Classical biological control: Nature-based solutions to reduce pesticide usage

Professor Martin Hill from the Centre for Biological Control at Rhodes University discusses the benefits of classical biological control and highlights the necessary considerations for this approach

The International Organization for Biological Control (IOBC) defines biological control as using living organisms or their products to prevent or reduce the losses or harm caused by pest organisms. A broader definition of this discipline would include reference to the development of nature-based solutions to reduce the pesticide footprint in the world. Biological control can be divided into three broad categories:

- Conservation biological control is the suppression of populations of harmful species by living organisms that occurs without deliberate intervention by humans other than the preservation of natural ecosystems to enhance natural enemies for pest control.
- Classical biological control (CBC) is the deliberate importation, release, and establishment of natural enemies in areas where they did not previously exist to reduce non-native invasive pest populations (the topic of this article).
- Augmentative biological control, in which natural enemies of pests are mass-reared under controlled conditions and released to temporarily suppress pests.

History of classical biological control

There is no doubt that humans have been using conservation biological control for thousands of years. For example, the Chinese used ants to control aphids on fruit trees. However, the first example of intentional CBC was the unfortunate and misguided introduction of Common Myna birds into the island of Mauritius as a biocontrol agent of the red locust in 1762. This was followed in 1888 with the highly successful introduction of the vedalia beetle to control the cottony cushion scale on citrus in California. It was credited with saving the emerging citrus industry in this region and was successfully introduced into Africa in 1892. This natural enemy was also used to control cottony cushion scale in the Galápagos Islands, where the goal was to conserve endemic and indigenous plants being killed by this pest. The first weed biological control programme was the release of the cochineal insect in South Africa in 1913 to control an invasive cactus, Opuntia monacantha.

Why use biological control

People are becoming increasingly aware of where their food comes from and questioning the human and environmental effects of long-term pesticide usage. Therefore, CBC is an environmentally safe intervention that can significantly reduce the reliance on pesticides for invasive alien weed and pest control.

The benefits of biological control

Classical biological control has had some of its most significant impacts in the Global South, notably Africa, where it has contributed to food security and economic development, especially in Africa.

Cassava is a very important staple food throughout most of Africa. This wonder plant was introduced to the continent by the Portuguese in the 1700s and rapidly became a vital crop. The cassava mealybug was inadvertently introduced to Africa in the 1970s and spread throughout the continent, resulting in widespread famine and food insecurity for more than three hundred million people. The parasitoid wasp, Anagyrus lopezi, was collected in South America, rigorously tested to ensure it was safe for release (i.e. it was not going to feed on anything else) and released widely across the areas affected by the mealybug. The wasp completely controlled the mealybug to the point where it was no longer considered damaging to the crop resulting in a total savings of $9–20bn, with benefit–cost ratios ranging from 170:1 to 430:1.

The South American floating aquatic plants such as water hyacinth and giant Salvinia have become problematic on waterways throughout the world, and nowhere more so than the lakes and rivers of Africa where they degrade aquatic ecosystems, significantly limit their utilization, increase disease outbreaks, and generally stifle development in affected areas. Biological control has been successfully implemented to reduce the impacts of these weeds. In the early 1990s, Lake Victoria had approximately 20,000ha of water hyacinth. Two South American weevils were introduced, through a community-based programme, onto the lake, which resulted in the reduction of the extent infested to less than 2000ha in less than five years, significantly increasing the productivity of the lake.

The biological control of water hyacinth in southern Benin provided economic returns of 149:1. An analysis of some biological control research programmes in South Africa found that the benefit–cost ratios for those species assessed ranged from 34:1 to 4331:1. A recent study in South Africa showed that biological control of waterweeds had saved the country $52m USD in herbicide costs over the last 20 years.

Challenges for biological control

Some early attempts at biological control in the late 1800s and early 1900s were misguided. Vertebrates do not make good biological control agents as they are not specific. Thus, the introduction of cane toads to Australia to control cane pests, the introduction of mongoose to control rodents and the introduction of Common Myna birds into the island of Mauritius as a biocontrol agent of the red locust were not based on good science as no pre-release testing to ensure specificity was undertaken and were thus misguided and unfortunate and have given biological control a bad name. Expectations from the public for biological control are also often too high, as biological control is a long-term solution and not a quick fix. Further,

increasing legislation and bureaucracy from governments impede and erode confidence in this science. Despite this, given the current movement towards more sustainable food production and environmental protection, biological control is becoming more mainstream and has a bright future.

Please Note: This is a Commercial Profile