



## Opportunities for biological weed control in Europe

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Received 12 April 2000; accepted in revised form 27 July 2000

**Abstract.** The development and application of biological weed control offer great opportunities not only for farmers, nature conservationists and other vegetation managers but also for institutions and companies that wish to sell plant protection services and products, and for the general public that demands safe food and a visually attractive and diverse environment. Despite the obvious opportunities for biological weed control, few control agents are actually being used in Europe. Potential agent organisms have features that make them particularly strong and useful for biological control, but they also have weaknesses. Weaknesses include a too narrow or too wide host specificity, lack of virulence, or sensitivity to unfavourable environmental conditions.

Developing specific knowledge on the interaction between weeds and potential biological control agents, as well as expertise to increase the effect of control agents and so achieve sufficient weed control in a cost-effective manner, should have the highest priority in research programmes. From 1994 to 2000 most ongoing research on biological weed control in Europe was combined in a cooperative programme. This COST Action concentrated on the interactions between five target crop weeds and their antagonists (pathogens and insects), on further characterisation of the specific blems and potential control agents and on the most suitable biological control approach.

The next major challenge will be to apply the findings provided by COST-816 to the development of practical control solutions. The leading objective of a new concerted research programme with European dimensions will be to stabilise or even promote biodiversity in the most important European ecosystems by integrating biological weed control in the management of these systems.

**Key words:** biological weed control, selective weed control, bioherbicide, pathogens, insects, narrow host spectrum, biodiversity, coordinated European research

### Strengths and weaknesses of biological weed control

Biological weed control is defined here as the deliberate use of natural enemies and plant pathogens (agent organisms) to reduce the population density of a target plant species below its economic injury level (Boyetchko, 1997). Mainly based on the way in which the agent organisms are used, three

fundamentally different approaches have been recognised in the biocontrol of weeds (Müller-Schärer et al., 2000):

- the inoculative or classical approach aims at control of naturalised weeds by one or several introductions of exotic control organisms from the weed's native range until it has become successfully established. After its establishment, no attempts are made to increase or to reduce the population of the agent. Traditionally, principally insects and only few plant pathogenic fungi have been the agent used in this strategy;
- the inundative or bioherbicide approach aims at weed control by release of an abundant supply of the control agent over the entire weed population to be controlled. To obtain sufficient efficacy of the agent, the application has to be repeated each growing season or even several times per crop cycle. Mainly indigenous plant pathogens have been used in this manner to control native weeds;
- the system management approach, which is related to the conservation and augmentative approaches (Müller-Schärer and Frantzen, 1996; Frantzen et al., this issue), aims at cautious manipulation of a weed-pathogen or weed-insect system by stimulating the build-up of a disease epidemic or insect outbreak on the target weed population. The application of a relatively low dose of inoculum to start an epidemic or outbreak will be necessary to reach a high enough level of the agent organism. Most efforts have focused on the use of native pathogens or insects to control native weeds.

As with all other weed control approaches, biological control has both strong and weak points. From the point of view of the agent organisms themselves, strong features that make them particularly useful for biological control are their inherent capability to damage their target weed, their selectivity in the choice of host plants, and the relative ease with which they can be reproduced and applied to the environment. The most obvious weaknesses of potential agent organisms may be their inability to reduce plant growth to acceptable levels (lack of virulence) and their sensitivity to environmental factors of which relative air humidity and temperature are the most important (Kempenaar and Scheepens, 1999). For the development of classical biological control it is important to recognise agent organisms that have strong features with respect to host specificity, virulence, and ability to survive and build up a high population density in their new environment. Weaknesses of the agent organism will irrevocably lead to failure of biological control. The agent can be successful even if it is not specific, but if it affects non-host plants, public perception will consider it as a failure. For the other two approaches, it may be possible to overcome weaknesses of the