ASSESSING THE SAFETY OF MICROBIAL BIOLOGICAL CONTROL AGENTS

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Over the last two decades, the environmental safety of biological control has been questioned. Surveys in the literature have shown that although there are some examples of negative impacts, negative generalizations across biological control as a whole are largely unjustified. The next step taken by researchers in Europe has been to develop procedures to ensure that continued use of biological control is safe for the environment. Between 1998-2003, the Environmental Risks of Biological Control Introductions in Europe (ERBIC) approach for safe use of biological control was developed. While concerns in the U.S. have principally focused on classical biological control, the ERBIC approach was developed for inundative biological control; in Europe, classical biological control is not commonly used and there is very active use of inundative biological control, especially in glasshouses. Organisms released inundatively for biological control in one European country could spread to another country, so regulations are coordinated. The European Union (EU) funded development of this risk assessment plan with involvement from nations participating in the EU. In the following description of the ERBIC system, I will focus on insect pathogens, which are usually applied inundatively.

For a full risk assessment of a biological control agent to be used inundatively, there are three steps: (1) identification of the risk; (2) a risk management plan dealing with risk reduction or mitigation; and (3) a risk/benefit analysis comparing use of the natural enemy with current and alternative pest management. Risk is composed of the likelihood of adverse effects versus the magnitude of potential effects.

Risk identification is the step that involves knowledge of the biology and ecology of the natural enemy. The attributes needed to identify risk are (1) establishment; (2) dispersal; (3) host range; (4) direct effects (e.g., effects on non-target herbivores and intraguild predation); and (5) indirect effects (e.g., competition with native natural enemies). To test insect pathogens, where host finding behavior is virtually never an issue (as compared with arthropod natural enemies), host range would be tested in petri dishes in the laboratory. If infection is rare or does not occur, then the hazard rating is low. Otherwise, testing would proceed to more realistic microhabitats and, if substantial levels of infection occur, the next stage would be field testing. Of course field testing is only possible for new exotic species that cannot establish or field studies must be conducted in the area of origin, to derive an idea of host range. To choose species to test, first species in the same genus would be tested and then, the same subfamily, etc. In addition, non-related non-targets of interest in the release area or areas to which the natural enemy might spread as well as any threatened and endangered species should be tested.

Detailed tables in van Lenteren et al. (2003) present numerical risk index values for likelihood of establishment, dispersal, host range and direct and indirect effects that range from 1 to 5. For example, if the distance moved per release is < 10 m the rating is 1 while a species moving > 10,000 m per release would be ranked 5. Likewise, the magnitude of these different factors is scored, e.g., host range restricted to one species ranks 1 while host range restricted to the order ranks 4. Then, for each of the five attributes (e.g., establishment, host range, dispersal, etc.), the values for likelihood and magnitude are multiplied and then all five attributes are summed. The lowest possible sum for the risk index is 5 and the highest is 125. van Lenteren et al. (2003) suggest that for organisms with less than 35, no objection regarding release would be raised while for those ranking 35-70, you might want to study them further so the risk is better understood. To see how this rating system works, 31 natural enemies are ranked by van Lenteren et al. (2003), and a table is provided showing the decisions behind the final sums. These natural enemies are ranked based on where they will be used, e.g., glasshouse, open field, etc. The lowest ranked (safest) natural enemies were very small and host specific parasitoids while the least safe were generalist predators. Among the natural enemies, three entomopathogenic fungi and one entomopathogenic nematode were rated. These received ratings near 50, largely due to broad host range. I applied the rating system to *Entomophaga maimaiga* with a resulting rating of 34. The gypsy moth NPV ranked still lower at 17. Use of non-woven fiber bands impregnated with cultures of *Metarhizium anisopliae*, a novel application method we are investigating for control of Asian longhorned beetle (Dubois et al. 2004), ranked 24, in part due to the limited area of application. At present, these are my ratings and I welcome others to repeat my rating.

After risk identification, risk management could take the form of labeling to restrict type of crop for application or use of specific application techniques, e.g., spraying from the ground, application to soil, application as bands on trees. Finally risk must always be weighed against benefit, comparing the different alternatives for control along with not controlling the pest.

In summary, rigid regulation of biological control releases would only allow use of highly specific natural enemies. However, the industry producing biological control agents often must produce less host specific natural enemies that are regularly available, to have a large enough market to stay in business. There must be a balance somewhere between these two extremes for biological control to be a viable option. The goals in developing this ERBIC rating system were to develop a system so that it would be possible to choose the safest control agent, when more than one is available, decide if more information is needed to understand whether a natural enemy is safe and conclude whether some natural enemies are not suitable for use.

References

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