Insecticides, fungicides, herbicides/weedicides, and nematocides can be broadly classified as pesticides. Many widely used pesticides are synthetic products (e.g., DDT, Malathion, Dichlorane, Antracol). A major problem posed by conventional synthetic pesticides is their toxicity to humans and other animals. This has led to renewed interest in the search for less toxic, natural substances—biopesticides.

What are biopesticides?

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. In 1984, there were more than 400 registered biopesticide active ingredients and 15,000 active product registrations. Biopesticides fall into three major classes: Microbial pesticides, Plant incorporated protectants (PIP's), and Biochemical pesticides.

1. Microbial pesticides consist of a microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest(s). For example, there are fungi that control certain weeds, and other fungi that kill specific insects.

The most widely used microbial pesticides are subspecies and strains of Bacillus thuringiensis, or Bt. Each strain of this bacterium produces a different mix of proteins, and specifically kills one or a few related species of insect larvae. While some Bt's control moth larvae found on plants, other Bt's are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larva to starve.

2. Plant-Incorporated Protectants (PIPs) are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the bacterium, manufactures the substance that destroys the pest. The protein and its genetic material, but not the plant itself, are regulated by EPA.

3. Biochemical pesticides include substances, such as insecticides, that interfere with mating, as well as various scented plant extracts that attract insect pests to traps.

4. "Botanicals" are plant products used as biopesticides. Some well-known examples are: Neem (kohomba) tree seed, pyrethrum (obtained from citronella) and citronella.

Brown plant hopper in rice. Often variable efficacy due to the influence of various biotic and abiotic factors (since biopesticides are usually living organisms, which bring about pest/pathogen control by multiplying within the target insect pest/pathogen)

Living organisms evolve and increase their resistance to biotechnological, chemical, physical or any other form of control. If the target population is not exterminated or rendered incapable of reproduction, the surviving population can acquire a tolerance of whatever pressures are brought to bear, resulting in an evolutionary arms race.

World Trade

It should be borne in mind, however, that the existing demand for biopesticides is not met by current production volumes, a situation only compounded by production costs generally above those of chemical products.

In most countries employing biological pest control strategies, biopesticides are purchased at considerably higher prices (1 kg of Bt, for instance, can command a price of 10 to 30 dollars or acquired from small local manufacturers selling their productions at 20 to 30 dollars per kg. These figures are sometimes higher than those reached by chemical pesticides.

Biopesticides represent a 200 million to 350 million US dollars/year market, amounting to less than 3% of worldwide spending on agrochemicals (20 to 25 billion US dollars/year). Although their higher price partially accounts for their lower market share, both pest control and pest resistance to biological control is one of the greatest factors contributing to this situation is the relentless advertising of large chemical corporations, which have made efforts to commercialize and exploit the advantages of biopesticides more widely known among prospective customers.

Cuba: A world leader

In no country has the application of biopesticides for phytosanitary purposes reached the level of organization, diversity and extension that exists in Cuba, according to the opinions of foreign specialists.

Until recently, Cuban agricultural production was based almost entirely on the conventional industrial model characterised by a strong dependence on synthetic pesticides and fertilisers, fossil fuel and other forms of chemical input. With the failure of the socialist trading block in 1989, however, the country's access to the pesticides and other inputs it relied on vanished almost overnight.

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 of the Cuban economy and government, a crisis intensified by escalation of the US government's long-standing economic and political blockade of the island nation.

To be continued tomorrow.