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Colombia's campaign to save plantain from *moko*

Farmers and scientists join forces to counter bacterial wilt epidemic sweeping number 2 crop

Smallholder farmers in Colombia have been working side by side with international and national agricultural scientists and extension agents for the past 3 years to save their plantain stands from bacterial wilt. Their collaborative campaign against *moko*, as this highly destructive disease is known in Latin America, has fortunately begun to pay off – but none too soon.

Among the more promising weapons in the emerging *moko*-management arsenal is a biopesticide that does double duty as an organic fertilizer. The liquid, called a "lixivium," is produced inexpensively on-farm by composting plantain residues, specifically the hanging, spine-like shafts called rachises from which the flowers and fruit protrude. This is the part of the plant that farmers routinely discard after harvest. Its systematic decomposition into a useable lixivium biopesticide takes about 75 days.

Typical symptoms of *moko* in plaintain.

More environment-friendly than conventional chemical treatments, the lixivium contains microorganisms that kill *Ralstonia solanacearum*, the bacterium responsible for bacterial wilt. It is also effective against black sigatoka, a fungal disease that attacks plantain and banana, and against powdery mildew in roses. As such, the biopesticide shows significant commercial promise, well beyond its current use by small-scale plantain growers.

Once the lixivium is collected from the composter, all that remains is a small quantity of solid organic material. This final solid residue is not used as a fertilizer or biopesticide as it may still harbor *moko*-causing bacteria. Rather, it is left in the composter to maintain the decomposition process as new crop residues are added.

"We wanted to give the farmers simple, easy-to-use solutions because they don't like complex technology," says Silverio González, director of FEDEPLATANO, the National Federation of Plantain Producers of Colombia and the chief designer of the composting system. "Our members prefer to solve problems using their own local resources, so they don't have to spend too much money."

González, himself a farmer, notes that the use of certain "green manures," as well as fertilizer rich in calcium and phosphorus, have also been shown to suppress *moko*-causing bacteria in the soil. Green manure is any fresh, leafy vegetable matter, even whole plants, purposely incorporated into the soil to improve its fertility or other properties.

Club del Moko

FEDEPLATANO is just one of several public and private stakeholder groups that form the *Club del Moko*, a broad alliance working on *R. solanacearum* diagnostics and the design and testing of disease-control measures. Other key alliance members include the International Center for Tropical Agriculture (CIAT), the Colombian Institute for Agriculture and Livestock (Instituto Colombiano Agropecuario, ICA), the Colombian Corporation for Agricultural Research (Corporación Colombiana de Investigación Agropecuaria, CORPOICA), and the International Network for the Improvement of Banana and Plantain (INIBAP).

A field day with the *Club del Moko*.

The rationale for creating this forum for cooperation was simple and compelling: *moko* was and is a national agricultural emergency. The disease, which sometimes causes total crop losses, now affects most or all plantain-growing regions of Colombia, including the highly productive central coffee zone. Annual plantain losses have been estimated at US$5.8 million. In 2003, CORPOICA estimated that 68 percent of a plantain-growing area it had investigated in Meta Department was infected. It is clear, say researchers, that in the absence of concerted intervention, the spread of *moko* could easily halt plantain production in many parts of Colombia in just a few years.

Several years ago, as the *moko* problem steadily worsened, farmers approached ICA and other institutions for help. A loose association of farmers, government and university researchers, and private agrochemical companies grew out of that contact. But unfortunately, they couldn't solve the problem.

By this point, producers were also quite worried about the ill effects, on human health and the environment, of continuously applying Formol (formaldehyde), one of the recommended pesticides for killing bacteria in the soil. The economic repercussions also concerned them since Formol's high toxicity rendered the soil lifeless, thus undermining production of other crops such as coffee, maize, and cassava.

All the while, the researchers and farmers were tracking the expansion of the *moko* epidemic. Their projections were alarming. "We suspected it would take only 2 years to destroy 27,000 hectares of plantain in Quindío Department alone," recalls González.

