Food security and local production of biopesticides in Cuba

Until recently, Cuban agricultural production was based almost entirely on the conventional industrialised model characterised by a strong dependence on synthetic pesticides and fertilisers, fossil fuels and other Green Revolution inputs. With the collapse of the socialist trading bloc in 1989, however, the country’s access to pesticides and other inputs it had relied on vanished almost overnight.

Peter Rosset and Monica Moore

The simultaneous loss of most of the country’s imported agricultural and industrial inputs, direct food imports, international markets and sources of foreign exchange resulted in a profound and continuing crisis for the Cuban people and government, a crisis amplified by escalation of the US government’s long-standing economic and political blockade of the island nation. Most critically, agricultural production and food access plummeted to record lows, resulting in acute food shortages in a country that for decades had guaranteed an ample, low-cost food supply as a right of citizenship.

In 1990, the Cuban President Fidel Castro declared the start of an indefinite ‘Special Period in Peacetime’ as the framework for the dramatic policy reforms necessary to meet the basic food requirements of the island’s population. It was to be a period in which Cuba’s agricultural and economic productivity would be rebuilt. As a direct result of the Special Period, Cuba has embarked on an unprecedented national transition from high-external input to low-input and organic agriculture, including the implementation of biological, control-based, integrated pest management (IPM) approaches throughout the country.

Drawing on experience and investments in human resources that predate the Special Period by many years, policy makers, producers and researchers began adapting and reconstructing Cuba’s agricultural infrastructures to facilitate low external input production, including the breakup of state farms into smaller units under more direct management by producers; the creation of a national network of small laboratories producing an increasing variety of biological control agents, botanical pesticides and biofertilisers; legalisation and promotion of private sector farmers’ markets; widespread development of urban agriculture; and a new emphasis on farmer-to-farmer and farmer-to-extensionist exchanges, on-farm research and agro-ecological training for producers and scientists alike.

Cuba’s agricultural conversion not only challenges the common belief that feeding a nation’s population depends on pesticides, but also highlights the strengths and limitations of two different versions of IPM: the ‘input substitution’ approach as opposed to using IPM as a component of an ecological agricultural system.

Local Production of Biological Agents

Coping with a more than 80 percent drop in the availability of pesticides and fertilisers was among the more desperate challenges at the start of the Special Period. Cuba’s decades of experience with biological control proved crucial in meeting this challenge. Historically, much of this experience was with mass-reared parasitoids. Since 1968, the parasitic fly Lixophaga diatracea had been used against the sugar cane borer in almost 100 percent of the areas planted with sugar cane. Parasitic wasps (Trichogramma spp.) have been widely used since the early 1980s against Lepidopteran pests in pasture management, and later in tobacco, tomato and cassava. Also in the early 1980s, the sweet potato weevil Cylas formicarius began to be controlled in sweet potato using predatory ants (Pheidole megacephala). Reservoir populations of these ants were established where they were naturally abundant, and colonies moved into sweet potato fields from these areas, achieving up to 99 percent control.

Despite such successes and the adoption of a national policy favouring IPM in 1982, pesticides remained the main form of pest control in Cuba until the onset of the Special Period. At that point, researchers working on biological control and other aspects of ecologically-based agricultural production systems were mobilised from within different universities, ministries and research institutions to respond to the crisis. In effect, this instantly mainstreamed the ideas of a number of younger scientists whose exposure to the environmental movement and ecological principles had led them to develop a critique of Cuba’s dependent modernised agriculture, but whose ideas were marginalised within the infrastructure supporting that system.

