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Biological Control in the Developing World: Safety and Legal Issues

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Abstract

Biological control of weeds is the only method that is affordable to many resource-poor farmers in the developing world. In the absence of biological control they tend to abandon weed-infested land and clear more primary forest. Massive land clearing is the biggest environmental problem in the developing world and far outstrips any other environmental issue. The present concern with possible minor non-target damage by introduced biological control agents is totally irrelevant in this situation. Nit-picking within the biological control community about host specificity and non-target impacts is picked up by bureaucrats in developing countries where there are no established protocols for biological weed control, as a reason to obstruct and delay projects. Therefore we need clear, simple guidelines for use by developing countries, based upon acceptance of testing done elsewhere, and acceptance of possible minor non-target damage in cases where the weed is causing serious economic loss.

Keywords: biological control, developing world, safety, legal aspects

Introduction

Most of the world's wealth is controlled by western industrialised nations, but most of humanity lives in the developing world. The west relies heavily on capital and technology, whereas in the developing world labour is the most important resource. One of the chief constraints on agricultural production throughout the world is invasion by weeds. A western farmer or land manager has a number of technological tools available to counter the threat posed by weeds, from bulldozers and helicopters to mycoherbicides and genetic engineering, but still weeds reduce crop yields by up to 10% (Labrada 1996). The ability of subsistence farmers in the developing world to feed themselves is frequently limited by the amount of land they can clear and maintain weed free by hand. Hand weeding accounts for up to 60% of pre-harvest labour in the developing world (Webb and Conroy 1995) and weeds reduce crop yields by 20-30% (Labrada 1996).

Classical biological control of weeds has an enviable safety record (McFadyen 1998; but see Simberloff and Stiling 1996a,b) and should be especially attractive in the developing world where conventional chemical and mechanical control methods are frequently beyond the economic and technological reach of farmers and land managers. The ability of biological control agents to search for and locate the target weed without external intervention or additional input of resources makes it a particularly appropriate method in subsistence economies (Labrada 1996). But the reality is that the overwhelming majority of biological control activity occurs in five industrialised nations: the USA, Australia, South Africa, Canada and New Zealand (McFadyen 1998).

Biological control has been used effectively against weeds on a number of notable occasions in the past in the developing world. In the 1930s *Clidemia hirta* in Fiji (Simmonds 1937) and *Opuntia elatior* in Indonesia (Mangoendihardjo and Soerjani 1978) were successfully controlled using introduced insects. These successes continued in the 1980s with *Cordia curassavica* in Mauritius and then Malaysia (Ooi 1992), and *Salvinia molesta* in Papua New Guinea (Thomas and Room 1986) and Sri Lanka (Room and Fernando 1992). Some of these projects have had extremely favourable cost-benefit ratios reported (eg: Doeleman 1989, Chikwenhere and Keswani 1997), but biological control in the developing world still has major legal and bureaucratic barriers in its way and there remain considerable doubts about its safety. In spite of its inherent advantages over alternative strategies, biological control is almost completely absent from agricultural pest management considerations in the developing world (Napompeth 1989, Ismael 1991).

Safety Issues

Not many practitioners of biological control of weeds would uncritically accept the verdict of Simberloff and Stiling (1996a,b) on the apparently poor safety record of agent introductions. In fact their prognosis has been shown to be particularly pessimistic and the practice remarkably safe (McFadyen 1998). But it is true that the establishment of biological control agents is irreversible and once an introduced agent is widespread in a new country it cannot be eradicated. Decisions to approve the release of any new agent must therefore be considered carefully by the authorities in the importing country, taking into account both the risks of introduction and the consequences of not proceeding. The risks include potential damage to non-target plants and the likelihood that the agent will spread across national borders to occupy its entire potential range, possibly including areas where priorities for control differ.

