Iowa (a corporate sponsor of ISAAA since 1992), was selected as the partner.

The project, brokered by ISAAA to assist Brazil, involved the development and donation by Pioneer of its proprietary ELISA technology for detection of diseases, in addition to training CNPMS scientists and technicians in laboratory and field techniques. Pioneer also agreed to organize and co-sponsor a three-week training program in Iowa, for a Brazilian scientist, on the development and application of ELISA diagnostic kits.

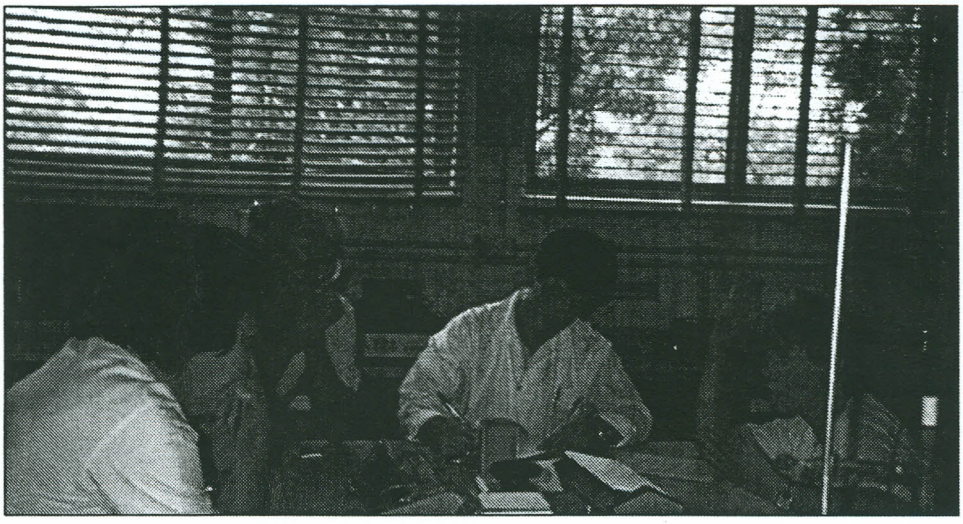
Of the three major diseases infecting Brazilian maize varieties, two diseases, Corn Stunt Spiroplasma (CSS; a bacterial disease) and Rayado Fino (RF; a virus), were selected by Brazil and Pioneer for initial study because of their prevalence in Brazil and many other countries in Latin America.

The production of enzyme-linked immunosorbent assays (ELISA) is a diagnostic kit in detecting viral and bacterial diseases. These diagnostics are based on a method that uses antibodies to detect disease causing organisms of plants.

In the summer and fall of 1993, Ellen Kulisek of Pioneer, developed and perfected two assays to detect CSS and RF viruses and field tested them in Johnston. The antigens necessary to initiate antibody production were donated by the US Department of Agriculture. The following January, Kulisek trained 14 Brazilian scientists and technicians at the Sete Lagoas research headquarters on both laboratory and field use of the assay procedures for each of the two ELISAs. The assays worked well because they were sensitive enough to detect infected plants that were considered free of disease based on visual observation.

Later that year, Carlos Casela of CNPMS benefited from a three-week ISAAA Biotechnology Fellowship at Pioneer on ELISA development. Meanwhile, CNPMS

named a researcher from the in-country training course, Elizabeth de Oliveira, to head a new diagnostic program at Sete Lagoas. There is a strong potential for diagnostics in Brazil that needs to be encouraged and supported. This requires not only financial support and commitment, but interested members of the scientific community who are committed and willing to donate their time to this. Pioneer had agreed to precisely this. It is also noteworthy that the cost of the project—which was low compared with the value of the diagnostics—was sponsored by CNPMS and Pioneer.



Workshop participants during laboratory work at the CNPMS/ISAAA Maize Disease Manangement *workshop*

Equipped with trained manpower, CNPMS was by then in a position to transfer this technology to others in Brazil, such as farmer cooperatives, seed companies and non-governmental organizations, all of which would strengthen the nation's maize breeding, seed testing, production and extension programs. It also set the stage for the transfer of the kits to other countries in Latin America. Indeed, a Latin American training workshop co-sponsored by CNPMS and ISAAA took place from 20-24 May 1996. It was entitled *Maize Disease Management* and was hosted by CNPMS at Sete Lagoas in Brazil. The present *ISAAA Briefs* No. 9 is a result of that workshop.

The objectives of the workshop were two-fold: First, economically important maize diseases in the whole of Latin America were reviewed to share knowledge and experiences about their occurrence, spread and management practices that have been successful. Second, a two-day hands-on seminar enabled participants to learn the ELISA technology developed as part of the collaborative project between Pioneer Hi-Bred International and Brazil. This is 'technology transfer' to the end-user in its true sense of the word. Over 150 people participated, ranging from the national programs of Bolivia to Brazil and of Colombia to Costa Rica; some 30 local and national companies from these countries; international agricultural centers, including CIP and CIMMYT; and other private companies ranging from Brasalkalb to Zeneca Seeds (now ADVANTA) and Cargill Seeds to Ciba Seeds (now Novartis Seeds).

From left to right: Drs. Carlos Casela (EMBRAPA), Ellen S. Kulisek (Pioneer Hi-Bred Int.) and Falvio Jader of EMBRAPA inspecting maize fields during a project visit to Sete Laogus, Brazil.

Pioneer's participation in the project was as part of its commitment with ISAAA and not to create a scientific advantage for Pioneer in Brazil. The company has

long standing business interests in Brazil and will always be interested in agricultural efforts and trends there. The company has an established global program for humanitarian assistance.

Brazil's view is that there are biotechnology applications, many developed at great cost and owned chiefly by private companies, that developing countries cannot afford, but that are vital to their agricultural development. Through this project, Brazil was able to establish a partnership with Pioneer that is benefiting Brazil and Pioneer, including the farmers, breeders, the environment and, through the workshop, Brazil's neighbors.

It is clear that such pragmatic projects are an effective means of building cooperation and trust between the public and private sector. The success of this project and workshop, the basis of the present *ISAAA Briefs No. 9*, is a result of the commitment by the country and the company to the technology and to the fact that it fulfilled a specific and important need for Brazil.

It is hoped that with such need-driven pilot projects, like the present one between Pioneer Hi-Bred International and Brazil, new mechanisms beyond traditional technology flows are being built, which will open the possibility for larger biotechnology transfers for the benefit of farmers and the environment.

The debriefing of workshop participants.