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**“Advances in Application of Agricultural Biotechnology to
Control Diseases and Pests of Tropical Crops”**

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ABSTRACT

The application of biotechnology tools has greatly enhanced our ability to diagnose diseases, determine the genetic diversity of pest and pathogen populations, understand host-pathogen interactions, combine genes from a wide array of organisms in transgenic technologies, and develop durable strategies for their management.

Molecular information about pathogens and their vectors is important in their basic characterization. Many pathogens and pests have complex populations, and these are being characterized using a variety of molecular techniques. Specific examples include the use of random amplified polymorphic DNA (RAPD) and sequence characterized amplified region (SCAR) to diagnose whitefly biotypes, to differentiate among spittlebug species in the tropical forage grass *Brachiaria*, and mealybug species in cassava. Amplified fragment length polymorphism (AFLP), random amplified

microsatellites (RAMs), and other techniques are being used to characterize various pathogen populations of rice, cassava, beans and tropical forages.

Biotechnology offers valuable tools to study and understand at a molecular level the complex genetic systems of host-parasite interactions. Identification of molecular markers and tagging of resistance genes are tools that are being used in marker-assisted-selection for genetic enhancement to speed the introgression of desired resistance genes into elite crop backgrounds. Molecular markers have been developed to assist in selection for resistance to bean insects such as bean pod weevil (*Apion godmani* Wagner), melon thrips (*Thrips palmi* Karny), and Mexican bean weevil [*Zabrotes subfasciatus* (Boheman)]. Markers are also being used to pyramid rice blast resistance genes, and to develop cassava genotypes that are resistant to African cassava mosaic disease.

Molecular maps as well as entire genome sequences of several plants and pathogens have been made available by various groups in several countries including those in the tropics. An example is a cassava molecular map developed at CIAT. Viral pathogens of cassava, rice and beans have been sequenced and characterized at CIAT to develop diagnostic tools, understand their diversity and pathogenesis, and isolate viral genes for use in transgenic resistance.

Resistance to pests or diseases often succumbs in time due to evolving pest or pathogen pressure. Biotechnology tools provide the possibility of novel forms of resistance from various sources through recombinant DNA technology. Transgenic plants are estimated to cover 81 million hectares in 2004. Of this, 27.6 million hectares are in developing countries. We have developed transgenic rice with resistance to rice hoja blanca virus, and are using transgenic mutant populations to identify pest and disease resistance genes.

The use of microbes in disease and pest control is another area of our research. Endophytic fungi that form complex and mutualistic associations with their host plants have been subjects of considerable research in the temperate zones. In recent years, advances have been made in endophytic fungi associated with the tropical forage grass *Brachiaria*. These fungi help to protect their hosts from biotic and abiotic stresses.

This paper focuses on some key advances made in agricultural biotechnology applications to plant disease and pest control strategies, with specific examples drawn from research on the various CIAT commodities and their respective pest and pathogens in the tropics.

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