BIOLOGICAL CONTROL OF PLANT PESTS

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Biological control is the regulation of a population of an organism by naturally-occuring enemies, so that the population density of the organism would remain at a lower level than would otherwise occur. The term biological control could also be used in an applied sense to encompass all activities man may take to control pests of animals and plants. For instance, pests of economically important crop plants could either be regulated or controlled by manipulating the population of the natural enemies of the pests.

Nearly all groups of organisms have natural enemies. Such enemies, which can be broadly classified into predators, parasites and pathogens, have a remarkable instinct to seek and prey on the host. A pest is an organism which inflicts damage to a living or a non-living thing useful to man. A pest of one organism could be the food of another organism. Two well known cases of biological control are the use of myxoma virus for the control of pest rabbits in Australia and the natural control of deer by the mountain lion in the U.S.A. In some parts of coastal waters of Sri Lanka, it is reported that the crown of throns starfish is predatory on the living corals. In a sense, the predatory starfish is exercising biological control, but it is also a pest because it attacks the useful coral.

Although pests range from microbes to mammals, most of the studies on biological control have been carried out on insect pests, as about 80% of all animals are insects. The other group of pests, where biological control techniques are employed is weeds, which compete with crop plants and reduce yields. In the control of insects, biological control agents could be classified into predators, parasites and pathogens, The first two are termed entomophagous, the latter entomogenous. Parasitic insects, often referred to as parasitoids, lay eggs in or near the host individual (pest). The resulting 'immature insects' ((larvae) feed on the host (pest) body, thereby killing the pest. At the sametime, the parasitic insect multiplies, and the free-living adult parasite emerges after completing the life cycle to start a new generation by attacking the pest once again. Predators behave differently. They consume the pest individuals. Pathogenic micro-organisms cause diseases in pests. Pathogens could be fungi, viruses, bacteria or even nematodes.

Biological control has a long history. One of the earliest known cases is the use of Red Ants for the control of insect pests of citrus trees in China. The farmers could purchase Red Ant nests and place them on their citrus trees, and the movement of ants from one tree to another was ensured by placing bamboo 'bridges' between trees. One of the earliest known successful introductions of a natural enemy from one country to another is the importation of the mynah bird to Mauritius to control the red locust, which was a very serious pest of crop plants. The first record of an observation of insect prasitism goes back to 1602 when it was noted that an insect, quite different from a butterfly, was seen emerging from a butterfly pupa. Of course, we now know that this is the emergence of a parasitoid from a butterfly. Around this time, the diseases of insects had been discovered. This was mainly because of man's interest in the silkworm, but diseases of bees had also been noted by Greeks. By about 1875, the idea of using pathogens to control insects was well established, and commercial production of micro-organisms for such purposes had begun.

The effectiveness of biological control was very well established in the United States with the discovery of the cottony-cushion scale in 1868 in California and its subsequent control. Within 20 years, this scale insect had threatned the important citrus industry with total destruction. So extensive was the damage that farmers abandoned their orchards. The entomologists involved with the project were anxious to experiment with the natural enemies of the scale, which was thought to have originated from Australia. However, the government did not support the idea and would not apportion funds to undertake an expedition to Australia, where the pest was under control, to look for natural enemies. With considerable difficulty, an expedition to Australia was eventually undertaken in 1888, where parasites and predators were found and imported into the United States and immediately liberated in

application of far more toxic pesticides. Although the consolidation to a single cropping schedule from the point of view of lowering pest population is more desirable, the achievement of such practice would be near impossible.

(k) Irrigation Practices

Poor water management practice, which either results in lack of or excess of water, induces the growth of pest and disease causing organisms The development of certain insect pests are favoured during water stress while continuous flooding encourages disease infestations. The irrigation might also act as a medium of transmission of pathogens and weeds from an area of high infestation to a healthy area.

It should now be evident that the cultural methods outlined above can be made to serve as good, efficient, and profitable techniques of pest and disease control of agricultural crops. Additionally, these measures have the preserving effects of soil, water and air environment.

orchards having scale infestations. The entomologists in California, who received the shipments of insects, set up elegant field multiplication methods and quickly multiplied the parasites. The programme was so successful that by 1889, the entomologists were unable to find living scales! The total cost of the operation, including expeditions, was less than US $ 5000. Benefits to the citrus industry have amounted to millions of dollars annually ever since. Also, the technology and the predatory and parastic insects were made available to a large number of citrus growing countries throughout the world.

In Sri Lanka, first attempts of biological control had been made in the late 30's. Some records of observations of natural enemies of insects pests of paddy are available, but it is doubtful whether any serious follow-up research had been undertaken. Of the main crops in Sri Lanka where any organized attempt of biological control has been carried out, is Coconut crop protection.

Because of the stature and geometry of the adult coconut palm, traditional crop protection measures such as sprarying of insecticides are very difficult. The scientsists were therefore compelled to look for other avenues of crop protection, and naturally. settled for biological control.