Host specificity. Historically, biological control practitioners have been obsessed almost exclusively with avoiding damage to crops or plants with some distinct commercial value (eg: Tillyard 1934, Wapshere 1975, Torres 1990). On the other hand, Howarth (1983) considered that "it must be proved conclusively that the new organisms will not harm the native flora and fauna" before they can be considered as safe to release. The pendulum is swinging away from the testing of long lists of unrelated crop plants to a more systematic investigation of the potential host range of the agent (McFadyen 1998). Once the host specificity has been determined, a decision can be made as to whether or not it is safe to release the particular agent.

Just how much damage to native flora and fauna should we tolerate? In the developed world we have resources, subsidies, mechanisation, alternative technologies, sophisticated biological control laboratories with experienced staff, overseas research stations dedicated to exploration for natural enemies, and extensive areas of natural vegetation set apart and preserved in national parks and elsewhere. It is probably reasonable to insist on extremely high standards of safety when introducing biological control agents (although far lower standards are generally accepted when introducing plants for agriculture or horticulture). But are these standards relevant to the millions of subsistence farmers in Africa, the Asia-Pacific region or Latin America, or to preservation of the remaining biological diversity in these regions?

In much of the developing world, landscapes are massively altered, indigenous flora and fauna are almost non-existent and introduced species abound. Examples of this fairly extreme scenario in the Asia-Pacific region include most of southern China, much of Luzon in the Philippines, and large areas of Sumatra, Java and the eastern islands of Indonesia. The greatest threat to native species and natural ecosystems in these areas is continued land clearing. Refuges in national parks are scarce, scattered and insecure. If farmers in the developing world cannot access effective, low-cost, low-input weed control, they will abandon weed-infested land altogether and clear yet more forest to replace it, or indulge in massive use of herbicides or indiscriminate use of fire without consideration for downstream effects.

One of the most aggressive weeds in the world's tropical regions, *Chromolaena odorata*, creates high costs for subsistence farmers and plantation owners alike. It requires a high labour input from farmers and it creates a blockage in the natural succession of old fields back to secondary forest in slash-and-burn systems (M'Boob 1991). As a result, vast thickets of *C. odorata* surround villages and the biological diversity associated with regenerating forest patches is lost. In plantation crops, *C. odorata* begins to invade as the canopy thins with age. It then becomes cheaper and easier to convert mature forest into new plantations than to re-establish plantations on existing, weed infested sites (de Rouw 1991). The result is vast areas of abandoned fields covered with *C. odorata* thickets, and accelerated clearing of primary forest.

It is our contention that the present concern with possible minor non-target damage by introduced biological control agents in the developing world is unnecessarily restrictive. The establishment of effective biological control against the major agricultural weeds in the developing world benefits subsistence farmers by increasing the productivity of the land and reducing the labour costs of working it. This will reduce the rate of clearing primary forest, re-establish the succession of slash-and-burn systems back into secondary forest, reduce the careless use of herbicides by untrained and frequently illiterate operators, and reduce the incidence and impact of wildfires.

Political Boundaries. Biological control agents are generally mobile organisms not constrained by artificial political boundaries. The five major players in biological control of weeds (McFadyen 1998) have the advantage that they all encompass entire eco-climatic zones with political boundaries at their northern and/or southern extremes. The potential for introduced agents to spread to adjacent countries is thus minimised. The developing nations of Latin America, Africa and Southeast Asia (and the industrialised nations of Europe), however, tend to have no overt physical or climatic boundaries separating them from their neighbours.

There are already a number of documented instances of biological control agents spreading naturally to neighbouring countries. For example, *Acanthoscelides* spp. seed beetles, established in Thailand to control the spread of *Mimosa pigra*, have spread unaided to Burma, Laos and Malaysia, while the water hyacinth weevil *Neochetina eichhorniae* has likewise spread from Thailand, where it was deliberately introduced, to Malaysia (Napompeth 1990).