Based on the work of such researchers and using existing technologies, the Ministry of Agriculture significantly accelerated and expanded existing plans to increase the production of natural enemies in order to replace the lost pesticide imports. By 1994 some 222 decentralised
For nematode control

*Beauveria bassiana* 781
*Nomuraea rileyi* 142
*Bacillus thuringiensis* (B.t.), is a bacterial insecticide widely used to control a great variety of Lepidopteran pests in many crops and is used for mosquito control in public health programmes. In addition to the CREE’s production of B.t., three ‘semi-industrial’ plants also produce a more uniform B.t. biopesticide, which is seen as a potentially important export product. Fungi-based biopesticides produced by the CREEs and in widespread use include: *Beauveria bassiana*, used extensively to control Coleopteran pests - including weevils that attack sweet potato and plantain; *Verticillium lecanii*, to control whitefly; *(Bemisia tabaci)*, a vector of viral diseases in tobacco, tomato, beans and numerous other crops; *Metarhizium anisopliae*, for various insect pests; and *Trichoderma* spp., used as an antagonist of the soil-borne pathogens of tobacco seedlings (see Table 1). Other biopesticides now being developed for scaled-up production include *Nomuraea rileyi* and *Hirsutella thompsonii*. Given the importance of tobacco in the Cuban economy and culture, the success of biological control in this crop is extremely interesting. Tobacco production in most countries is heavily reliant on methyl bromide, a highly hazardous and ozone-depleting fumigant pesticide listed for worldwide phase-out under the Montreal Protocol. Based on the success of *Trichoderma* spp. as an alternative, Cuba now plans to prohibit all use of methyl bromide in 1998.

**No panacea**

We do not mean to suggest that biological pesticides have been a panacea for Cuba. First, it is hard to obtain accurate estimates of efficacy in Cuba. Second, many other factors have gone into stimulating increased food production, not the least of which are the higher prices paid to farmers, land distribution and new marketing mechanisms. Furthermore, artisanal production of biopesticides may not have been without problems.

CREE staff readily admit they cannot ensure quality control standards or production goals in their artisanal laboratories, given unpredictable supply shortages and poor crop cuts that are still common features of the Special Period. The resulting uneven quality and availability of biopesticides are significant obstacles to the efficacy of the pest management systems that depend on them. Producers’ unfamiliarity with biological control is, more generally, another obstacle. Most extension personnel are new to biopesticide themselves, and training capacity is not yet sufficient to ensure that the biopesticides are always used to greatest effect. As chemical pesticides are either unavailable and/or unaffordable, however, producer experience with and enthusiasm for biological pest control continues to grow. According to the Director of an award-winning CREE in the Province of La Habana, the country’s most important food-producing province, demand for biopesticides outstrips supply at most CREEs during peak seasons, suggesting that limited production capacity may also constrain IPM efficacy.

In a larger sense, pesticides - whether biological or chemical - cannot substitute for prevention. In that light it is interesting that there has been a virtual explosion of intercropping across Cuba’s previously monocultural landscape, as farmers have raced ahead of agronomic research to use traditional methods where modern ones have disappeared. Many farmers argue that the intercrops reduce pest attack and produce more per unit area. A now ubiquitous cropping system is the maize/sweet potato intercrop, which is said to greatly reduce both sweet potato weevil and armyworm infestations, enabling high productivity without pesticides. In the absence of precise data, it is difficult to measure the relative contributions of new technologies like biopesticides versus traditional and suddenly back-in-style practices like intercropping. The Cuban case is a crucial one in that it extends what have been local experiences to the level of national self-reliance and food security. That is important in the 1990s, an era in which concrete proof is more important that idealistic rhetoric. It cannot be denied that locally produced biopesticides have played a key role in allowing Cuba to overcome a food crisis, although the actual efficacy of these products and their importance in relation to other changes in contemporary Cuba have proven hard to quantify.

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References

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Table 1. National production figures for biopesticides in Cuba (metric tons).

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<td><em>Bacillus thuringiensis</em></td>
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<td><em>Beauveria bassiana</em></td>
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<td><em>Verticillium lecanii</em></td>
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<td><em>Metarhizium anisopliae</em></td>
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<td><em>Trichoderma</em> spp.</td>
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<td><em>Paecilomyces ilacins</em></td>
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*Source: Díaz, 1995.*