LENTEREN, J. C. VAN (ED.) 2003. Quality control and production of biological control agents. CABI Publishing; Cambridge, MA. xi + 327 pp. Hardback. ISBN 0-85199-688-4. $195.

So many books have recently been produced on non-target effects of classical biological control agents that the subject is running out of steam. This book deals with an aspect of biological control that has received much less attention: commercial production of biological control agents. Use of the products of commercial biological control producers is still a fringe market, but by one account is expanding by 15-20% annually with a $50 million turnover worldwide in the year 2000.

In general, commercial producers have not faced the intense scrutiny that importation of "alien = exotic" classical biological control agents has met in recent years. Nevertheless, their oversight by government agencies in numerous countries has become more demanding of documentation and guarantees. The guarantees are in most instances to lack of any harm to non-target species, but sometimes are guarantees to lack of harm "to the environment." Purchasers, of course, are interested in guarantees of fitness.

Consider the market that a commercial producer enters. It is one where the release of large numbers of individuals of a biological control agent may rapidly, or at least within a growing season, suppress pests below the economic threshold. Unlike in classical biological control, there is no attempt to establish a permanent population and, in fact, such permanent establishment might hinder future sales of the same organism. The direct competition is chemical pesticides. In some instances commercial biological control has an advantage over chemicals simply because its price is lower. In other instances, use of chemical pesticides would disrupt ongoing regulation of other pests in the same environment by pre-existing natural enemies. In yet other instances, use of chemical pesticides is restricted in some areas by law, or to maintain labelling of "organically-grown" produce. In this book, the commercial advantages of using biological control agents are not addressed in great detail but readers should be aware of the background. Some countries ban the importation of non-native biological control agents, whether these be for the purposes of classical biological control or commerce.

The book is multi-authored, with 37 authors contributing to one or more of the 20 chapters. More than half the authors are European, appropriately, because there are more commercial producers in Europe than in North America, and almost all the others are North American. Australians, New Zealanders, South Africans, South Americans, and Asians are not represented. Eight of them are owners or employees of commercial production facilities. The rest are employed at universities or government research organizations. There are more producers in Europe than in North America because more crops are grown in greenhouses in Europe than in North America, and the greenhouse industry is an important consumer of these products.

Commercial producers of biological control agents are judged by purchasers of their products. Pertinent questions are: (a) will this product do for me what the producers claim it will?, (2) is the price of buying and using this product competitive with my other control options, and (3) is the product of the commercial biocontrol producer I am dealing with the best available to me? This inevitably leads to quality and price comparisons, and of methods of evaluating quality. This book deals with factors that affect quality, and of methods of judging and maintaining quality, from the viewpoint of the producer and that of the purchaser.

We have not yet arrived at a universal method of judging quality. The proportion of living biological control agents, and whether they are of the specified species, are by no means enough. This is made plain by the various chapters which talk about quality in terms of suppression of the pest, reproductive ability of the biocontrol agent, greenhouse-cage searching ability by the agent, or size/fitness of the biocontrol agent. Some of these concepts are more suited for laboratory or field testing than for growers to use. Growers, too, want a means of testing the quality of purchased biological control agents. Chapter 19 then gives details of 26 tests designed for individual species (or groups of related species), to be used by growers for testing quality of 30 products (insects and mites).

The section titles are (1) Quality control for natural enemies, (2) Variability in foraging behaviour of natural enemies, (3) Coping with variation in foraging behavior, (4) Mass-produced natural enemies, (5) Quality control testing of natural enemies, and (6) Quality control tests. Included is a chapter on insects, mites, and nematodes now commercially available in Europe or North America (or both).

The book is a most useful compendium of knowledge of the commercial biological control industry in industrialized countries. It covers many of the aspects of commercial biological control production that a researcher would want to know. I found a few gaps. The title of the book suggests that it covers biological control agents, but it covers insects, mites, and nematodes – not bacteria, viruses, and fungi. That is no particular shortcoming because bacteria, viruses, fungi, and nematodes have been treated in other recent books. I would have liked to know how commercial biological control production is organized in less-industrialized countries where pay scales are lower and where the product may have to sell for a lower

price (as in South America and Asia). Can companies in less-industrialized countries meet the quality standards that are now being set in industrialized countries? That leads to international competition in sales: will there come a time when low-cost production in less-industrialized countries outcompetes that in Europe and North America?

Another gap concerns how international shipments are now made, knowing that at least the United States Postal Service and many if not all of the express package delivery companies that operate internationally (DHL, FedEx, UPS, etc.) list "living insects" or "living animals" among items that they will not handle. Why are "living insects" thus listed by these companies? In their lists of prohibited items, they do not explain, but we can guess at three of the reasons. One is that these express package delivery companies do not offer controlled temperatures during shipment (a package may be exposed to extreme temperatures that are likely to kill insects), and it would cost more to maintain room-temperature. Another is that importing countries (and some exporting countries) require permits from various government agencies; even if all the necessary permits are affixed to the package, the express package delivery companies may not understand whether affixed permits are valid and complete, and the extra paperwork will cost additional effort to handle. A final reason is an unfortunate consequence of events in September 2001 in the USA: it may be that certain incoming packages are now being routinely irradiated in attempt to destroy any "biothreat" (such as anthrax spores); such irradiation will doubtless kill biological control agents.

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