The potential for artificial political boundaries to create anomalies was recently illustrated by the successful release in Papua New Guinea of the *Mimosa invisa* psyllid, *Heteropsylla spinulosa*, following acceptance by the authorities in that country of host specificity tests carried out in Australia (Kuniata 1994). One release site was at Vanimo, just east of the border with Irian Jaya, a province of Indonesia (L. Kuniata personal communication 1998). Indonesian authorities do not accept host specificity tests carried out by other jurisdictions, and at present it is illegal to import or release *H. spinulosa* anywhere in Indonesia. When the psyllid inevitably appears in Jayapura, not far west of Vanimo but in Indonesia, it will be perfectly legal to collect specimens and transport them throughout the archipelago. This includes transport across the Wallace Line (between the islands of Bali and Lombok) that separates two major zoogeographic zones, and to the island of Sumatra, within sight of Malaysia and the Southeast Asian mainland.

With no established protocol for biological control, the bureaucratic processes involved in gaining approvals to import or release become extremely slow. Bureaucrats all over the world do not respond well when asked to agree to something new for which there is no established procedure. They fear blame if something goes wrong, and their reaction is inaction and delay. So when a useful biological control agent fortuitously appears from across a national border, it avoids red tape and nobody gets the blame if it becomes a disaster.

In the words of Napompeth (1990), "insect natural enemies of weeds are more readily cooperative in their regional effort than researchers and scientists." He may well have added "and bureaucrats."

Legal Issues

Australian researchers have a great deal of expertise and experience in host specificity screening and typically test more than 100 plant species to establish the host range of a potential agent (Forno *et al.* 1990) destined for release in Australia. Little further testing should be necessary before the agent could be released in Southeast Asia. However, some governments refuse to permit releases of biological control agents based on results of host specificity tests carried out in neighbouring countries. This leads to much duplication of effort. Countries with this policy include India (eg: Jayanth and Nagarkatti 1987), Thailand (eg: Napompeth and Winotai 1991), the Philippines and Indonesia. Other countries such as Malaysia (eg: Anwar *et al.* 1994a,b), Zimbabwe (eg: Chikwenhere and Keswani 1997), Fiji (eg: Kamath 1979) and Papua New Guinea (eg: Kuniata 1994) are notable exceptions.

There is a fear, based on a lack of understanding and knowledge, that introduced biological control agents will become serious pests. In a climate of fear of new technologies, strict regulations may act to increase this sense of danger (Torres 1990, Hokkanen *et al.* 1995) and this is becoming one of the major hindrances to proceeding with biological control (McFadyen 1998). As a result of this concern, some governments have adopted a deliberate 'go-slow' on biological control projects with a policy of allowing only one agent to enter the country for host testing, mass rearing and release at a time. New agents can only be imported following the successful establishment and evaluation of the previous agent. This greatly slows the process and adds significantly to costs.

Conclusions

Human activities have resulted in plant species being transported into new regions of the globe at rates unprecedented in geological history. Many thousands of species are now permanently established in zoogeographic zones that would not have been reached under normal evolutionary circumstances. In the affluent western world this free-for-all is now being questioned and progressively controlled, but the developing world has different priorities. Environmental protection for its own sake is less important than economic development. We are witnessing massive clearance of native vegetation in developing economies, exacerbated by the invasion of arable lands by intractable weeds.

Classical biological control carries with it small risks, but they must be seen in perspective. The risks need to be assessed rationally against the potential benefits, and against the costs and benefits of alternative control methods. Biological control is a particularly appropriate technology for use in the developing world, and the costs of not proceeding with it are increasing environmental devastation and destruction of livelihoods. Outright rejection or delayed release of agents that are less than perfectly host specific is akin to fiddling while Rome burns.

Many biological control agents that have controlled major weeds in affluent western countries were sourced from poorer countries. Now the challenge, and perhaps the obligation (Waage 1992), is to help develop technologically, culturally and economically appropriate protocols and methodologies for bringing the benefits of biological weed suppression to subsistence farmers in the developing world. These should include an acceptance of testing done elsewhere, and an acceptance of a low level of possible non-target damage in cases where the weed is causing serious economic loss.

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