

The Cuban response to scarcity of inputs

Crop associations

Maria de los Angeles Pino and Humberto Ríos Labrada

Until 1989, Cuba's agricultural system was characterised by its dependency on foreign external inputs. This system covered over 70% of the country's arable land. In some parts of the country, such as in the eastern region and in the western province Pinar del Rio, traditional agriculture still played a dominant role. It was official policy to reduce the land share of small farmers: producers had to either pass on their land to state farms or form co-operatives (Trinks and Miedema, 1999).

After the collapse of the socialist countries in 1989, the share of monoculture-based agriculture diminished drastically. The use of fuel, the main agricultural input, fell from 13.0 to 6.1 million tonnes in two years. In the same period, the amount of fertiliser used fell from 1.3 to 0.3 million tonnes and expenditure on pesticides from 80.00 to 30.00 million USD (Rosset and Benjamin, 1993).

At the same time, farmers and scientists in Cuba began to look for alternatives that would protect plants from biotic and abiotic stresses. They attempted to use the land efficiently and experimented with low input levels. In these experiments, farmers' knowledge, underestimated for so long, played an essential role once again.

Traditional crop associations, such as maize-beans and maize-pumpkin that had been used before by small farmers, became a common practice in large areas. At the same time, unusual crop combinations, such as carrot-cabbage, lettuce-cabbage, carrot-garlic, tomato-beans, sweet potato-pumpkin, maize-tomato, banana-beans, banana-taro-beans-maize, sugar cane-beans, began to appear in areas that had long been dominated by monoculture practices. Even though most of the work by formal research institutions was still directed towards monocultures, many areas started to produce food in a manner that remained invisible to formal statistics by the early 1990s.

In this new situation of virtually no external inputs, most of the new crop associations were found to be more productive than monocultures. Many farmers practising crop associations were able to obtain two or more crops on the same piece of land, previously monocropped. The different crop production schemes made it possible for farmers to operate in different ways: first, to produce and sell the entire harvest of the principal or "duty" crop to the state market at very low prices, as is obligatory; second, to produce and sell on the free market, with strong price incentives. For instance, in huge sugar cane

tracts, one or two rows of beans or cowpea were planted between two rows of sugar cane. In this way, farmers who sowed beans at the start of the growing period of sugar cane could either be self-sufficient in beans or sell them on the free market. Thus, polycropping allowed farmers to produce one official crop, and at the same time secure an income through selling secondary crops.

Polycropping also led to better control of pests and diseases in the absence of chemical pesticides, to more efficient use of very scarce inputs and to higher economic profitability. The polycropping approach quickly spread all over Cuba as a way of alleviating the consequences of the external input crisis. Scientists joined the movement and started research on this method.

Tomato and maize: an unusual association

Tomato (*Lycopersicon esculentum* Mill) was a typical monoculture in Cuba before 1989. This crop requires a combination of temperature, radiation and relative humidity that is optimal between October 21 and December 20 in Cuba. Producing tomatoes out of season, though extremely lucrative, is very expensive, as the production should, ideally, be in greenhouses with high-energy consumption.

The solution to this problem was found in using maize as natural shade for tomato, and thus modifying the microenvironment favouring tomato production off-season. Different spatial arrangements of tomato-maize were tested under small farm conditions. Fertilisation was done with a combination of biofertiliser and 90 kg/ha of Nitrogen (120 kg/ha of Nitrogen being the normal recommendation).

The most productive spatial arrangement was three rows of tomato planted between two rows of maize (see Figure 1). Maize was sown 30 days before tomato was transplanted. Every row was oriented from north to south.

This spatial arrangement led to a reduction of the radiation intensity by about 25% and a temperature decrease of approximately 3°C. Yields of tomatoes produced under maize shade increased by 5-6 tonnes/ha in comparison with tomatoes grown as a monoculture. The tomato-maize association decreased adult white fly presence by some 24% and reduced virus infections by 6%. Fruit quality was found to be better.

The main advantage for farmers is in being able to plant before and after the optimum sowing period, allowing them to

market fresh tomatoes off-season and thereby increase income. In the transition from tomato grown as a monoculture to the tomato-maize crop association, the benefit-cost ratio increased from 1.9 to 3 when sown after the optimum moment or from 2.4 to 3.5 when sown before the optimum sowing time. At the same time, some maize was produced for home consumption or sale on the free market. (Pino, 2000, in preparation).

The once unusual combination tomato-maize is becoming more and more common in small, private farms (with, on average, one hectare of land) of the San José de Las Lajas municipality. One of the principal obstacles to further spreading of this crop association has been the difficulty of mechanisation. It is interesting to note how quickly farmers have adopted this and other low input systems, in a setting where few Cuban functionaries realised the advantages of crop associations as a principal component of the new Cuban agriculture. In spite of the fact that such alternative practices in agriculture have contributed to a slight recovery of the Cuban economy and to higher food security, policy makers still advocate a backward move towards use of high external inputs. In order to avoid a renewed dependency on external inputs, the challenge now, for researchers and farmers alike, is to gather more evidence on successful crop associations. ■

Maria de los Angeles Pino and Humberto Ríos Labrada. National Institute of Agriculture Sciences (INCA, San José de las Lajas, La Habana, Cuba cp32700 e-mail: angeles@inca.edu.cu and Humberto@inca.edu.cu)

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