

The Future of Biological Control

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In the 30 years since these International Symposiums on the Biological Control of Weeds began in 1969, advances in this area and other fields of science have had a profound impact on weed biocontrol. This control technology has come under greater scrutiny at the same time as exotic invasive weed species have increased their world-wide impact on the environment. Invasive weeds have adversely affected agriculture, native species (both plant and animal), and the long-term ability of man to sustain himself. The field of biological weed control moves into the twenty-first century with many new challenges and tools, but the most important change in the field is the growing number of new scientists making a career of biological control and the increasing sophistication of their equipment.

A number of papers presented at this symposium utilize molecular genetic techniques to resolve issues where, until recently, we lacked research tools with the ability to answer these questions. For example, accurate identification of target weeds is essential to successful control. While this is an obvious objective, hybridization between putative species, the existence of biotypes with different characteristics, and instability of morphologic characteristics in progenitor populations confounds the problem of weed identification. In other instances, the origin of a particular invasive weed is unknown or poorly documented, which complicates the search for specific biological control agents against the targeted weed. Genetic techniques originally developed by plant geneticists are now routinely employed by researchers in weed biocontrol, and include RAPDs, RFLPs, and the more recent AFLPs, to distinguish between closely related species and to establish the location of founder populations. DNA sequences are also commonly used to identify potential agents

and as species-specific biomarkers. In addition, DNA sequencing and related technologies provide a powerful tool to determine previously unidentified microbial endosymbionts associated with potential biocontrol agents. DNA sequences from these organisms can now be compared to similar sequences that are available in databases on the web, and provide a tentative identification or information on relationships. Both beneficial organisms, such as those associated with nutritional absorption and utilization, and potentially harmful organisms which may impact longevity, reproduction and successful agent establishment have been identified using this technology.

Other advances in the science of weed biocontrol include modeling plant phenology and climate matching between an agent in its native range and potential foreign release sites. Effective weed biocontrol may require matching the phenology of the targeted weed with the potential agent so that interactions in development between weeds and agents are coordinated.

Technology transfer plays a central role in successful biological control. The advent of Internet-based databases and web sites provides immediate access to up-to-date data on current noxious weed distribution. This information provides a valuable and timely resource for weed scientists and land managers. In the future, it is likely that more information will be disseminated using this technology. Increased mobility and inexpensive global positioning systems (GPS), coupled with communications via satellites and geographic information system (GIS) software, have greatly facilitated foreign exploration and research. E-mail-based communications around the world has further reduced isolation, increased the speed of communication and thus, facilitated teamwork across international borders.

During the second half of the twentieth century, pesticides became the technology of choice to reduce pest impact, be it insect, weed or disease. By the end of the century, the unrestricted use of chemical pesticides was seen to carry its own set of problems, and the model of Integrated Pest Management (IPM) to address pest problems gained support as an environmentally sound alternative. This concept uses biologically based technological components as its foundation, and pesticides when other technologies fail to reduce a pest population below acceptable levels. With the

advent of IPM and its renewed emphasis on biological control of weeds, new scientists and practitioners have been enticed into the field, fueling the robust scholarship so evident in these Proceedings.

Research reports in this lengthy volume touch on subjects not previously mentioned in volumes I-IX. Volume XI and beyond will continue to chronicle the changes in the field as we deal with wide scale weed problems in many of the countries of the world. The infusion of new scientists into the study of weed biological control ensures the continued advancement of this science, making it a particularly exciting time to participate in this dynamic field of science.