Prospects for IPM in Greenhouse Ornamentals in Australia

N. Gough
Entomology Branch, Department of Primary Industries, 80 Meiers Road, Indooroopilly, Queensland 4068.

INTRODUCTION

Integrated Pest Management (IPM) in glasshouse vegetables is now well accepted in Europe (van Lenteren and Woets, 1988; van Lenteren, 1990) but IPM in ornamentals is more experimental. However, it is clear that the trend away from purely chemical control of insects and mites in glasshouses is irreversible and that much research is now focused on non-insecticidal methods (including natural enemies) to control pests in protected ornamentals. The latter include those grown in glasshouses, greenhouses (defined here as any enclosed structure), and in plastic tunnels. This paper provides a brief overview. It has its origins in a more comprehensive report, the result of an overseas study tour by the author in 1991 (Gough, 1992).

THE TREND AWAY FROM PESTICIDES IN GLASSHOUSES

In Europe and North America the trend away from purely chemical control to IPM/ biological control in glasshouses is being driven by a number of factors. The examples below show that these trends are also important in Australia.

1) Increasing Miticide and Insecticide Resistance. Two spotted mite (TSM, *Tetranychus urticae* Koch) is a key pest of ornamentals and is notorious for its capacity to develop resistance (the ability of a strain of mites to tolerate doses of miticide which would normally be lethal). In continually warm conditions miticide resistance is a major problem. Thus, recent studies on the chemical control of TSM on roses (a very heavily sprayed crop) in Queensland and NSW (Gough, 1990; Goodwin et al., 1992 and unpublished data) have shown rapidly deteriorating control over the past 5 years. On some properties all registered miticides are now ineffectual because of resistance, which developed in under two years to some new compounds. Resistance has also been recorded overseas in some insect pests such as aphids, thrips, whiteflies, and dipteran (fly) leafminers.

2) Increasing Concern for Environmental and Work Safety Issues. The Dutch government is aiming for a 50% reduction in pesticide use by the year 2000, one reason being to reduce pollution of groundwater— IPM will be important in achieving this aim (J.J. Fransen pers. comm.; Van Lenteren, 1990). There is little weathering of pesticides by rain and sun in greenhouses. In the U.S.A., greenhouse re-entry time post-spraying is now as long as 72 h for some chemicals, which virtually precludes their use on ornamentals (Parrella, 1990). In Australia there is increasing concern about the lack of designated re-entry times for workers after greenhouse spraying. This is important in the warmer areas where workers are often scantily clad and there is a lot of skin contact with plants. Many growers already minimise residue problems by spraying immediately before weekends or rostered days off, when staff are absent. However, it is likely that occupational health and safety bodies, now acutely aware of safety in the rural work-place, will formalise re-entry times. Already applications for the registration of new insecticides require information on re-entry periods established overseas.

3) Decreasing Availability of Insecticides. The Australian Federal Government plans to institute a new national registration system for agricultural and veterinary chemicals in mid 1992. Off label or minor uses, which are important for ornamentals because of the diversity of crops included under that heading, will become a Commonwealth responsibility. No matter how efficient, the new system is likely to be less flexible than the old where minor uses were approved by the various state departments of agriculture. There will also be a reassessment of older chemicals. It is not expected to be as draconian as that in the U.S.A. in 1989 which resulted in the loss of 20,000 pesticide registrations across that country (Parrella, 1990), but some chemicals may disappear. Companies are naturally hesitant to develop new pesticides for use in the ornamental industry because it represents only a small market on which to recover the significant costs.

4) Increasing Consumer Demand for Pesticide-Free Produce. In Holland and Germany consumers prefer cucumbers and other glasshouse vegetables on which pests are controlled biologically (Ramakers, pers. comm.). In Australia consumer groups are moving to encourage minimal pesticide usage on many crops, including apples and pears.

5) Increasing Encroachment of Suburbia on Ornamental Production Areas. This is a problem in the USA (Parrella 1990), and also in Queensland (where there have been several court cases because of spray drift from orchards). In a recent survey of flower growers in southeast Queensland, Parker (1992) found that most expressed concern about suburban encroachment. In California recent legislation requires monthly reporting of the use of all pesticides and public warnings before their application, both of which are very time consuming for growers (Parrella, 1990). Consideration was given to introducing similar legislation into Queensland but it was not proceeded with.

6) Biological Control Can be Cheaper and More Effective for Some Species Than Chemical Control. In European glasshouses TSM is effectively controlled by the Chilean predatory mite (*Phytoseiulus persimilis* Athias-Henriot), and the greenhouse whitefly (*Trialeurodes vaporarorium* Westwood) by *Encarsia formosa* Gahan (van Lenteren and Woets, 1988; van Lenteren, 1990).

