COMMENTARY

BOOSTING BIOCONTROL EFFORTS

by Bernard Dixon

We seldom look back with satisfaction and relief on past failures to develop exciting avenues of research. But those reactions do seem appropriate in the case of some excellent work on the biological control of crop diseases that was carried out at the Experimental Station of Cheshunt in the U.K. during the late 1940s. Particular optimism surrounded the idea that damping-off diseases of tomato could be combatted by *Penicillium patulum*, the mould that produces patulin. As Erna Grossbard recorded in the *Journal of General Microbiology* (6:295, 1952), the organism and its antibiotic had undoubted potential for their value in preventing costly infections of tomatoes and perhaps other plants, too. What was not known in 1952 was that patulin is both a mycotoxin and a carcinogen.

Since that time, only two fungi have been exploited commercially for plant disease control. *Trichoderma viride* has been marketed for use against several conditions, including Dutch elm disease and silver leaf of fruit trees. Although widely adopted in Eastern Europe (where 11 laboratories in Bulgaria alone have been producing *T. viride* to control pathogens such as *Botrytis cinerea* on strawberries), there are doubts about the reliability of some of these preparations. On the other hand, *Peniophora gigantea*, painted onto cut tree stumps, achieves fairly consistent results in combatting root rot caused by *Heterobasidion annosum* in pine trees.

One man who believes that there is now considerable scope to extend this very short list is Jim Lynch, who works at the Institute of Horticultural Research, an Agricultural and Food Research Council center at Littlehampton (and successor to the successor to the old Cheshunt laboratory). In part, his confidence is founded on the need to replace chemical agents (e.g. methyl bromide) that have become unacceptable on environmental grounds, because they persist in the soil or enter food chains. Equally significant, he feels, is the opportunity to attack plant diseases for which chemical weapons have never been devised—including pathogens whose minor nuisance value has not seemed to justify the costs of research and the registration of biocontrol agents.

One intriguing dimension of the Littlehampton work is illustrated by a short paper by Lynch and his colleagues in the current issue of *Letters in Applied Microbiology* (12:59, 1991). They have been investigating the utility of *Trichoderma* in combatting damping-off diseases caused by *Pythium ultimum* and *Rhizoctonia solani* in lettuce. The earlier literature contained suggestions that particular strains of *Trichoderma* could stimulate the growth of certain plants, although some of these reports were inconsistent or contradictory. Lynch and co-workers decided to see, therefore, whether any of 11 different strains of the fungus could affect the establishment and growth of lettuce even in the absence of disease pressure.

So it proved. When cultured in a molasses medium and

inoculated into a peat/sand potting compost before adding lettuce seeds, some strains had zero or even negative effects on the emergence and development of the plants. But two of the inocula were dramatically successful in promoting germination and producing larger plants. Moreover, the effects were consistent in 20 separate trials—the fungi increasing the mean yield by 54 percent in terms of fresh weight and by 27 percent in dry weight terms.

Other genera responded well, too. *Trichoderma* strains advanced the time of flowering in petunias, and increased the size and weight of marigold flowers by 100 percent. Publication of a full paper describing these findings in much greater detail awaits the completion of discussions in which Lynch is currently engaged with a major company.

Although buoyant about the potentialities of *Trichoderma* and other fungal antagonists of plant pathogens, Jim Lynch intercalates his ruminations on the subject with a degree of caution. He points out, for example, that it is not difficult to isolate fungi antagonistic towards agents of crop disease, especially *in vitro*. A far steeper task is to convert laboratory observations into field triumphs. The fact that we have seen remarkably few such conversions confirms that other parameters require attention too.

What needs to happen, clearly, is for research on biocontrol, still preoccupied with selection procedures, to embrace collateral aspects that are equally relevant to horticultural success. "It is important to generate R&D programs where factors such as toxicology and shelf-life are investigated alongside more fundamental aspects," says Lynch. Adoption of such a broader remit should obviate past disappointments when biocontrol agents have given capricious results in routine use after impressively positive trials under glass. "A multi-disciplinary approach, involving cooperation between soil scientists and crop physiologists, is needed to evaluate the boundary conditions of efficacy. This would lead to effective recommendations being made on the labels of products, as is done for many chemicals."

Trichoderma certainly commends itself as a well-positioned genus for efforts of this sort. In addition to Lynch's new work on growth promotion and the established, albeit small, commercial niches occupied by *T. viride*, we have substantial knowledge of the ecology of *Trichoderma* species upon which to assess their behaviour following release into the environment. Secondly, the recent development of protoplast technology for this organism raises the exciting prospect that more effective strains can be engineered by shifting around genes which code for protein associated with biocontrol activities.

The time is ripe, Jim Lynch suggests, for a major international effort on this organism, analogous to the exploitation of *Escherichia coli* that was at the heart of the emergence of molecular biology two decades ago. But then (as he cheerfully admits) he is somewhat prejudiced.