A remarkable event in the annals of pest management in Sri Lanka is the control of *Promecotheca cumingi*, , the introduced pest of coconut, first observed in 1971 near Colombo. The pest multiplied unchecked and spread rapidly throughout the country, aided by our transport system. Within 2 to 3 years. the pest had devasted about 30,000 acres, of coconut and posed a serious and a major threat to the industry. The scientists working on the project were anxious to embark on a programme of biological control and were able to import a nucleus culture of 10 ant-like parasitic insects. These were bred and released in the field. The *modus operandi* of these parasitic insects is spectacular. They would walk on the coconut leaflets, and seek, by instinct, the larvae of *Promecotheca* which are in a mine, in between the two surfaces, in the leaflets. Once located, the parasite would deposit its eggs on the body of *Promecotheca* by piercing the leaf epidermis using a fine swordlike ovipositor. Parasitic larvae would emerge from the eggs, and would devour *Promecotheca larvae* thereby controlling the pest. An unbelievably high level of control of the pest was achieved within a relatively short period at a total cost of less than US $ 500,000. The benefits to this important industry, which was saved from extinction, are incalcuable.

Similar but less spectacular biological control programmes are in use for the control of other coconut pests. The Coconut Caterpillar is kept under control by the use of a variety of parasites which attack different stages of the pest. The rhinocerous beetle control programme uses virus, fungus and a nematode, all of which are pathogenic on the larval stage of the pest. A recent introduction is the use of an insect predator for the control of a pernicious weed on coconut land, *Chromolaena odorata (Eupatorium odoratum)*. The insect used was rigidly screened for its specificity of the target plant prior to its multiplication and field release. The insect has proved to be efficient, and has already been established in various parts of the country carrying out its useful role as a predator.

The full potential of biological control has yet to be harnessed. Considering its merits such as the low cost, permanency of control achieved and the lack of harmful and undesirable effects on the environment, with no danger to man and other non-target organisms, biological control offers an ideal opponity for pest control.

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* public release of health and safety data gathered by European registration authorities.

The papers of the chemical firm Ciba-Geigy reveal that in 1976 six Egyptian volunteers between the ages of 10 and 18 were exposed to the poisonous pesticide Galecron so that its effects on human beings could be tested. Galecron is a means of plant protection which, because of its "secondary effects", is today only applied in cotton plantations.

The "child experiments", which gave rise to public indignation, nevertheless constitute only a fraction of the questionable behaviour of the chemical company. Further internal examinations of Ciba-Geigy in the possession of the Bern Declaration (Zurich) reveal that while the weak to medium strong cancer-producing Galecron is indeed recognized as damaging to health, it is nevertheless exported to countries of the Third World.

Inquiries made by the company in Central America, Bolivia, Columbia and Egypt indicated that residues of the poison in urine were above the allowed limits in most of the workers examined. Thus, in 1980, examinations of workers in Bolivia showed that 70 per cent had levels above the limit of 0.3 miligram per litre of urine established by Ciba-Geigy itself. Independent tests made in Mexico showed similar results.

When Galecron is sprayed from aeroplanes only 25–50 per cent of the poison reaches the field. The remainder falls on human beings, animals, plants and also on neighbouring fields growing food crops. The dangerous nature of the chemical, as estimated by the firm itself, is evident at the production plant in Monthey (Switzerland), where security requirements are similar to those operating in an atomic power plant. The production process is largely handled through remote control. For repair work and revisions the workers must wear one-piece. protective clothing which is used only once. Subsequently, a complicated

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decontaminating procedure, as well as regular urine tests, are prescribed. When the upper limit is exceeded a transfer to another work place is affected.

After the case of Galecron was made public by the Bern Declaration and Swiss television, Ciba-Geigy reacted by announcing; "In countries where security measures come up against special difficulties" Galecron can only be applied "either under the company's own supervision" or through companies which "commit themselves to observe the security measures". In "all other cases" the firm will suspend the sale of Galecron.

The Bern Declaration compares with a similar measure ordered by Ciba-Geigy in 1978 "without drawing the appropriate conclusions as to its uselessness". Moreover, the security precautions do not take into consideration the "acute danger to people in neighbouring settlements, as well as to food crops and drinking water".

Meanwhile, Ciba-Geigy has announced its intention to file action against Swiss—German television following the broadcast of Kassensturz on November 15, 1982 which was concerned with the use of Galecron in the Third World. According to the company this decision was taken because "the images broadcast had been falsely presented as a documentary film and the reputation of the company as well as that of the cotton growers of Tapachula (Mexico) had been deliberately sullied." The Union of Swiss Postal, Telephone and Telegraph Workers has expressed astonishment that the chemical company refused to participate in an interview for the broadcast which it now condemns. According to the PTT Union the arguments used by Ciba—Geigy "didn't hold water" and the company "had only itself to blame".

(Source: *Development Forum* Jan 1983)