A role for CIAT

So it was that sheer economic necessity once again found itself to be the motherhood of invention. With FEDEPLATANO and CIAT serving as institutional midwives, the *Club del Moko* was born in February 1998

Elizabeth Alvarez, a CIAT plant pathologist with long experience in farmer participatory research, sketches the background of her Center's involvement. "In the hope of finding a solution to the *moko* epidemic, the farmers decided to approach CIAT for help. The reason they didn't come to us earlier was that they thought we worked only on beans, cassava, rice, and forages. That was true a long time ago; my mandate, for example, was cassava diseases. But then we ended up helping out a group of flower growers who had a mildew problem. So the directors of CIAT allowed us to begin helping clients outside our traditional set of crops, on a demand-driven basis."

The collaborative project, operating under the *Club del Moko* umbrella, has covered a lot of R&D ground:

- A survey of 21 farmers in several municipalities in Quindío Department provided the scientists with a snapshot of the *moko* problem in one area where disease pressure is

growing. It showed that 11 percent of the plantain production area had become infected with the bacteria – a disturbing 43 percent increase in just 5 years. In addition, nearly all the respondent farmers reported problems with *moko*, and most were using recommended control methods but with little positive effect.

- Later, back at the CIAT laboratory, Alvarez and her colleagues identified 68 strains of *R. solanacearum* bacteria using molecular markers. These were isolated from samples of plant tissues, soil, water, and insects with a view to establishing the pathogen's genetic diversity. CIAT has also collaborated with CORPOICA to study the genetic diversity of the pathogen in Colombia's Eastern Plains (Llanos Orientales). However, being able to detect the bacteria not only under lab conditions but also on-farm is essential if plantain producers are to make effective use of new alternative methods of control, that is, at the right time and place. Accurate on-farm diagnostic tools are therefore a priority in the next stage of research.

- In Quindío about 50 farmers have been building, testing, using, and in some instances adapting the FEDEPLATANO composter design. Apart from the cost of materials (roughly US$75) to shelter the 20-square-meter composting area and collect the rachis lixivium, the main farmer investment is labor. Construction is done under the supervision of one of three institutions: ICA; the Servicio Nacional de Aprendizaje (SENA), which is particularly interested in good management practices; and the Corporación Regional del Quindío (CRQ), one of whose aims is to promote ecologically sound agricultural practices. In each case, FEDEPLATANO supplies farmers with a small quantity of compost starter, a liquid inoculum developed by González. Since the lixivium production process is being patented by CIAT, he is reluctant to discuss the inoculum formula, saying only that ripe plantain is one of the ingredients.

A system for artesanal production of the biopesticide for *moko* control.

- During 2003, the project carried out numerous experiments both in greenhouses and on-farm in Quindío to test a range of alternative *moko*-control methods. Apart from the rachis lixivium., other promising options for reducing the bacterial load were marigolds (*Tagetes patula*) and velvet bean (*Mucuna pruriens*), used as green manures, and Calfos, a calcium and phosphorus fertilizer.

Three's a crowd: coffee, plantain ... and coca

Plantain, like coffee, occupies a special place in Colombian rural life, notes González. "This crop is important even for our small farmers who grow it on a single hectare. It gives people the extra money they need to buy basic goods – like cooking oil and salt, and even books for their children's education. Plantain is an essential part of our people's daily diet, along with cassava and potatoes. In the Amazon region in the south, it's actually the number-one food crop, more important than cassava." Indigenous people there, says González, cultivate plantain almost exclusively for home consumption; but elsewhere in the country it is mostly a dual-purpose crop, for both food and income, often intercropped with coffee.

Plantain is, after coffee, the country's most important crop. It is grown on about 125,000 farms and covers some 450,000 hectares. Among the traditional advantages of this starchy staple are its low production costs by weight – in comparison with rice and maize, for example – and the fact that it can be grown year-round in a diversity of environments. Around 14 percent of the 2.5 million tonnes of plantain grown annually in Colombia is exported. Colombia's biggest foreign customer is the USA, whose appetite for plantain is on the rise.

Apart from its role as an importer of plantain from Colombia, the USA also actively encourages its production there – as an alternative to coca. According to a 2001 fact sheet prepared by the US State Department, Colombia is the world's top coca producer and cocaine exporter and "90 percent of the cocaine and most of the heroin [made from poppies] in the US market now comes from Colombia."