IPM/BIOLOGICAL CONTROL

Greenhouses provide ideal conditions for the growth of both pests and their natural enemies. Confinement leads to easier release of beneficials which may, with efficient prey-searching behaviour, lead to effective biocontrol. Greenhouses also provide ideal conditions for the development of pesticide resistance and, if it eventuates in a key pest, predators, parasites, or insect pathogens provide the principal means of control. However, crops are rarely attacked by a single pest. The biological control of a key species must therefore be integrated with the control of other pests and diseases using compatible chemicals, natural enemies, and pathogens, resistant plant varieties, etc. IPM focuses on integrating a range of control options with biological control, because the action of the natural enemies is often the most important and easily disrupted (Way, 1973). By screening and good hygiene many important pest species can be largely excluded from enclosed structures, often an essential prerequisite to successful IPM. Widespread biological control in glasshouses is contingent upon the large scale production and sale of beneficials (predators, parasites, and pathogens). This is an important industry in the northern hemisphere (e.g. there are five producers in the UK (Helyer and Richardson, 1991) and 60 in the U.S.A. (Raupp et al., 1992). There are currently at least four producers in Australia.

Extent of IPM in Glasshouses. Biological control and IPM of insect pests and mites in protected (glasshouse) vegetables is now widespread and successful with some 12,000 ha involved worldwide (van Lenteren, 1990). IPM in ornamentals is much more experimental and has had varying degrees of success. However, Wardlow (pers. comm.) is confident that biological control/IPM on glasshouse ornamentals can be a reality. In southern England insects and mites are under almost complete biological control in several very large nurseries, giving credence to his opinions. In these nurseries, biocontrol is more expensive than chemical control but quite acceptable to nursery management (Wardlow, pers. comm.). This is a result of good applied research and extension and close cooperation with growers. The latter are prepared to take some risks and want to reduce pesticide usage. In Germany, Albert (1990) has also reported some success. My impression is that the Dutch have a philosophy of not recommending IPM until it is proven under most conditions (van Lenteren, 1990), and so IPM on ornamentals in Holland is not widely used yet. This rationale can be adopted where excellent experimental glasshouses (on a commercial scale) and adequate research staff are available. When this is not the case (as in most parts of Australia) one is often forced to experiment on growers' properties and to promote commercial use of IPM before every problem is ironed out. While there are obvious drawbacks, a bonus is that growers are innovative and persistent, and often make a major contribution to the success of the programme. My impression in the U.S.A. is that IPM is much discussed but only beginning to be used. Whatever the present status, greater use of non-chemical methods (including biological control) on greenhouse ornamentals is inevitable.

IPM IN AUSTRALIAN ORNAMENTALS

Present Status. At the 1991 conference "Australian Horticulture — Clean and Green in the 1990s" it was clear that limited IPM in ornamentals is developing significant momentum in Australia. The predatory mite (*P. persimilis*) is now used by about 50% of flower growers in southeast Queensland (Parker, 1992) because of severe miticide resistance. Here it can be very effective (Gough, 1991).*Phytoseiulus persimilis* is also used in NSW (Goodwin et al., 1992) and Victoria (Osmelak and MacFarlane, 1992). However, as insecticide usage is reduced to allow these predatory mites to be fully effective, other pests often proliferate. Thus, mealybugs, thrips, and whiteflies have increased in pest status in Queensland and must now be controlled in a non-disruptive manner.

The Future in Australia. In those areas where miticide (and insecticide) resistance is not a major problem, chemical control will continue to dominate. For those areas where chemicals are not effective (or can not be used), Australia's current research and development on IPM in ornamentals needs expanding beyond the use of *P. persimilis*. Where TSM is resistant to chemicals, ultimate success with preditory mites will depend on the integration of a range of control strategies including the use of natural enemies, insect pathogens, and insect growth regulators (which selectively control some homoptera and gross feeders e.g. caterpillars) for secondary pests. As mentioned previously, hygiene and pest exclusion are very important. Indeed biological control of some pests will be impossible if they are able to constantly migrate, unimpeded, into the greenhouse. Success also depends on biocontrol companies increasing their range of natural enemies. The commercial production of beneficials is expensive and needs early coordination with developmental research and extension. On several occasions biocontrol companies began producing new parasites for greenhouses in Australia, but production was curtailed because there were no markets due to minimal research and development or advice to growers. Developing IPM in ornamentals is a long term commitment and will continue only if funding support is available. The nursery and flower industry in Australia is very large (e.g. in Queensland alone the total value is worth more than $200 million per annum) but the funds available for research are not commensurate to its size.