US support of plantain production is part of its $1.3 billion contribution to Plan Colombia, a national program launched by former Colombian President Andrés Pastrana, aimed at promoting peace, security, democracy, and economic growth in that country. Among the Plan's key aims is a halt to the cultivation of coca and opium poppies – in part by encouraging alternative crops with income-earning potential. US involvement in Plan Colombia has been highly controversial, however, because a major thrust of the antidrug campaign is the eradication of coca fields by military force, via aerial spraying of chemical defoliants launched from helicopters. This strategy, critics argue, is counterproductive, causing social, economic, and environmental damage.

Besides plantain, the commodities being promoted as substitutes for illicit crops include oil palm, rubber, and cacao (the main ingredient of chocolate). But for most farmers these options are less attractive than plantain because they have longer payback periods.

Moko disease in plantain and banana was first reported in Colombia in 1954, in Tolima Department. By 1968 it was affecting banana production in Urabá in northern Colombia. In the

ensuing years, its emergence as an economically significant disease prompted many poor farmers, particularly those in remote areas, to switch to coca production for the lucrative narcotics trade.

Over the past decade or so, following the price-related crisis in the coffee sector that began in 1993-94, many Colombian coffee growers have come under heavy economic pressure to abandon production or at least find complementary sources of income. This partially accounts for the surge in production of coca during the 1990s. But now, with a well-financed war on illicit crops being waged by the government, that option is not as attractive as it once was, and plantain is once again seen as a viable option – a complement to coffee or a substitute for coca. Indeed, the rapid spread of bacterial wilt is undoubtedly linked to the resurgence of plantain as a smallholder crop, particularly the exchange of uncertified, *moko*-infected materials between farms.

The coffee crisis forced many farmers to choose one of two options: abandon coffee production altogether and switch to cattle production, or keep the coffee and intercrop it with plantain. Industrious farmers, says González, chose the latter option, in part because plantain is more labor-intensive than livestock, thus providing rural jobs. "We also wanted to maintain our way of life related to coffee production."

Gonzalez's faith in the economic complementarity of coffee and plantain for Colombian smallholders should come as no surprise. He is not only the current leader of FEDEPLATANO, but also its founder. And in the late 1920s his great-grandfather, Carlos E. Restrepo, who was President of the Republic from 1910 to 1914, founded the now famous National Federation of Coffee Growers of Colombia.

Silverio González, director of FEDEPLATANO, the National Federation of Plantain Producers of Colombia

Local benefits, global recognition

To date, the activities of the *Club del Moko* have provided four major benefits to farmers. First, the application of selected disease-control methods at test sites covering 4,000 hectares in Quindío has dramatically reduced disease incidence and therefore crop losses. Second, local plantain growers have made the rural environment safer by eliminating the use of Formol (formaldehyde) and other chemical pesticides. Formol, although highly toxic to people, had been routinely used to disinfect soil. Three applications per year of farmer-produced plantain lixivium, diluted in water and then applied to the foliage, now replaces as many as 12 applications of commercial chemical pesticides to control black sigatoka. Third, reduced reliance on agrochemicals has helped farmers cut their production costs. Finally, the Club has enhanced local capacity for rural learning and innovation, mostly in Quindío, through on-farm experimentation. So far, more than 1,000 farmers have participated in the research and technology validation work. Several thousand more farmers and agricultural technicians were also trained in *moko* control in 2003 and 2004 at demonstration sites and at CIAT headquarters in southwest Colombia.

Future prospects

So where should joint R&D by researchers and producers go from here? Alvarez and González see eye to eye on priorities for the *Club del Moko.* Rapid-diagnosis kits must be designed for farmers. *Moko* control technologies, including production and use of rachis-compost lixivium, should be further improved and widely disseminated. And communities should be assisted in producing disease-free planting materials. But can the momentum of better *moko* management be sustained? And, just as important, how can the benefits of improved control technologies be expanded to other communities across Colombia?

In many Latin American countries, local agricultural research committees (called CIALs in Spanish) are an established mechanism for boosting crop production, conserving natural resources, and fostering rural innovation. Encouraging the creation of new committees of this type, to focus specifically on plantain, may be a sound strategy, says Alvarez. It has worked for other commodities and inputs such as maize, cassava, soybean, and organic fertilizers. Why not for plantain?

Such a grass-roots effort in support of plantain would see diverse groups of small farmers build on the modest yet significant gains to date by the *Club del Moko.* It might also provide them welcome respite from the continuing stress of low coffee prices and, who knows, from the roar of low-flying helicopters defoliating the jungle.