Australia is fortunate that it does not have several key pests which greatly complicate IPM, such as western flower thrips (*Frankliniella occidentalis* Pergande) and several species of leafminers (*Liriomyza* spp.) which occur in North America and Europe. Cotton or sweetpotato whitefly (*Bemisia tabaci* Gennadius) does occur here but our strain appears to be innocuous, unlike those of the U.S.A. and Europe. *Thrips palmi* Karny appears to be confined to the Northern Territory. Several important exotic beneficials are already in Australia (Gough, 1992) but are used rarely or not at all in ornamentals. The Federal Government has stringent import requirements for biocontrol agents which host-specific parasites normally meet, but polyphagous predators are difficult to import. Consequently, we need to examine the native fauna for potential predators such as anthocorid bugs (*Orius* spp.) and chrysopid larvae, which are common in Queensland field crops and are used as greenhouse predators overseas. Small ladybirds, *Stethorus* spp., are commonly found in unsprayed greenhouses in southeast Queensland and feed on TSM. Australia has many species of phytoseiid mites and some of these species already provide effective biocontrol on other crops (e.g. James, 1990). Workers in the northern hemisphere have discovered many of their best beneficials locally, in unsprayed glasshouses. We should follow their example.

It is clear that once growers achieve successful control using beneficials, they are prepared to persist and experiment. They are innovative and take pride in their success. Finally, the Australian ornamental industry and various government funding bodies have recognised the importance of IPM and made it a high priority area for research. All these factors are a cause for optimism that IPM in ornamentals, and especially in greenhouses, can be expanded.

Acknowledgements. I thank the ANIA, QNIA, QFGA, and HRDC for making an overseas study tour possible.

LITERATURE CITED

Albert, R. 1990. Experiences with biological control measures in glasshouses in southwest Germany. IOBC/WPRS Bull. XIII/5:1-5.

Goodwin, S., N. Gough, and **G. Herron.** 1992. Miticide resistance and field control in two spotted mite, *Tetranychus urticae* Koch, infesting roses. Proceedings of ASHS Conference Sydney, Sept. 1991.

Gough, N. 1990. Evaluation of miticides for the control of two-spotted mite *Tetranychus urticae* Koch on field roses in southern Queensland. Crop Protection 9:119-127.

Gough, N. 1991. Long term stability in the interaction between *Tetranychus urticae* and *Phytoseiulus persimilis* producing successful integrated control on roses in southeast Queensland. Experimental and Applied Acarology 12:83-101.

Gough, N. 1992. Prospects for IPM on greenhouse ornamentals in Australia. Report of a study tour on IPM in ornamental crops in Holland, UK, and U.S.A.. July 1991. QDPI Report QS 92004.

Helyer, N. and **P. Richardson.** 1991. Biological control - protected crops. Grower Digest 11. Desmond Day (ed.). Grower Publications Ltd, 50 Doughty St, London. 36pp.

James, D.G. 1990. Biological control of *Tetranychus urticae* Koch (Acari: Tetranychidae) in southern New South Wales peach orchards: The role of *Amblyseius victoriensis* (Acarina: Phytoseiidae). Aust. J. Zool. 37:645-55.

Osmelak, J.A. and **J. MacFarlane.** 1992. Integrated pest management of two spotted mite in roses and carnations. Proceedings of ASHS Conference Sydney, Sept. 1991.

Parker, R.J. 1992. The widespread use of integrated mite control in flower crops in S.E. Queensland. Proceedings of ASHS Conference Sydney, Sept. 1991.

Parrella, M.J. 1990. Biological control in ornamentals: status and perspectives. IOBC/WPRS Bull. XIII/5:161-167.

Raupp, M.J., C.S. Koehler, and **J.A. Davidson**. 1992. Advances in implementing integrated pest management for woody landscape plants. Ann. Rev. Ent. 37:561-586.

van Lenteren, J.C., 1990. Integrated pest and disease management in protected crops: the inescapable future. IOBC/WPRS Bull. XIII/5:91-99.

van Lenteren, J.C. and **J. Woets.** 1988. Biological and integrated pest control in greenhouses. Ann. Rev. of Ent. 33:239-69.

Way, M.J. 1973. Objectives, methods and scope of integrated control. In: Insects: studies in population management. Geier, P.W., L.R. Clark, D.J. Anderson, and H.A. Nix (eds.). Ecological Society of Australia. (Memoirs 1): Canberra, pp.138-153.